Implementation of Watermarking Techniques in Images and Videos using 2D-DWT/IDWT Compression and Decompression Methods

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***Abstract*— Nowadays in every field there is an enormous use of digital contents handled with the help of Internet, Multimedia and Network system in digital form. There are more chances of copying of such digital information, so that the necessity of prohibiting illegal activities. The watermarking is the powerful technique to give the solution to this problem. In this paper, we designed a MATLAB model for the secure video streaming and images for remote access with the help of visible watermarking which is required to authenticate the videos or images using secured models. Watermarking is the process of hiding of some message or other kind of information into an image, this information is called watermarking image. The MATLAB inbuilt functions like 2D-DWT simulink blocks used to perform these watermarking methods in videos and images.**

Keywords-Watermarking in videos and images; MATLAB; 2D-DWT;

I. INTRODUCTION

Recent advantages in computer technologies offer many facilities for duplication, distribution, creation, and manipulation of digital contents. Nowadays digital multimedia content can be copied and stored easily without loss in fidelity. Therefore it is important to use some kind of property rights protection system.

The majorities of the content provided follow the production companies and use copy protection system called Digital Rights Management (DRM). DRM protected content is encrypted during transmission and the storage at the receiver side and protected from copying the data. The main disadvantage of the DRM is that once the content is decrypted, it can be easily copied using widely available utilities. Disadvantages of the DRM can be eliminated by using another protection system called watermarking. Watermarking is a part of information hiding science called steganography. Steganographic system permanently hides information into cover content, so that it is not noticeable. Thus, when anybody copies such content, the hidden information also copied as well.

This watermarking algorithm optimizes for three separate factors i) Robustness: the ability of the watermark to resists attempts by an attacker to destroy it by modifying the size, rotation, quality or other visual aspects of the video. ii) Security: the ability of the watermark to resist attempts by an attacker to remove or destroy without modifying the video itself. iii) Perceptual fidelity: the perceived visual quality of the marked video compared to the original unmarked video.

II. BACKGROUND THEORY OF WATERMARKING [1]

Watermarking is the process of embedding information into a digital signal which may be used to verify its authenticity or the identity of its owners with visible or invisible based techniques. In digital watermarking the information may be video, or picture. If the signal is copied then the information also is carried in the copy. The watermarking information might be a text or a logo which identifies the owner of data. Example when a television broadcast advertisements, its logo also will be telecasted in the corner of transmitted video and this is a good and easiest example of visible watermark.

A digital watermark is a digital signal or pattern inserted into digital content. The digital content could be an image, a video clip, a text document or some form of digital data that the creator or owner would like to protect. The main purpose of the watermark is to identify who the owner of the digital data is but can also identify of the intended of the receiver side.

The internet boom is one of the reasons that watermarking has become an important technique, since the digital documents like images, videos and documents can be easily obtained from the internet through home computers or some other internet centers. So it enables that all the contents which are available in the internet can be allow to copy even the original content and it can be easily produced indistinguishable from the original and then the content can be reproduced in large quantities without its owner knowledge. Watermarking is classified as two types:

i) Visible watermarking
ii) Invisible watermarking

A. *Visible watermarking*

Visible watermark are designed to be perceived by a viewer, they can clearly identify the owner of the digital data but watermark cannot take away from the content of the data. Visible watermarks give an immediate indication of who is the owner of the digital content of the data.

B. *Invisible watermarking*

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 [2].

C. *Uses and Features of Watermarking*[3]

Watermarking is a way to improve the robustness of the digital contents like image or videos. The watermarking in digital data is permanent and unalterable. So that, the source as well as the intended recipient of the digital work, copyright owners can incorporate to identifying information into their work. This watermark is used for protection of the ownership, if any data content copied from the internet which has a watermarking can be identified and prove that it has been copied.

The features of the watermarking are i) It should be difficult to remove a digital watermark without noticeably degrading the watermarked content. ii) It should be ensuring the copyright information and cannot be removed. iii) The watermark should be robust means that it should remain in the same data after various types of attacks. If the watermark is a fragile watermark however it should not in the digital data after attacks on it. It should be easy for the owner or authority to detect that the watermark document has been copied without any difficulties.

III. DWT IN IMAGE COMPRESSION[4]

The transformation of a signal is that converts one to another form of the signal to representing it. It does not change the data present in the signal. The Wavelet Transform gives a time-frequency representation of the signal. The Wavelet Transform utilizes multi-resolution technique by which various frequencies are examined with various resolutions. In other words, the basic functions of signals are known as wavelets, the wavelet transform decomposes a signal into a set of basic functions. It can be obtained from a single prototype wavelet called *mother wavelet* by *dilations* and *shifting*. The wavelet transform is figured out separately for various division of the time-domain signal at different frequencies. Wavelets are obtained from a single prototype wavelet *y (t)* called *mother wavelet* by *dilations* and *shifting:*

$$\psi_{a,b}(t) = \frac{1}{\sqrt{a}}\psi\,\frac{(t-b)}{a} \qquad \text{------ Eq (1)}$$

Where "a" is the scaling parameter, "b" is the shifting parameter.

Wavelet transform has gained widespread acceptance in signal processing and image compression, because of their inherent multi-resolution nature. Discrete wavelet transform, which transforms a discrete time signal to a discrete wavelet representation. It converts an input series into one high-pass wavelet coefficients series and one low-pass wavelet coefficient series. There is quite good time differentiated rate in high frequency part of signals DWT transformed. Also there is quite good frequency differentiated rate in its low frequency part. Wavelets are still the information from

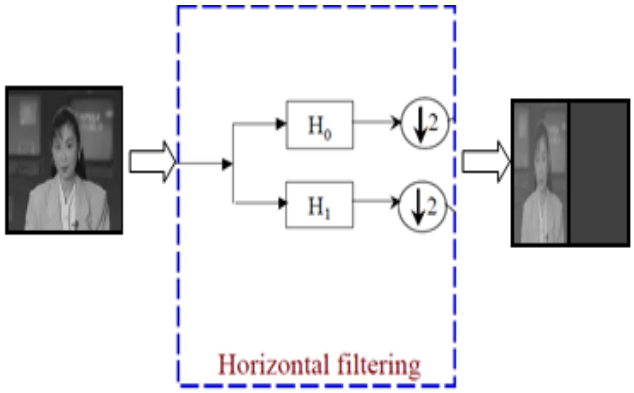


Figure1. Image wavelet transformation in 1D

signal effectively. Then transform the coefficient of sub-image. After the original image has been DWT transformed, it is decomposed into 4 frequency districts which is one low-frequency district(LL) and three high-frequency districts(LH,HL,HH). If the information of low-frequency district is DWT transformed, the sub-level frequency district information will be obtained. This four LL, LH, HL HH

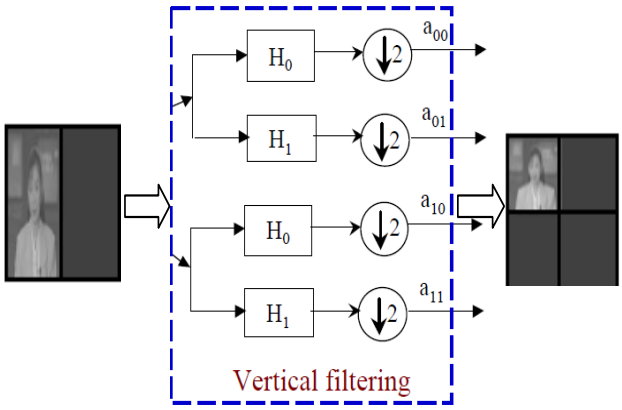


Figure2. Image wavelet transformation from 1D to 2D DWT

district used to compress the image in wavelet transform. This compression technique has been utilized to secure the digital data with the help of watermarking.

Table 1. Coefficient values of Daubechies 4-Tap wavelet

Vertical Filtering		Horizontal Filtering	
H0	**H1**	**H0**	**H1**
0.4830	0.1294	-0.1294	0.4830
0.8365	0.2241	0.2241	-0.8365
0.2241	-0.8365	0.8365	0.2241
-0.1294	0.4830	0.4830	0.1294

The working of the 1D wavelet transform function is explained in figure 1 and followed by 2D wavelet transform in figure 2. An original image has been fed to the 1D DWT as input and output of the 1D DWT transform will be filtered by horizontal filter, this output again fed back to the

2D DWT as input and filtered vertically. The Daubechies filter has been used to implement DWT/IDWT block. This technique has good compression and de-noise for two dimensional signals, the table no 1 shows the co-efficient values of DWT for vertical and horizontal filtering. Another advantage of this filter is used to remove or reduce the scratches form the image or videos.

IV. IMPLEMENTATION OF WATERMARKING

We have discussed about watermarking and image compression using DWT techniques in previous techniques. In this section, the implementation of the watermarking will be carried out on images and videos by using the DWT algorithm.

The software model for implementation has been created using MATLAB simulink tool. This model has been shown in figure 3. The watermarking has been implemented in images with the help of MATLAB software model which has been done through simulink with its inbuilt function called 2D-DWT.

The figure 3 illustrates the simulink model to implement the watermarking in images and figure 4 represents the simulink model to implement the watermarking in videos. The details of each model have been explained below.

A. Implementation of watermarking on images

The figure 3 is used to implement the watermarking in images which consists of input image file block; resize blocks, DWT, IDWT blocks and video viewer. There are two inputs image file blocks available in this model, one is used for original and another one is for watermarking image.

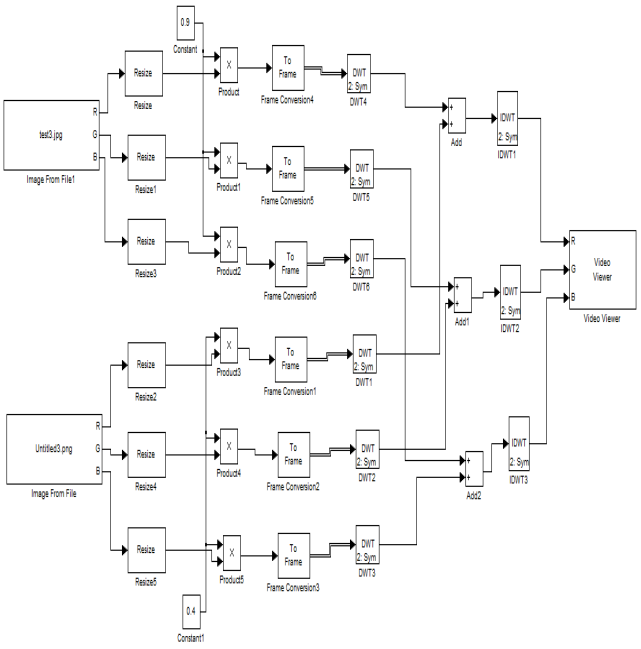


Figure 3. MATLAB Simulink model for implementing watermarking on images

These two images are given to the input image file block. These images will be separated as Red (R), Green (G) Blue (B) by color space conversion block and resized back. Input image to the resize block will be altered based on the parameters mentioned in it. We can specify a scalar percentage that is applied to both rows and columns whatever the size required. Here we've used to resizing block parameter as 256 x 256. The output of the resized parameter is multiplied with the constant value in product block and the output of the product block is given to the frame conversion which is used to convert the images in to frame and store if necessary. Constant block for the original image is used to increase/reduce the intensity of the image, because original image and watermarked image should not be overlapped. Due to that reason, intensity of the watermarked image has been reduced.

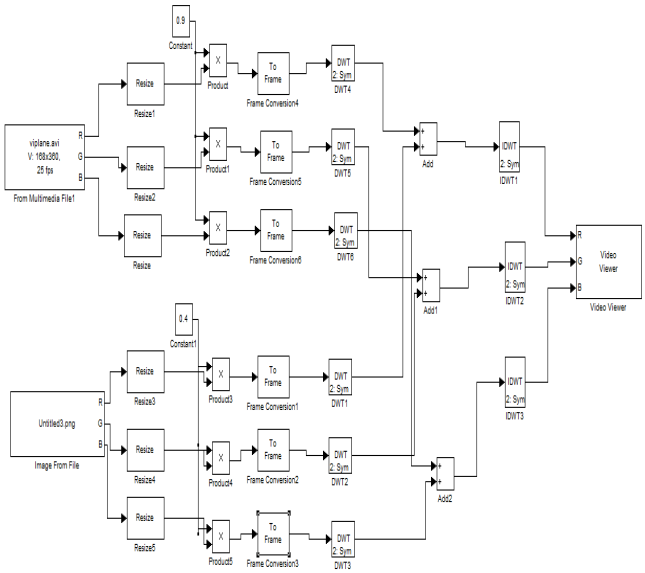


Figure 4. MATLAB Simulink mode for implementing watermarking on videos

Discrete wavelet transform is a cosine function, used to compress any image. It is decomposed into 4 frequency districts which is one low-frequency district (LL) and three high-frequency districts (LH, HL, HH). Once the DWT transformation has been performed on images with low-frequency districts, the sub-level frequency district information will be obtained. The image which is converted as a frame is compressed by DWT block. The output of the DWT is given to the input of the adder to merge original image and watermarked image. The output of the adder is given to the input of the IDWT block it computes the inverse discrete wavelet transform uses a filter bank with specified high pass and low pass FIR filters to reconstruct the original image with watermarking from its sub bands. For this model Daubechies filter has been utilized implement DWT/IDWT, since it has very good advantage of compressing and de-noising technique, and the output of the IDWT block is given to the input of the image viewer, this

block is used to display the output images. In original image, watermarked image has been added and simulation result has been placed in table 2 in results in section V.

B. Implementation of watermarking on videos

The figure 4 shows the simulink model for implementing the watermarking in videos. It consists of a multimedia file block, resize, DWT, IDWT and video viewer blocks. These blocks are the inbuilt blocks in a simulink.

It consists of the two inputs one is video where the original video will be acquired and another one is watermarking image. The video and watermarking images are given to the input of the image from file block, this block separate in to three colors like R, G, B, output of this block given to the input of the resize block, the resize block parameter is used to resize your image based on the requirement, you can specify a scalar percentage that is applied to both rows and columns based on the required size. Here 256x256 sizes have been used as scalar parameter. Even other blocks like resize blocks, constant blocks, frame blocks and DWT and IDWT blocks also working on the same principle which is explained in section IV-A. DWT and IDWT block has been implemented with the help of Daubechies filter due to its advantages in compression and de-noise one dimensional signals and images. In constant block for the video is used to reduce the intensity of the image, because original video and watermarked imaged should not be lapped on each other. The simulation output of the implementing watermarking on videos explained in table 3 of the result and discussion section.

V. RESULTS AND DISCUSSIONS

The simulation result of implemented watermarking in an image has been mentioned in table 2 and output of each stages like after the input image file (the RGB color map), 2D DWT output and IDWT/final output has been placed. In stage-1 the input image has been adjusted with contrast and resized based on the resizing parameter and contrast parameter. In stage 2 after DWT, the original image will be compressed as shown in table 2. The final image output will be comes out as mentioned in stage 3.

The table 3 shows the simulation result of implementing videos with watermarking. In the table, the output of the stage 1 shows the video after frame has been formed and resized. The output of stage 2 is wavelet transformation which is used to compress the video and watermarking image. The final stage 3 shows the final output from the IDWT block. Stage 1 show the video after frame has been formed and resized. The output of stage 2 is wavelet transformation which is used to compress the video and watermarking image. The final stage 3 shows the final output from the IDWT block. From these tables we can say that, the watermarking on images and videos can be implemented using the discrete wavelet transfer functions. It has been implemented using the available MATLAB blocks from the Simulink tool.

TABLE 2. SIMULATION RESULT WITH INPUT AND OUTPUT OF THE WATERMARKED IMAGE

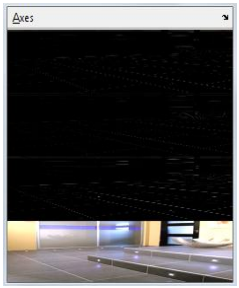
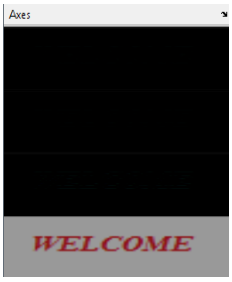
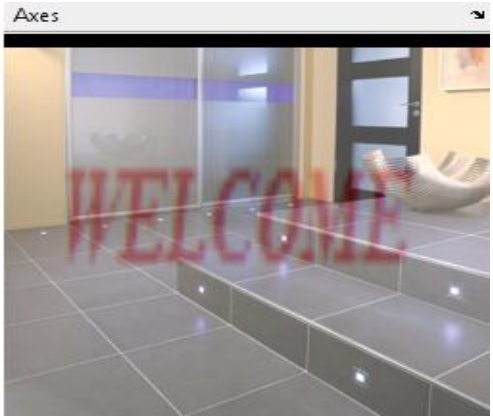
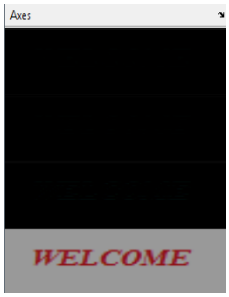
Blocks	**Inputs of the blocks**	
	Original Image	***Watermarked Image***
Inputs		
	Output of orginal image	**Output of watermarked**
After framed the input image file (Stage - 1)		
DWT (Stage - 2)		
IDWT/ Final Output (Stage - 3)		

TABLE 3. SIMULATION RESULT WITH INPUT AND OUTPUT OF THE WATERMARKED VIDEO

Blocks	**Inputs of the blocks**	
	Original multimedia file	***Watermarked Image***
Input	.AVI based Multimedia file	
	Output of the original video	**Output of the watermarked image**
After framed the input Multimedia /Image file (Stage - 1)		
DWT (Stage - 2)		
IDWT/ Final Output (Stage - 3)		

VI. CONCLUSION

Watermarking is used protect the digital contents and tracking back illegally produced copies of the protected data. The watermarking based copyright is that the watermark which is embedded with the data is permanent and unalterable. Along with this advantage improved DWT concepts also has been added to ensure the robustness of the watermarking in digital contents compared to previous Discrete Cosine Transform algorithms. Our model has been implemented using both of these DWT and watermarking techniques with the help of MATLAB simulink tool.

VII. REFERNCES

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