Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 3, Issue. 11, November 2014, pg.612 – 622

RESEARCH ARTICLE

An Upgraded Approach for Robust Video Watermarking Technique Using Stephens Algorithm

Paramjit Kaur M.Tech, **Dr. Vijay Laxmi**
CSE &Guru Kashi University, Talwandi Sabo, Bathinda, Punjab India

Pk57360@gmail.com

Abstract- Digital data is easily available in the form of images and videos, over the internet. Because of their digital nature, multimedia data can be duplicated, modified, transformed and diffused very easily. The growth of internet is so vast that any data can be easily transferred to the other person in just a single click. In video watermarking, protection of multimedia data becomes increasingly prominent. So, recent development of digital watermarking can solve this problem. Our objective is to implement an effective algorithm for robust video watermarking. In this thesis, we have studied and implemented an algorithm using Matrix Laboratory which gives better result than previously used techniques. Techniques used in video watermarking are discussed with the literature survey and then the shortcoming is analyzed and as conclusion proposal for new points for hiding watermark in video is given. So there is need for new robust technique which will be able to hide watermark at such place in frames so cannot be extracted easily and provide more security over video watermarking old techniques. For this as a new research in same field an algorithm with efficient point finding will be proposed to hide watermark in video to provide robust and secured watermarking. I have implemented new robust techniques gives the better result. I analyzed the results on the basis of different parameters (Peak Signal to Noise Ratio, Mean Square Error, Bit Error Rate).

1. Introduction

Digital watermarking helps securely identify important records and bank notes, adding an invisible layer of protection against unauthorized alterations or reproduction. Digital watermarks allow information about the owner, usage rights and more to be permanently attached to the content. The technology also provides the means to embed copy and play control instructions that indicate when play is not allowed and/or that copies can or cannot be made. A watermark is a visible embedded overlay on a digital photo consisting of text, a logo, or a copyright notice. The purpose of a watermark is to identify the work and discourage its

unauthorized use. Though a visible watermark can't prevent unauthorized use, it makes it more difficult for those who may want to claim someone else's photo or art work as their own. Another type of watermark is the digital watermark, pioneered by Digimarc Corporation. Digimarc offers a service for embedding digital code into photos and other media that is undetectable during normal use, but enables tracking and identification of the media.

The mission of the Digital Watermark Working Group (PDWG) is to work jointly and cooperatively with leading content and technology companies to describe appropriate and voluntary best practices for the use of digital watermarking to

1) establish such practices for the deployment of watermarking technology implementations as a step to facilitate the legitimate consumption of licensed content through the distribution channel;
2) provide systems with the ability to effectively identify infringing copyrighted content; and
3) Ensure that the watermark methods and solutions favored by content rights holders and watermark technology providers can be scaled effectively by network operators.

Digital watermarking is defined as a process of embedding data (watermark) into a multimedia object to protect the owner's right to that object. The embedded watermark may be either visible or invisible. Images can be processed in two main approaches as spatial domain and frequency domain approach. Watermarking algorithm that rely on spatial domain, hide the watermark by modifying pixel values of the host image. On the other hand in frequency based techniques the host image is first converted into different frequencies by suitable transform. Watermarking is closely related to steganography, but in watermarking the hidden information is usually related to the cover object. Hence it is mainly used for copyright protection and owner authentication.

Digital watermarking also known as watermark insertion or watermark embedding, it represents the method of inserting information into multimedia data e.g. text, audio, image, video. The embedded information or watermark can be a serial number or random number sequence, gray level images, text or other digital data formats. These algorithms modify the original media to generate the watermarked media. After embedding watermark, the watermarked media are sent over Internet or some other transmission channels. Whenever the copyright of the digital media is under question, the embedded information is decoded to identify copyright owner. The decoding process can extract the watermark from the watermarked media or can detect the existence of watermark in it.

According to the working domain, video watermarking techniques are classified in pixel/spatial domain and transform domain techniques. In pixel domain the watermark is embedded in the source video by simple addition or bit replacement of selected pixel positions.

The main advantages of using pixel domain techniques are that they are conceptually simple to understand and the time complexity of these techniques are low which favors real time implementations. But these techniques generally lacks in providing adequate robustness and imperceptibility requirements. In transform domain methods, the host signal is transformed into a different domain and watermark is embedded in selective coefficients. Commonly used transform methodologies are discrete cosine transformation (DCT) and discrete wavelet transformation (DWT). Detection is generally performed by transforming the received signal into appropriate domain and searching for the watermarking patterns or attributes. The main advantage of the transformed domain watermarking is the easy applicability of special transformed domain properties. For example, working in the frequency domain enables us to apply more advanced properties of the human visual system (HVS) to ensure better robustness and imperceptibility criteria.

2. Literature Review

Robust video watermarking techniques in the digital watermarking environment has an important impact on the performance. An upgraded robust video watermarking technique makes video watermarking more efficient and improves user satisfaction. There have been many studies of robust video watermarking techniques.

Ashish M. Kothari et al. [1] in 2012: In this paper, we emphasized on the transform domain method for the digital watermarking of video for embedding invisible watermarks behind the video. It is used for the copyright protection as well as proof of ownership. In this paper we have specifically used the characteristics of 2-D Discrete wavelet Transform and discrete cosine transform for the watermarking. In this work we first extracted the frames from the video and then used Frequency domain characteristics of the frames for watermarking. We calculated different parameters for the sake of comparison between the two methods.

Yujie Zhang et al. [2] in 2012: This paper presents a video watermarking algorithm in detail based on DCT, DWT and neural network technology and digital watermarking was proposed and a professional video copyright protection platform was built using the above algorithm. This algorithm effectively enhances the robustness of the video stream. The platform includes video watermark embedding, watermark detection and video piracy tracking and other functions. It doesn't only achieve the prevention beforehand but also the piracy tracking afterwards. The simulation results show that the platform can effectively implement the copyright protection of digital video works.

Nisreen I. Yassin et al. [3] in 2012: In this paper, a comprehensive approach for digital video watermarking is introduced, where a binary watermark image is embedded into the video frames. Each video frame is decomposed into sub-images using 2 level discrete wavelet transform then the Principle Component Analysis (PCA) transformation is applied for each block in the two bands LL and HH. The watermark is embedded into the maximum coefficient of the PCA block of the two bands. The proposed scheme is tested using a number of video sequences. Experimental results show high imperceptibility where there is no noticeable difference between the watermarked video frames and the original frames. The computed PSNR achieves high score which is 44.097 db. The proposed scheme shows high robustness against several attacks such as JPEG coding, Gaussian noise addition, histogram equalization, gamma correction, and contrast adjustment.

Prachi V. Powar et al. [4] in 2013: Objectives of this scheme is to develop low power, robust and secure watermarking system for authentication of video. Here we present an FPGA based implementation of an invisible watermarking encoder. It consists of a watermark generator module and watermark insertion module. The system is initially simulated and tested for various attacks in MATLAB/Simulink and then prototyped on VERTEX-6 FPGA using VHDL. The watermarked video is same as that of original video with an average Peak-Signal-to-Noise Ratio (PSNR) of 46 db.

Bernd Girod et al. [5] Digital Watermarking of Text, Image, and Video Documents, The ease of reproduction, distribution, and manipulation of digital documents creates problems for authorized parties that wish to prevent illegal use of such document. To this end, digital watermarking has been proposed as a last line of defense. A digital watermark is an imperceptible, robust, secure message embedded directly into a document. The watermark is imperceptible both perceptually and statistically. Robustness means that the watermark cannot be removed or modified unless the document is altered to the point of no value. The watermark is secure if unauthorized parties cannot erase or modify it. Current watermarking schemes may be viewed as spread-spectrum communications systems, which transmit a message redundantly using a low-amplitude, pseudo noise carrier signal. An example highlights the basic mechanisms and properties

of spread spectrum and their relation to watermarking. Finally, specific issues in watermarking of text, images, and video are discussed, along with watermarking examples.

Melinos Averkiou et al. [6] Digital watermarking is the act of hiding a message related to a digital signal (i.e. an image, song, and video) within the signal itself. It is a concept closely related to steganography, in that they both hide a message inside a digital signal. However, what separates them is their goal. Watermarking tries to hide a message related to the actual content of the digital signal, while in steganography the digital signal has no relation to the message, and it is merely used as a cover to hide its existence. Watermarking has been around for several centuries, in the form of watermarks found initially in plain paper and subsequently in paper bills. However, the field of digital watermarking

Sanjana Sinha et al. [7] in 2011: Digital Video Watermarking using Discrete Wavelet Transform and Principal Component Analysis, Due to the extensive use of digital media applications, multimedia security and copyright protection has gained tremendous importance. Digital Watermarking is a technology used for the copyright protection of digital applications. In this paper, a comprehensive approach for watermarking digital video is introduced. We propose a hybrid digital video watermarking scheme based on Discrete Wavelet Transform (DWT) and Principal Component Analysis (PCA). PCA helps in reducing correlation among the wavelet coefficients obtained from wavelet decomposition of each video frame thereby dispersing the watermark bits into the uncorrelated coefficients. The video frames are first decomposed using DWT and the binary watermark is embedded in the principal components of the low frequency wavelet coefficients. The imperceptible high bit rate watermark embedded is robust against various attacks that can be carried out on the watermarked video, such as filtering, contrast adjustment, noise addition and geometric attacks.

G. G. Chiddarwar et al. [8] in 2013: The protection and illegal redistribution of digital media has become an important issue in the digital era. This is due to the popularity and accessibility of the Internet now days by people. This results in recording, editing and replication of multimedia contents. Digital watermarking can be used to protect digital information against illegal manipulations and distributions. Digital watermarking technique is the process of embedding noise-tolerant signal such as audio or image data in the carrier signal. This technique provides a robust solution to the problem of intellectual property rights for online contents. This paper reviews different aspects and techniques of digital watermarking for protecting digital contents.

Loganathan Agilandeeswaril et al. [9] in 2013: In this paper we proposed a novel video watermarking technique using Discrete Wavelet Transform and Singular Value Decomposition based on sub-band selection procedure. To increase the level of authentication, the two watermarks are used: one is the original watermark and the other is the owners' fingerprint. These two watermarks are embedded into the cover video based on the sub-band selection scores. From the experimental analysis, we found that the proposed watermarking technique is more robust to all possible attacks than existing video watermarking technique.

3. Problem Formulation

Many of the algorithms have been introduced in the concern of this specific issue but they lack in few stages. According to various facts it is concluded that earlier watermarking techniques are more robust, 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 and geometrical attacks. The commonly used transform domain techniques are Discrete Fourier Transform (DFT), the Discrete Cosine Transform (DCT), and the Discrete Wavelet Transform (DWT), Principle Component Analysis (PCA) and Singular Value Decomposition (SVD).

1. But they are not efficient in finding the interest points where to embed the watermark.
2. Even they all are not so stable.
3. Cannot reduce the attacks on watermark image.

Thus to overcome these issue a new technique is introduced in implementation of watermarking.

3.1 Parameters used in Video Watermarking Technique

There are three parameters will be considered in robust video watermarking are discussed below.

(a) Mean Square Errorr(MSE)

$$MSE = \frac{1}{NxM} \sum_{i=0}^{N-1} \sum_{j=0}^{M-1} [X(i,j) - Y(i,j)]^2$$

Where N and M are rows and columns, repectively of the image. X(i, j) is the original image and Y(i, j) is the corresponding output image. The MSE should be less, which means the pixel intesityof the input and output image should be as close as possible.

(b) Peak Signal to Noise Ratio (PSNR)

$$PSNR = 10 \log_{10} \frac{L^2}{MSE}$$

Peak Signal to Noise Ratio should be as large as possible which means that the content of signal in the output is large and the noise is less. Since it is Peak Signal to noise Ratio that's why the value of signal is considered as maximum which is 255(for gray scale images the gray scale range from 0-255). L reflects the range of values that a pixel can take. For example, if the Y channel is encoded with a depth of 8-bit, then L = 2^8 - 1 = 255.

(c) Bit Error Rate (BER)

BER= 1/ PSNR

The number of bit errors is the number of received bits of a data stream of a communication channel that have been altered due to noise, interference, distortion or bit synchronization errors.

3.2 Objectives

Video watermarking technology is a new effective way to solve the problem of copyright protection, ownership, video authentication, finger printing etc. The key objective of this research work is to provide video authentication, robust and secured watermarking. Objectives for this research work are:

1. Develop the system to achieve a high user satisfaction and hence improving the overall performance of the video.

2. To improve the security.

3. To enhance the robustness against the attack.

4. To provide better efficiency and secured watermarking.

5. To implement Stephens Corner Detection Algorithm using MATLAB.

6. To analyses the behavior of the video watermarking algorithm using following paramerts:
   (a) PSNR
   (b) MSE
   (c) BER

4. Research Methodology

4.1Stephens Corner detection:

The Stephens corner detector is a popular required corner point detector due to its strong invariance to rotation, scale, illumination variation and image noise. A corner can be defined as the intersection of two edges. An edge is a sharp change in image brightness. A corner can also be defined as a point for which there is two dominant and different edge directions in a local neighborhood of the point. In simpler terms: Find the points where two edges meet.

The Stephens corner detector is based on the local auto-correlation function of a signal, where the local auto-correlation function measures the local changes of the signal with patches shifted by a small amount in different directions.

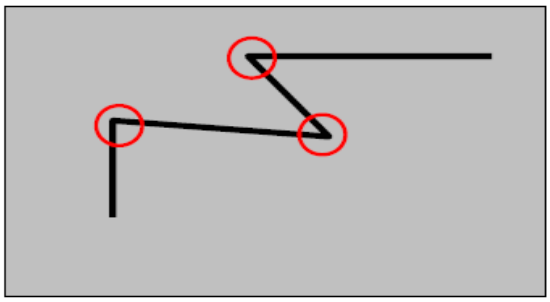

Figure 4.1.1 Stephens Corner Detection Algorithm

4.2 Steps of Stephens Corner detection:

1. To find out required corner point we take a small window.

2. We should easily recognize the point by looking at intensity values within a small window.
3. Shifting the window in any direction should yield a large change in appearance.
4. If flat region than no change in all direction.
5. If edge than no change in all direction.

6. If Corner is detected than significant change in all direction.
7. To calculate this change of intensity, local window is shifted in various directions.
8. Now Stephen will work on the basic of intensity change at corner make a second moment matrix or autocorrelation matrix.
9. Now this autocorrelation matrix will have two Eigen values and can be calculate by using Stephen detector.
10. These points are smoothened using a filter (Gaussian noise window), so that are refine and easily detected.
11. Next step to declare threshold value for obtaining best corner co-ordinates
12. A threshold value say (t) is generated or set so as to select most refined points.
13. If the point detected have value less than threshold value than those points are not counted as interest point for embedding watermark, but points have value greater than threshold value, then they are counted for watermarking.
14. Thus on these points the watermark image is embedded.

For an instance, in figure shown below we have three regions that are

1. Flat
2. Edge
3. Corner

In short, the procedures of embeding and extracting watermark in video watermarking.

1. Select a video to which a watermark is to be added. Then divide the video into frames.
2. Now apply "**Stephen Corner"** detection algorithm to find the interest point in all the frames consecutively.
3. Now select an image to be watermarked and then divide the image in to sub images.
4. Now check count of blocks and corners which are detected, though if corners are more than sub images.
5. Then insert parts of images in to selected frames.
6. Now the final watermarked video is prepared
7. Now from this watermarked video which is ready the watermark is extracted.
8. Watermark can be extracted using a reverse algorithm of embedding.
9. Here the quality comparison will take place for the frame and watermark which has been extracted.

5. Result

The experimental results showed that there is no perceptible distortion in the embedded video. The main advantage of this method is that it is robust and has hundred percentage efficiency. In the experiments, various .avi videos are used as the host where as .jpg images are used as watermark images. The proposed algorithm is tested on many images. Every time, it gives hundred percent efficiency of video. The embedded video and embedded frames and the performance evaluation of algorithm are summarized in Table 1.

5.1 Output Table

Output table shows the different values of different parameters as shown below

Output Table 5.1.1

WATERMARK	MSE	PSNR	BER
WATERMARK 1	0.7217	49.5469	0.0202
WATERMARK 2	0.7228	49.5406	0.0202
WATERMARK 3	0.8494	48.8398	0.0205
WATERMARK 4	0.1938	55.2579	0.0181
WATERMARK 5	0.9183	48.5009	0.0206
WATERMARK6	0.7065	49.6396	0.0201
WATERMARK7	0.7344	49.4715	0.0202
WATERMARK 8	0.1938	55.2579	0.0181
WATERMARK 9	0.5117	51.0409	0.0196
WATERMARK 10	0.3698	52.4513	0.0191
WATERMARK 11	0.5170	50.9963	0.0196
WATERMARK 12	0.5004	51.1379	0.0196
WATERMARK 13	0.4478	51.6203	0.0194
WATERMARK14	0.4651	51.4551	0.0194
WATERMARK 15	0.4758	51.3562	0.0195
WATERMARK 16	0.5759	50.5273	0.0198
WATERMARK 17	0.5095	51.0591	0.0196

WATERMARK 18	0.6197	50.2088	0.0199
WATERMARK 19	0.8897	48.6382	0.0206
WATERMARK 20	0.5325	50.8673	0.0197
WATERMARK 21	0.6535	49.9786	0.0200
WATERMARK 22	0.6651	49.9020	0.0200
WATERMARK 23	0.5424	50.7876	0.0197
WATERMARK 24	0.7514	49.3723	0.0203
WATERMARK 25	0.4072	52.0330	0.0192
WATERMARK 26	0.4514	51.5854	0.0194
WATERMARK 27	0.6189	50.2147	0.0199
WATERMARK 28	0.6039	50.3208	0.0199
WATERMARK 29	0.4718	51.3935	0.0195
WATERMARK 30	0.4012	52.0970	0.0192

5.2 Efficiency (100 percent)

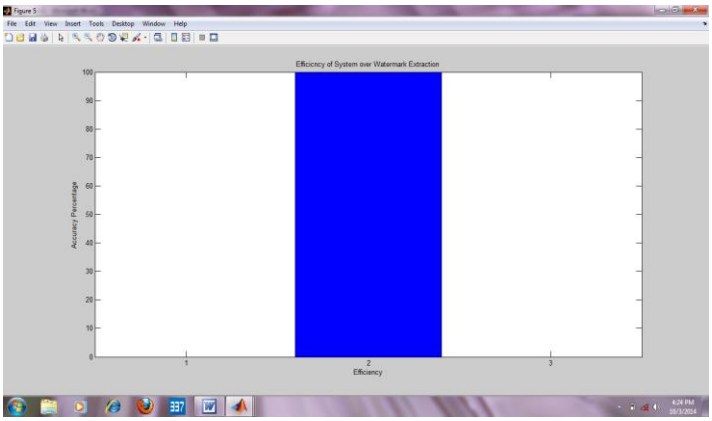

Figure.5.2.1 show efficiency

5.3 MSE Value (Minimum)

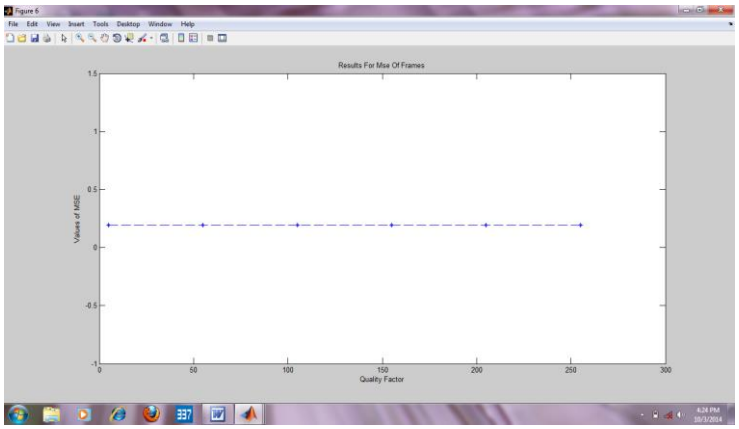

Figure.5.3.1 show MSE value

5.4 PSNR Value (Maximum)

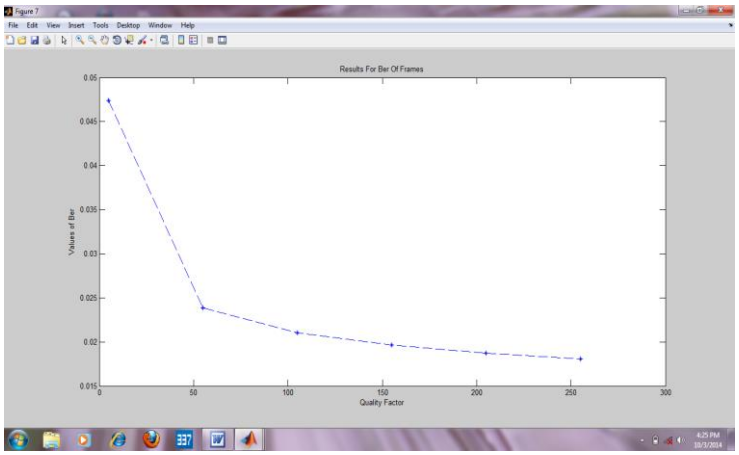

Figure.5.4.1 show PSNR

5.5 BER rate (Minimum)

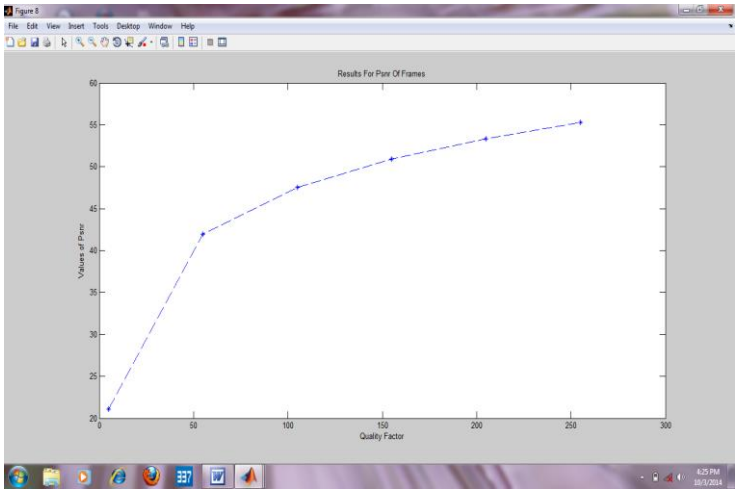

Figure.5.5.1 show BER

6. Conclusion and Future Scope

In my research work, now we come to the result that articulated a high-level overview of how digital watermarks can be used in networks to enable new robust technique for video authentication and robustness. I implemented the algorithms in MATLAB described in methodology. This algorithm makes the video copyright protection effect is largely improved and it can effectively enhance the robustness of the video stream. The implementation results show that embedded video is excellent with high PSNR, better efficiency and has very low visual artifacts. The algorithm is fairly robust against attacks like image cropping, rotation.

Future Work

Video watermarking is a vast concept and plays a very important role in today's life. There is a huge scope of improvement in this area. I have implemented digital watermark on gray scale video, but further research implemented on the coloured video. The performance of the given algorithms can also be increased by decreasing the execution time of video.

References:

[1] Ashish M. Kothari (2012), "Transform Domain Video Watermarking: Design, Implementation and Performance Analysis," 978-0-7695-4692/12 $26.00 2012 IEEE, pp. 133-137.
[2] Prachi V. Powar (2013), "Implementation of digital video watermarking scheme based on FGPA," International Journal of Electrical, Electronics and Computer Systems, vol.1, pp. 99-104.
[3] Yujie Zhang (2012), "Research on Video Copyright Protection System," IEEE, pp. 1277-1280.
[4] Nisreen I. Yassin (2012), "Block Based Video Watermarking Scheme Using Wavelet Transform and Principal Component Analysis," International Journal of Computer Science Issues, pp. 296-301.
[5] Survey on Different Video Watermarking Techniques and Comparative Analysis with Reference to H.264/AVC Sourav Bhattacharya, T. Chattopadhyay and Arpan Pal Digital Video Watermarking using Discrete Wavelet Transform and Principal Component Analysis, 1-4244-0216-6/06/$20.00 ©2006 IEEE
[6] Md. Maklachur Rahman, A dwt, dct and svd based watermarking technique to protect the image piracy
[7] Sanjana Sinha, Prajnat Bardhan, Swarnali Pramanick, Ankul Jagatramka, Dipak K. Kole, Aruna Chakraborty
[8] Proceedings of COST 254 Workshops on Intelligent Communications, L'Aquila Italy, June 4-6, 1998.
[9] Watermarking of Digital Video Stream for Source Authentication Kesavan Gopal1, Dr. M. Madhavi Latha2
[10] A Robust Video Watermarking Algorithm for Content Authentication using Discrete Wavelet Transform (DWT) and Singular Value Decomposition (SVD)
[11] Loganathan Agilandeeswari1 and Kumaravel Muralibabu2
[12] M. G. Kuhn, "Stirmark", available at http:// www.cl.cam.ac.uk /~mgk25/stirmark/, Security Group, Computer Lab, Cambridge University, UK (E-mail: mkuhn@acm.org), 1997
[13] H. Choi, H. Kim, and T. Kim, "Robust Watermarks for Images in the Subband Domain", Proc. of The 6th IEEE International Workshop on Intelligent Signal Processing and Communication Systems (ISPACS'98), Melbourne, Australia, pp. 168–172, 19
[14] Dr. Sandeep Kumar Sood Digital Image Watermarking Technique Based on Different Attacks Review of Robust Video Watermarking Algorithms
[15] Mrs Neeta Deshpande Shojanazeri, H. ; Dept. of Comput. & Commun. Syst. Eng., Univ. Putra Malaysia, Serdang, Malaysia ; Wan Adnan, W.A. ; Ahmad, S.M.S. ; Saripan, M.I. Analysis of watermarking techniques in video.
[16] Rubaljeet (2012), "A Comparative Analysis of Different Techniques for Removing Artifacts from Graphical Images" International journal of Computers Applications (0975-8887), pp. 24-27
[17] Aditi Agarwal (2011), "A Robust Video Watermarking Scheme using DCT and DWT" International Journal of Computer Science and Information Technologies, Vol. 2 (4) , 2011, pp. 1711-1716

