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A Video Watermarking Technique Using Dwt and SVD

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Abstract: The main aim of the project is to increase the authentication by means of performing video watermarking in multilevel DWT and SVD. The process of Digital watermark embeds the data known as watermark in digital media like picture, video, audio file etc. so that it can be attest for rights. This paper represents the complete software implementation of 3-Level DWT algorithms and to have more secure data a secret key is used. During embedding process a secret key is used for embedding and the same secret key is used during the extraction process.Applying Discrete Wavelet Transform (DWT) on the video to convert the spatial data into spectral data. To evaluate Singular Value Decomposition (SVD) is to achieve high robustness.
Index Terms – DWT, SVD, video watermarking, MATLAB, Color.

I.INTRODUCTION

With an astounding improvement in the fields of science and technology, there has been radical growth in the Internet. With the increase in demand of internet, broadband communication has also taken its own pace. This leads to the digital transfer of data such as images, videos, etc. Hence, it is important to avoid the unwanted redistribution of such data or unauthorized access by the illegal users. Digital Watermarking is one of the appealing methods to protect the copyright and unauthorized access to the content. Such type of watermarking can be applied to images, audio, videos etc. These watermarks should not alter the quality of content and it should be robust to the various attacks and distortion. Lot of work has been done on image watermarking and few has been done on video. This paper presents the digital watermarking applied on videos. The digital video watermarking is used to protect the video from digital manipulation and provides the copyright authentication. The two video watermarking methodologies to embed the watermark bit are Spatial Domain Watermarking and Spectral Domain Watermarking. Spatial Domain method is not robust to many signal processing attacks. Spectral Domain method ensures the robustness of watermark. Frequently used transforms are the Discrete Fourier Transform (DFT),
Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT). The Discrete wavelet transform is more frequently use because of its excellent multi-resolution and spatial localization characteristics.

A. Colors

The two main color spaces are RGB and CMYK are used for the science communication.

B. RGB

The RGB color model relates very closely to the way we perceive color with the r, g and b receptors in our retinas. Additivecolor mixing used by RGB and is the basic color model used in television or any other medium that projects color with light. RGB is the basic color model used in computers and also for web graphics, for print production it is not used. The mixing of two of the primary colors (red, green or blue) and excluding the third color to produce the secondary colors of RGB –cyan, magenta, and yellow. Combination of Red and green produces yellow, green and blue produces cyan, and blue and red producesmagenta. All the three primary colors combined in full intensity makes white.

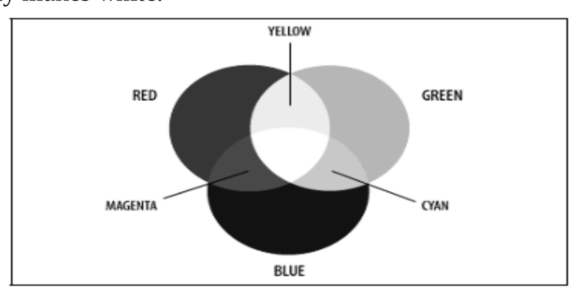

Figure 1.2. RGB

Using the “screen” mode for the different layers in an image will make the intensities mix together according to the additive color mixing model in Photoshop. This is similar to stacking slide images ontop of each other and shining light through them.

C. CMYK

It is used in printing lays down overlapping layers of varying percentages of transparent cyan (C), magenta (M) and yellow(Y)inks are used in the 4-color CMYK models. In addition a layer of black (K) in k can be added. The CMYK model uses the subtractive color model.

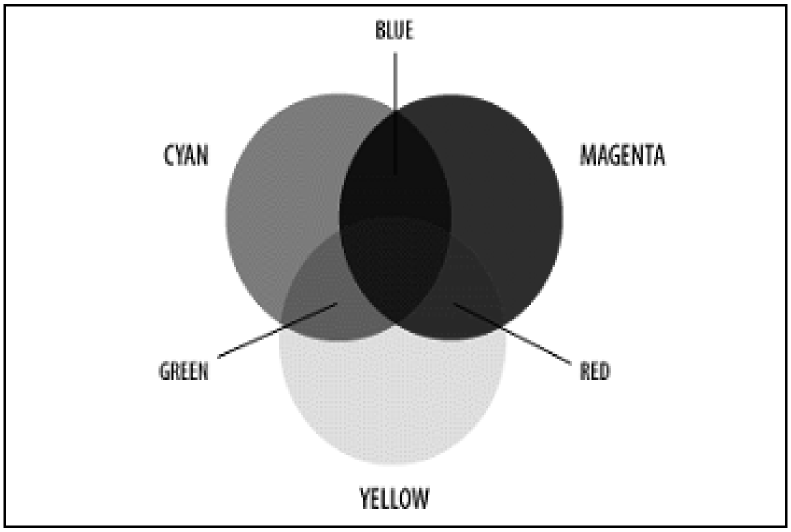

Figure1.3. CMYK

D. Images and pictures

As we mentioned in the preface, human beings are essentially visual creatures: we entrust heavily on our vision to make sense of the world around us. We can scan for differences, and obtain an overall rough feeling for a scene with a quick glance by looking things to identify and classify them. Humans have emerged very precise visual skills: we can identify a face in a moment; we can differentiate colors; we can process a large amount of visual information very quickly.

However, the world is in constant motion: stare at something for long enough and it will change in some way. Depending on the time of day (day or night); amount of sunlight (clear or cloudy), or various shadows falling upon it when a large solid structure, like a building or a mountain, will change its appearance. We are concerned with single images of a visual scene. Although the changing of scenes will depend on image processing, we shall not discuss it in any detail in this text. For our purposes, taking a single picture as an image which represents something. It may be a picture of a person, or people or animals, or an outdoor scene, or a micro photograph of an electronic component, or the medical image result. Even if the picture is not immediately detectable, it will not be just a random blur.

Image processing involves modifying the nature of an image in order to either

1) Improve its pictorial information for human interpretation,

2) Render it more suitable for autonomous machine perception.

We shall be concerned with digital image processing, which involves using a computer to modify the nature of a digital image. It is necessary to realize that these two conditionsrepresents two separate but equally important conditions of image processing. A procedure which satisfies condition, a procedure which makes an image look better may be the very worst procedure for satisfying condition.Sharp, clear and detailed images are liked by the humans and the simple and uncluttered images are preferred by the machines.

A. Images and digital images

Suppose we take an image, a photo, say. For the moment, let’s make things easy and suppose the photo is black and white (that is, lots of shades of grey), so no color. We may consider this image as being a two dimensional function, where the function values give the brightness of the image at any given point. We may assume that in such an image brightness values can be any real numbers in the range (black) (white).

A digital image from a photo in that the values are all discrete and taking only on integer values. The brightness values also anging from 0 (black) to 255 (white). A digital image can be considered as a large array of discrete dots, each of which has a brightness associated with it. These dots are called picture elements, or more simply pixels. The pixels surrounding a given pixel constitute its neighborhood. A neighborhood can be characterized by its shape in the same way as a matrix: we can speak of a neighborhood. Except in very special circumstances, neighborhoods have odd numbers of rows and columns; this ensures that the current pixel is in the center of the neighborhood.

B. Video Watermarking

Watermark encountering with *Algorithm* various attacks like data compression, low pass filtering, subsampling D/A, A/D conversions, can change very less content of low pass sub-band compared to higher sub-bands. Using watermarking algorithm, level-3 DWT is computed and then watermarks embedding in LL3 i.e. low frequency sub-band of level-3 DWT is performed on video frames.

C. Existing System

The existing system used embed watermark in low frequency sub-band first and remaining in higher frequency sub bands depending on the significance of sub band. Watermark embedding is done with different embeddingformulae. This algorithm incorporates the features of visualmasking of human vision system in watermarking. In this paper, DWT is applied on each frame and the video watermarking is done on every frame to which DWT is applied. For 2-D frame, applying DWT means applying 1-D filter in two dimensions. The filter then divide the frame into four non overlapping sub-bands called as LL1, LH1, HL1 and HH1. L stands for low pass, H stands for high pass, while, the number indicates the level of DWT applied. To obtain the next level, the LL1 sub-band is selected and again it is divided into four non overlapping
LL2, LH2, HL2 and HH2

D. Proposed System

1) The coefficient of watermark video is selected. Extract the watermark image, and then separating its RGB panel.
2) Applying 3-level DWT on this B panel of the selected watermark image.
3) With the help of watermark coefficient the watermark is extracted.

E. Objectives

1) To convert the spatial data into frequency domain, having low pass and high pass components.
2) To extract the embedded watermark.
3) It is robust against the various attacks and addition of noise to the video.

F. Motivation

1) This algorithm is found to be robust to most common attacks.
2) Extracted watermark is much similar to the original watermark
3) Secureagainst various processing operation such as averaging, noiseaddition, histogram equalization.

G. Conclusion

The robust video watermarking algorithm is proposed by embedding watermark on each frame of the video. This algorithm realizes blind watermarking with watermark detection and extraction and is found to be robust to most common attacks. It is also observed from that the proposed method works well for the watermarking of the video contents. The Normalized Correlation Coefficient (NC) and Structural Similarity (SSIM) index are approaching towards the value 1 which indicates that reconstructed watermark is matching to that of the original one.

H. Early Works

This literature review presents the survey of previously presented different methods of monitoring boiler drum parameters. In order to identify the complexity of monitoring boiler drum and a survey was conducted to identify the most frequently occurring defects. In case of boiler monitoring system, several researchers have addressed the problem of monitoring and controlling of boiler drum in automation. A various literatures are available related to the present work is explained below. ragyaAgarwal, Arvind Kumar, AnkurChoudhary [1]A Secure and Reliable Video Watermarking TechniqueIn this paper, LWT(Lifting Wavelet Transform) and SVD(Singular Value Decomposition) is used to design a video watermarking technique.. They have used Histogram Difference

Method fordividing the video into scenes. The Imperceptibility and robustness of the watermarkingmethod is checked by applying some intentional attacks on thewatermarked video frame.

A.Kirthika, A.Anitha rani [2] Different Video Watermarking Techniques and Relative Study with Reference to H.264/AVC Due to the rapid growth in information transmission technology, the technology to protect data from unauthorized users. Data could plagiarize, modified, deleted etc. without proper authentication and authorization. The main technique used for protection of academic rights and copyright security is digital watermarking. Digital watermarking can be applied to media like text, audio, image, video etc. There is a growing importance in authentication and protected copyright for Digital video streams .H.264 is a next generation video compression format. H.264/Advanced Video Codec (AVC) is significant regarding smaller bandwidth, better quality and network friendliness.

Hamid Shojanazeri, Wan Azizun Wan Adnan, SharifahMumtadzah Syed Ahmad,, M. IqbalSaripan [3] Analysis of Watermarking Techniques in Video In this paper the video piracy has become an increasing problem particularly with the proliferation of media sharing through the advancement of internet services and various storage technologies. Thus, research in copyright protection mechanisms, where one of which includes digital watermarking has been receiving an increasing interest from scientists especially in designing a seamless algorithm for effective implementation. Basically digital watermarking involves embedding secret symbols known as watermarks within video data which can be used later for copyright detection purposes. This paper presents the state of the art in video watermarking techniques. It provides a critical review on various available techniques. In addition, it addresses the main key performance indicators which include robustness, speed,capacity, fidelity, imperceptibility and computational complexity.Sourav Bhattacharya, T. Chattopadhyay and Arpan Pal [4] A Survey on Different Video Watermarking Techniques and Comparative Analysis with Reference to H.264/AVCIn this paper they perform a comparative analysis based on robustness and computational complexity ofdifferent watermarking algorithms.Video watermarking applications can be grouped as security related like Copy control, fingerprinting, ownership identification, and authentication, taper resistance etc. or value added applications like legacy system enhancement, database linking, video tagging, digital video broadcast monitoring, Media Bridge etc.

Jeebananda Panda, InduKumari, NitishGoel,Dr.Savithakumari [5] Dual Segment video watermarking using Energy Efficient TechniqueTheobjective of this paper is to present a novel digital video watermarking scheme using dual watermark. The binary watermark image is distributed over audio samples in which firstfour samples of each frame are watermarked with 4 bits of the image using multiple bit plane schemes. For the gray scale watermark, the FFT is taken and the samples are embedded in the FFT samples of video frames using Energy Efficient scheme. The watermarked video is subjected to different attacks and the efficiency of the technique is measured using Correlation Factor and PSNR. The algorithm presented is robust, secure and is energy efficient with decreased payload on the host signal.

II. PROPOSED METHODOLOGY

This chapter deals with the block Figure and the design flow of the system. The individual components used in the system and the interconnects made in the simulated design are explained with the maximum explanation possible, so that one can get clear picture of all the individual components before viewing the simulated results.

A. Proposed Video Watermarking Algorithm

In the proposed method:

1) For more security of video a secret key is used.
2) Watermarking using 3-level DWT.
3) Improve the quality of watermark video.
4) Less error that is MSE value should be as low as possible.
5) Host video may be of any size.

B. Watermark embedding

A continuous video frames is called a video shot. In order to increase the performance of watermark embedding process the proposed system will separate the video into video shots. Each video shot has one or more video frames. According to video standard, the intensity for a RGB frame.

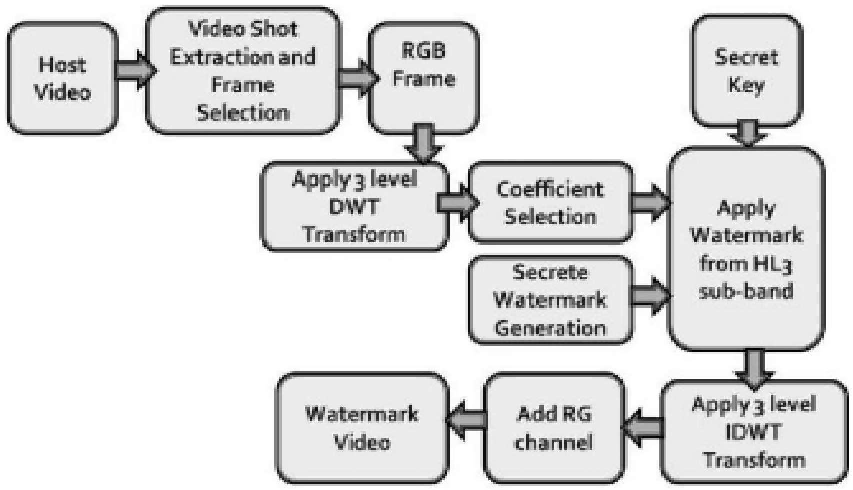

Figure3.2. Proposed watermark embedding process

C. Watermark extraction

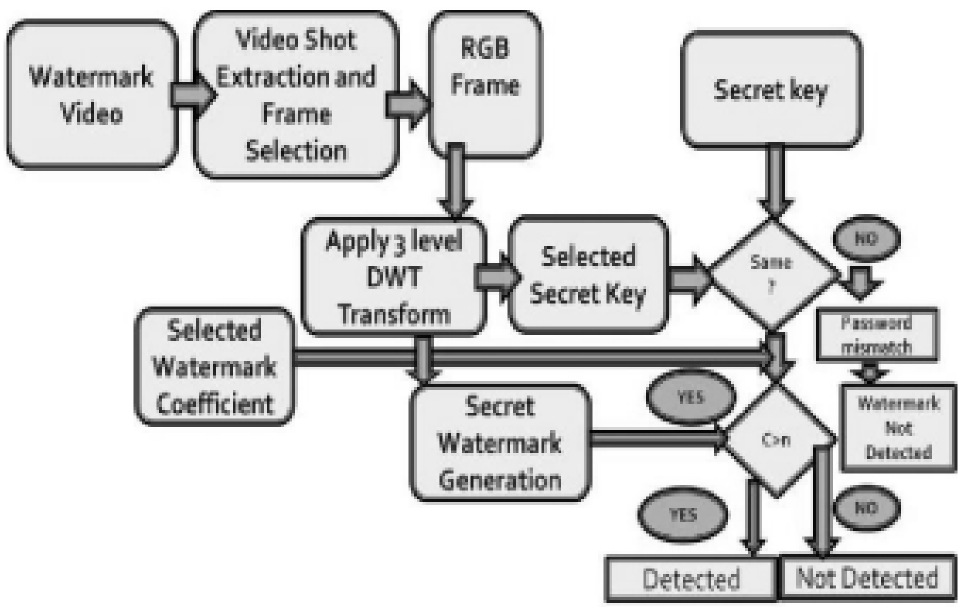

Figure3.3. Proposed watermark extraction process

The coefficient of watermark video is selected. Extract the watermark image, and then separating its RGB panel. Applying 3- level DWT on this B panel of the selected watermark image. With the help of watermark coefficient the watermark is extracted.

D. Extraction algorithm

Step 1. Read the video and separate it into video frames.
Step 2. Read the watermarked image as 256 X 256 pixels.
Step 3. R, G and B panels are separated
Step 4.Applying 3-level DWT on B-panel of the watermark image.
Step 5. Dialog box will open to enter secret key.
Step 6. If secret key is correct, then it will show whether watermark is detected or not.
Step 7.If secret key is in-correct a pop up message displayed showing “secret key not successfully detected enter correct secret key.

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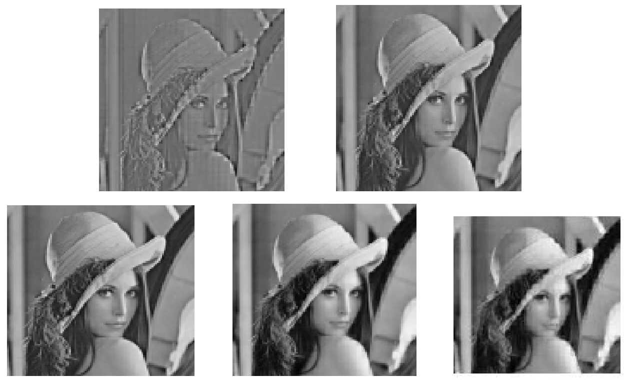

Figure 3.4. Watermarked images using DWT

III. SOFTWARE DESCRIPTION

A. MATLAB Product Description

Language of Technical Computing MATLAB is a high-level language and interactive environment for numerical computation, visualization, and programming. Using MATLAB, you can analyze data, develop algorithms, and create models and applications. The language, tools, and built-in math functions enable you to explore multiple approaches and reach a solution faster than with spreadsheets or traditional programming languages, such as C/C++ or Java We can use MATLAB for a range of applications, including signal processing and communications, image and video processing, control systems, test and measurement, computational finance, and computational biology. More than a million engineers and scientists in industry and academia use MATLAB, the language of technical computing.

B. Features

1) High-level language for numerical computation, visualization, and application development
2) Interactive environment for iterative exploration, design, and problem solving
3) Mathematical functions for linear algebra, statistics, Fourier analysis, filtering,
4) Optimization, numerical integration, and solving ordinary differential equations
5) Built-in graphics for visualizing data and tools for creating custom plots
6) Development tools for improving code quality and maintainability and maximizing performance
7) Tools for building applications with custom graphical interfaces

Format	Variants
BMP	1-bit, 4-bit, 8-bit, 16-bit, 24-bit, and 32-bit uncompressed images; 4-bit and 8-bit run-length encoded (RLE) images
CUR	1-bit, 4-bit, and 8-bit uncompressed images
HDF	8-bit raster image datasets, with or without an associated colormap; 24-bit raster image datasets
ICO	1-bit, 4-bit, and 8-bit uncompressed images

.

JPEG	Any baseline JPEG image; JPEG images with some commonly used extensions
PBM	Any 1-bit PBM image; raw (binary) or ASCII (plain) encoded
PCX	1-bit, 8-bit, and 24-bit images
PGM	Any standard PGM image; ASCII (plain) encoded with arbitrary color depth; raw (binary) encoded with up to 16 bits per gray value
PNG	Any PNG image, including 1-bit, 2-bit, 4-bit, 8-bit, and 16-bit grayscale images; 8-bit and 16-bit indexed images; 24-bit and 48-bit RGB images
PPM	Any PPM image; ASCII (plain) encoded with arbitrary color depth; raw (binary) encoded with up to 16 bits per color component
RAS	Any RAS image, including 1-bit bitmap, 8-bit indexed, 24-bit truecolor and 32-bit truecolor with alpha
TIFF	Any baseline TIFF image, including 1-bit, 8-bit, and 24-bit uncompressed images; 1-bit, 8-bit, and 24-bit images with packbits compression; 1-bit images with CCITT compression; also 16-bit grayscale, 16-bit indexed, and 48-bit RGB images
XWD	1-bit and 8-bit ZPixmaps; XYBitmaps; 1-bit XYPixmaps

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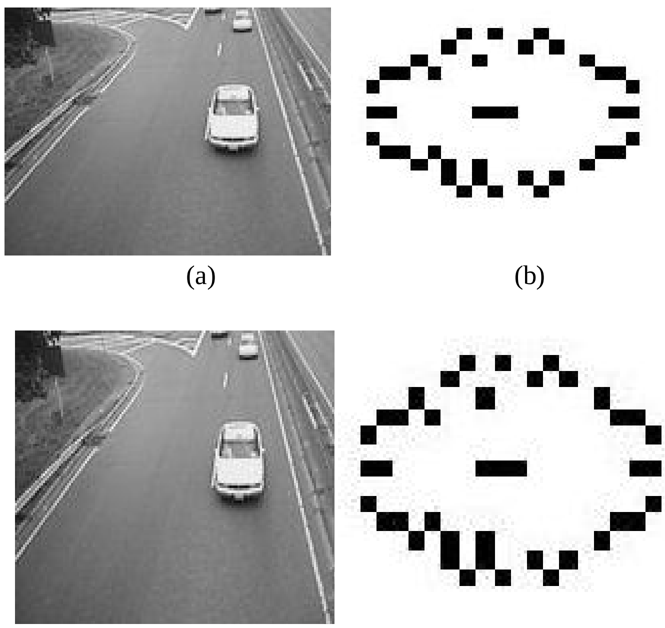
IV. RESULTS AND DISCUSSION

The proposed Algorithm is implemented using MATLAB asthe basic tool on the video database consisting of videosdownloaded from internet, standard video databases and alsoon the videos captured in the laboratory under non-standardconditions as specified in Figure5.1.

Sr. No.	Video Name	Specifications			Source
		Frame size	*Duration(in sec)*	*No. of frames*	
1	viptraffic.avi	120×160	8	120	Standard Database
2	rhinos.avi	240×320	6	114	Standard Database
3	Shaky_car.avi	240×320	4	132	Standard Database
4	Scenevideoclip.avi	160×120	7	92	Standard Database
5	Video_1.avi	240×320	44	448	Downloaded
6	Video_2.avi	288×360	43	1077	Downloaded
7	Video_3.avi	480×640	5	67	Downloaded
8	Video_4.avi	640×480	18	543	Captured in lab
9	Video_5.avi	480×640	14	140	Captured in lab
10	Video_6.avi	480×640	15	155	Captured in lab

Figure5.1. Table of Video Database

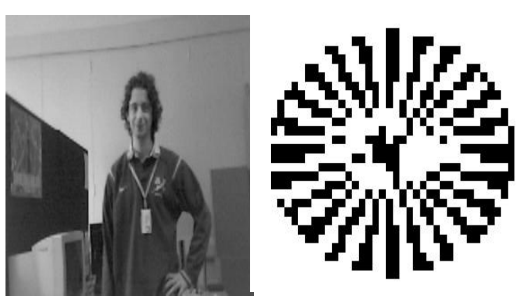
The computations werecarried out on the system with configuration details as, Intel(R)Core™ i7-4770 processor having maximum clock frequency of3.4 GHz and 32 GB of RAM.



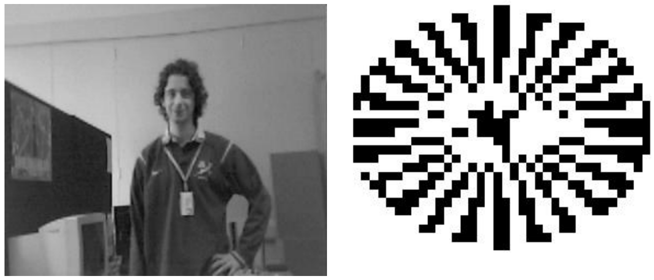
(a) (b)

(c) (d)

Figure 5.2. For 'viptraffic.avi'; (a) original frame #20 (b) original watermark testpat1, (c) watermarked video frame, (d) Extracted water mark from (c)

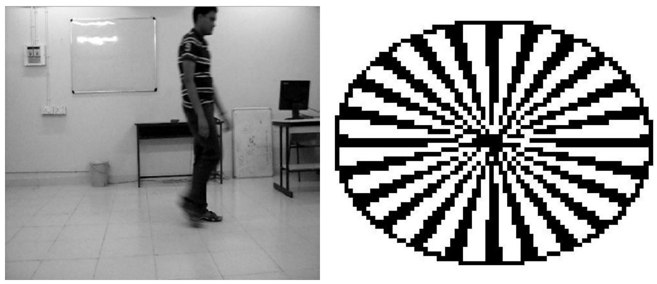


(a) (b)

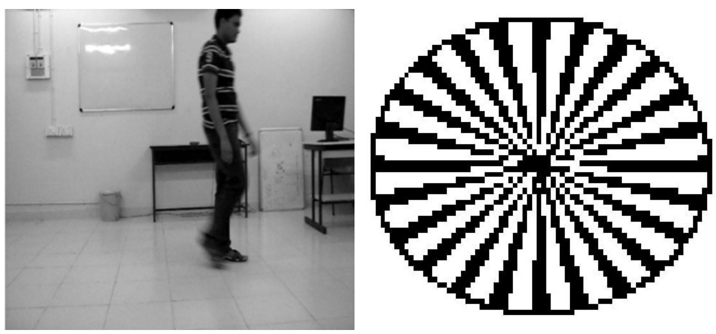


(c) (d)

Figure 5.3. For Video_1.avi'; (a) original frame #410 (b) original watermarktestpat1, (c) watermarked video frame, (d) Extracted water mark from (c)



(a) (b)



(c) (d)

Figure 5.4. For 'Video_4; (a) original frame #47 (b) original watermark testpat1, (c) watermarked video frame, (d) Extracted water mark from (c)

The algorithm is tested on a large number of videos but here, in this paper only ten videos are indicated. The Figures are shown only for one video i.e. viptraffic.avi which is a standard video available in the MATLAB directory. The watermark image used in this work is again taken from standard MATLAB database i.e. testpat1which is having dimensions of 256×256 which is resized then to the size of the LL3 part of the DWT decomposition applied on the frames. Results of no attack are shown in Figure. 1to Figure. 3. Figure. 1 indicates the resultsof proposed work for frame number 20 of the viptraffic video. Figure. 2 indicates the frame number 410 of Video_4 (Standard database) and Figure. 3 indicate results for Video_4(Captured inlab) for frame number 47.
The robust video watermarking algorithm is proposed by embedding watermark on each frame of the video. This algorithm realizes blind watermarking with watermark detection and extraction and is found to be robust to most common attacks. It is also observed from Figure5.5 and 5.6 that the proposed method works well for the watermarking of the video contents. The Normalized Correlation Coefficient (NC) and Structural Similarity (SSIM) index are approaching towards the value 1 which indicates that reconstructed watermark is matching to that of the original one.

Video	Parameters	No attack	Average filter	Median filter	Gaussian Noise	Salt and Pepper Noise	Histogram equalization
viptraffi.avi	PSNR(dB)	Inf	22.101	19.749	13.778	12.93	15.970
	NC	1	0.993	0.987	0.956	0.947	0.969
	SSIM	1	0.994	0.989	0.957	0.948	0.969
rhinos. avi	PSNR(dB)	Inf	26.637	25.921	17.7435	17.165	12.57
	NC	1	0.997	0.997	0.9776	0.975	0.9301
	SSIM	1	0.998	0.998	0.9842	0.983	0.9258
scenevideoclip.a vi	PSNR(dB)	Inf	21.714	19.094	18.883	18.020	11.4421
	NC	1	0.993	0.985	0.986	0.982	0.896
	SSIM	1	0.993	0.986	0.987	0.986	0.929
shaky_car.avi	PSNR(dB)	Inf	25.914	24.817	17.864	16.876	7.934
	NC	1	0.997	0.996	0.983	0.979	0.838
	SSIM	1	0.998	0.997	0.992	0.989	0.934
Video_1.avi(net)	PSNR(dB)	Inf	27.842	28.759	19.946	19.183	13.685
	NC	1	0.998	0.998	0.989	0.987	0.942
	SSIM	1	0.999	0.999	0.993	0.992	0.942
Video_2.avi(net)	PSNR(dB)	Inf	25.428	22.071	16.076	15.351	17.964
	NC	1	0.997	0.993	0.975	0.975	0.983
	SSIM	1	0.998	0.995	0.981	0.977	0.987
Video_3.avi(net)	PSNR(dB)	Inf	27.908	25.682	18.071	17.120	13.320
	NC	1	0.998	0.997	0.984	0.997	0.953
	SSIM	1	0.998	0.998	0.988	0.986	0.967
Video_4.avi(lab 1)	PSNR(dB)	Inf	32.350	32.453	19.919	19.633	8.893
	NC	1	0.999	0.999	0.989	0.989	0.870
	SSIM	1	0.999	0.999	0.992	0.992	0.899
Video_5.avi(lab 2)	PSNR(dB)	Inf	27.716	27.674	15.649	14.9470	7.575
	NC	1	0.998	0.998	0.972	0.967	0.824
	SSIM	1	0.998	0.998	0.981	0.977	0.880
Video_6.avi(lab 3)	PSNR(dB)	Inf	25.143	24.959	15.632	14.973	11.221
	NC	1	0.997	0.997	0.972	0.968	0.924
	SSIM	1	0.998	0.997	0.981	0.978	0.948

Figure 5.5. Experimental results of watermark after various attacks on watermarked video

Video Name	Parameter	No attack	Average Filter	Median Filter	Gaussian Filter	Salt and Pepper	Histogram Equalization
viptraffic.avi	Extracted Watermark						

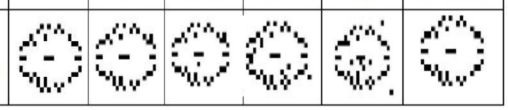
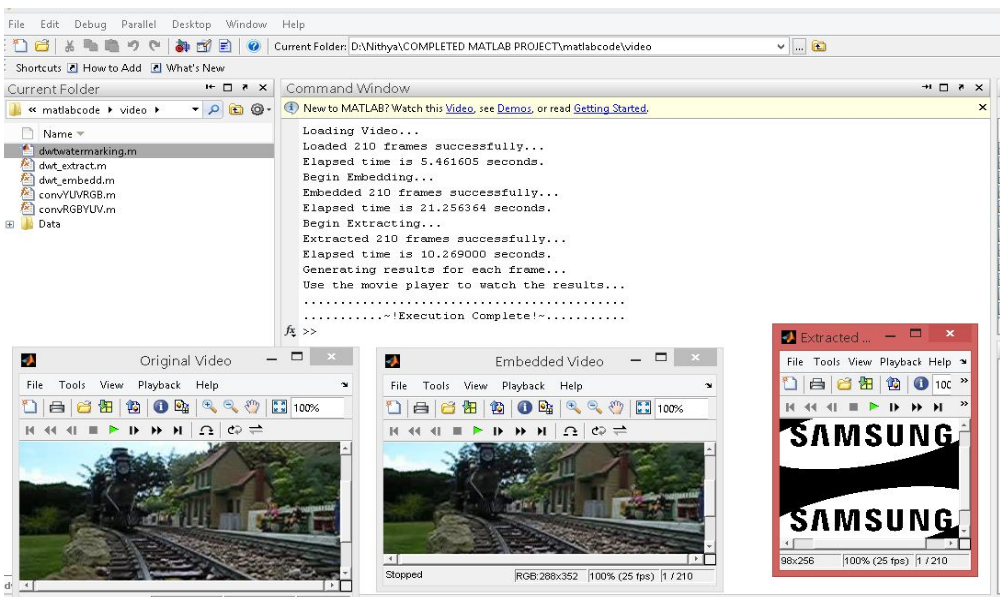


Figure 5.6. Extracted watermark of frame #20 after various attacks on viptraffic video

A. Simulation Result



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