Catalogue of Hybrid Video Watermarking Techniques

Manoj Kumar
Asst. Professor
JEMTEC, Gr. Noida
India

Sandeep Gupta, PhD
Asst. Professor
JEMTEC, Gr .Noida
India

Arnold Hensman
Asst. Professor
ITB
Ireland

ABSTRACT
Authentication and copyright protection of digital data is a matter of big concern in the present times. As forgery techniques are becoming more sophisticated day by day, incidents of copying and tampering of digital data without the owner's permission are on the rise. Digital data can be manipulated and copied easily, therefore it becomes important to protect owner data by using some rights protection system. In this paper, various approaches to protect digital data (Audio, Video etc.) using watermarking techniques are discussed. Watermarking is one of the best approach to protect digital data and prove user authenticity. Watermarking technique provides protection against illegal distribution of digital data. Watermarking is a process to embed some noise tolerant signal in the original signal. This technique is very effective against various types of attacks on the digital data and hence provides a robust solution for data theft cases. This paper is a review of different watermarking techniques for protecting digital data.

Keywords
Video Watermarking, Data Security, User Authenticity

1. INTRODUCTION
Digital data are spread all over the networks because of the fast growth of the Internet and WWW. Owners can use these networks and techniques to share their data across the networks, it leads to a wide concern in multimedia security and multimedia copyright protection [1]. For the protection of owner's personal property or digital data, watermarking is used. This is an active area of research. A watermark provides the information about the origin & ownership of data and is a useful copy right control application. The watermark information is embedded with the original signal and later as per requirement extracted from the original signal to prove authenticity and also its robustness. [2].

Video watermarking is quite difficult as compared to image watermarking because of the heavy amount of data and redundancies between various frames and hence it is susceptible to piracy attacks. In the previous works, many methods exist which solve this problem and are discussed in the latter sections of this paper. Many watermarking techniques have been proposed to embed the watermark data into the original content. Traditional watermarking techniques use visible mode watermarking that is watermark is visible to the naked eye, on the original content. But to improve security and quality of the data, blind watermarking approaches are preferred. Main characteristics of watermarking techniques include payload capacity, blind detection, robustness, perceptual transparency, tamper resistance, sensitivity and scalability. A good watermarking approach should have all these characteristics [2]. This paper discusses various digital watermarking schemes which are uncited in the previous works.

2. LITERATURE REVIEW
An overview of existing technologies is given and other considerations are discussed in this section. A good watermarking algorithm should be robust against geometrical and removal transformations. Video watermarking is different as compared to image because video watermarking has a large amount of data and redundancies between video frames. A good video watermarking algorithm must be robust against video compression, frame dropping, frame swapping, geometric attacks, frame rate conversion, frame cropping, collusion attacks, noise, filtering, lighting change, histogram equalization, etc. [3]. Video watermarking is required to protect the user identity. The classification of different techniques is given here. Video watermarking is quite similar to image watermarking because video is composed of frames. These video frames are used for hiding the watermarked data within them.

2.1 Existing Approaches
Many techniques exist for the study of video watermarking. Watermarking schemes operate in the uncompressed domain, while some of the techniques directly embed content in the compressed domain. The researchers are still trying to make video watermarking robust and secure. Based on domains, watermarking is divided into three parts. These are spatial domain, frequency and MPEG coding structure based techniques as shown in Figure 1. Most of the work that exists under spatial domain techniques are now obsolete while researchers follow frequency domain techniques because of its beneficial features.

2.1.1 Spatial Domain Techniques
This part discusses about watermarking techniques in the spatial domain. Spatial domain algorithms generally have the following characteristics [4].

- Watermarks are applied to the pixels.
- No transformations are used during embedding of watermark in the host signal.
- Watermarks are extracted through spread spectrum modulation.
- Before watermark embedding it is transformed into the frequency domain.

Spatial domain watermarking techniques are simple with low time complexity. Redundant part of the carrier signal is used for embedding digital data. Watermarking Methods in spatial domain are discussed as:

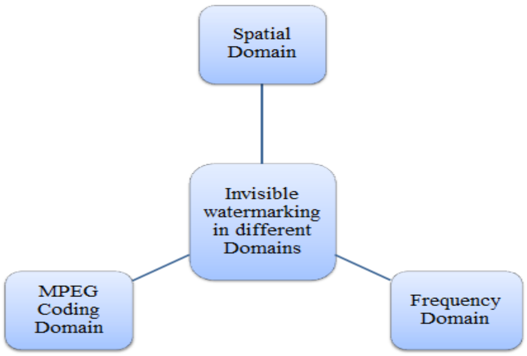

Figure 1: Classification of Invisible Digital Video Watermarking

2.1.1.1 Correlation Based Methods

Examples based on this technique in the literature are discussed in [5] [6] [7] [8] [9]. Most straightforward way to add a watermark to an image is to add a PN pattern to the luminance values of the image pixels [10]. Generally pseudorandom noise patterns consist of integers {-1, 0, 1} but floating point numbers can also be applied. The pattern is generated based on a key using seed, linear shift register etc. In the correlation based technique watermark is added to the original content using equation 1. In this I(x, y) is cover object while W(x, y) pseudorandom noise pattern. Figure 2 shows the embedding procedure in this domain.

$$I_w(x, y) = I(x, y) + kW(x, y) \quad (1)$$

In this k is a gain factor and I_w is a watermarked image. If the value of k increases, robustness of the watermark increase at the expense of the quality of watermarked image.

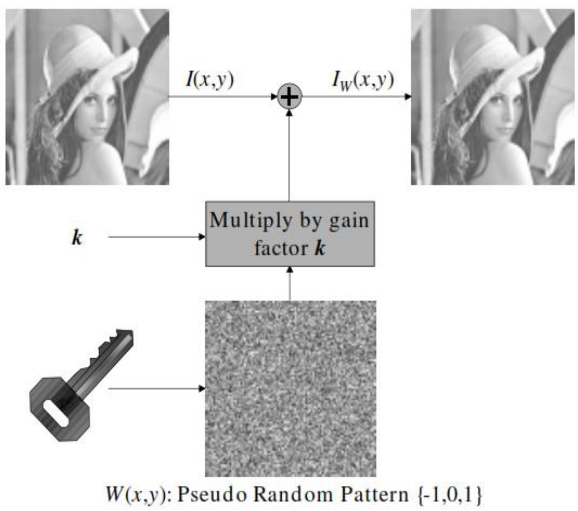

Figure 2: Watermark Embedding Procedure in Spatial Domain [10]

During the extraction procedure same key is used and correlation between watermarked image and noise pattern is computed. If the correlation value exceeds a threshold T, the watermark is detected and a single bit is used {-1, 1}. This detection procedure is as shown below.

$R_{I'_{w (x, y)} W_{(x, y)}} < T$ W(x, y) Detected

$R_{I'_{w (x, y)} W_{(x, y)}} < T$ No W(x, y) Detected

This method can be extended to multi-bit watermarking which is done by dividing image or frame into multiple blocks that is performed with the independent approach on those blocks. This basic algorithm can be improved in a number of ways. First, the notion of a threshold being used for determining a logical ’1’ or ’0’ can be eliminated by using two separate pseudorandom noise patterns. One pattern is specified as a logical ’1’ and the other a ’0’. The above procedure is then performed for each pattern, and the pattern with the higher resulting correlation is used. This will increase the probability of correct detection even if the frame is subject to attacks [4].

2.1.1.2 LSB (Least Significant Bits) Modifications

Simple example of spatial domain watermarking is LSB method. If each pixel in grayscale image is presented by 8 bits, then the image can be divided into 8 bit planes. This method is not a secured approach of watermarking because LSB planes do not have visually significant information. This information is easy to change by modification attacks. A more advanced approach based on this technique is described in [11]. Dehkordi et.al. [12] Proposed a robust algorithm based on this technique for image watermarking. They used structural similarity basics and taking 11x11 blocks of watermarks and carrier host to implement their technique. Based on the similarity threshold, they are shifting the bits from right to left or vice versa for embedding data. Their simulation results prove that the proposed method can find a better trade-off between capacity and imperceptibility than the old LSB method. More methods based on this technique found in [13] [14]. These techniques are not secure and robust because LSB planes are easily replaced by random numbers.

2.1.2 Frequency Domain Watermarking Methods

In the frequency domain generally DCT and DWT methods are used for data transformation. These methods offer more strength over pixel based methods and offer additional characteristics like in the spatial domain, DCT offer better implementation in MPEG video coding algorithms. Frequency domain techniques are more robust, particularly with compression, noise addition, scaling and rotation. The disadvantage of these methods is that they require more computational requirements. In this section frequency domain techniques are discussed.

2.1.2.1 Discrete Cosine Transform

Transform coding provides the essential components for image/video watermarking applications. The main principle behind is that these methods reveal more correlation between pixels. For image watermarking DCT is the most popular method because this method allows a frame to be broken up into different frequency bands. Embedding data in middle frequency bands make the embedding procedure easier. The lower band is known as middle band which is used for data embedding. Embedding data in these bands make the technique robust and secure [10] [15]. In the DCT domain a 2D watermark signal is embedded in the middle frequency band of the 8x8 DCT block. From this 8x8 DCT block frequency coefficients are modulated using the following equation.

$I_{W\,x, y} = I_{x, y}(u, v) + k{*}W_{x, y}(u, v)$ if $u, v \in F_m$

$I_{x, y}(u, v)$ if else

Here ‘I’ is the image data and W represents watermark data. F_m denotes the frequency band with gain factor k and (u, v) are the DCT coefficients in 8x8 block. Some of other approaches based on this technique are found in [16] [17] [18] [19] [20]. Finally block based DCT techniques are heavily used for image and video compression, which is applied in real time watermarking.

2.1.2.2 Discrete Wavelet Transform

Another domain in this type of video watermarking is wavelet domain. The DWT divides an image into resolution approximation, horizontal, vertical and diagonal detail components. These components are shown in Figure 5-1. DCT technique is also similar to this technique, but in this technique multiple watermarks can be embedded into a video frame. Using this transform watermark data is embedded in the high resolution DWT bands because human eyes cannot see the hidden information in the carrier signal. DWT coefficients in these three bands can be modulated by using the below mentioned equation.

$I_{W\,(u,\,v)} = I_{(u,\,v)} + k^{*}\, W_{(u,\,v)}$

Advantages of this technique are that watermark data is not restricted to some pixels but distributed to all pixels in the domain. This technique is compatible to video compression standard and HPS (Human perceptual System) can be embedded in the encoding process [21]. These frequency domain techniques are more robust, stable and invisible compared to spatial domain techniques. DWT provides both spatial and frequency domain characteristics of host signal. Some of other approaches using this DWT based technique are found in [22] [23] [24] [25] [26]. One of the popular method was proposed by F.Bartolini [27] using DWT. They obtained improved results compared to existing techniques by means of a new approach to mask the watermark according to the characteristics of the human visual system (HVS).

2.1.2.3 Discrete Fourier Transform

This technique is more robust against spatial and temporal shifts. To embed the watermark into a host signal a DFT (Discrete Fourier Transform) is performed on the original content and then a watermark is embedded by modifying the frequency domain elements. To recover the watermark inverse DFT is applied. Some of the DFT techniques include [28] [29] [30] [31]. Kalker et.al. [32] Proposed a method named JAWS (Just another Watermarking System) for broadcast monitoring applications. They use the spatial domain which essentially compresses and un-compresses the video. They embed the same watermark into consecutive video frames using Gaussian and high pass filters. JAWS was the robust technique for broadcast monitoring applications of video watermarking. Watermarked digital data using this 3D discrete Fourier transformation are more robust against local frame averaging or collusion and synchronization attacks.

2.1.3 Watermarks based on MPEG Coding Structures

Video watermarking techniques in MPEG coding structure include MPEG-1, 2, 4. The main purpose of these techniques is to provide integrated watermarking and compression. This approach of watermarking reduces real time video processing complexity. Compression in MPEG-2 is achieved by taking forward and bi-directional motion prediction to remove temporal redundancy while the statistical method used to remove spatial redundancy. This technique is not vulnerable against re-compression and format conversion.

Hartung and Girod [33] Proposed digital watermarking oh MPEG-2 coded video in the bit stream domain. Their basic principle using this technique is that they split I-frames into 8x8 pixels which are later compressed using the DCT quantization, zig-zag-scan, run level coding and entropy coding. This is as shown in figure 3. P and B frames are motion compensated and residual prediction error signal frames splits into block of 8x8 pixels. These frames are also compressed as like I-frames. Instead of adding the watermark in the pixel domain, extract, for each encoded 8 x 8-block of the video, the corresponding block from the watermark signal. Then they transferred watermark block using DCT and add two blocks in the transform domain as shown in Figure 4.

On the left side, MPEG-2 information is split into header, side information, motion vector and DCT encoded side blocks. Motion vector and header information are copied to watermark MPEG-2 bit stream while the later part of the bit stream is altered.

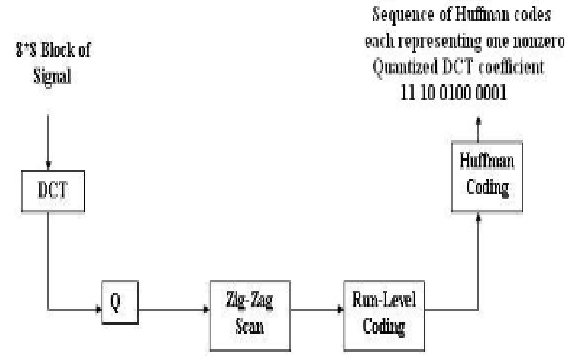

Figure 3: DCT Encoding on 8x8 Signal Block [33]

The DCT encoded signal blocks are represented by a sequence of a Huffman code. Each incoming Huffman code is decoded (EC^{-1}) and inversely quantized (Q^{-1}). After inverse quantization, apply DCT coefficients of the current signal block. After this, append the corresponding DCT coefficients from the transformed watermark block, yielding a watermarked DCT coefficients. In the final step of this approach apply quantize (Q) and Huffman encode (EC) to the watermarked coefficient.

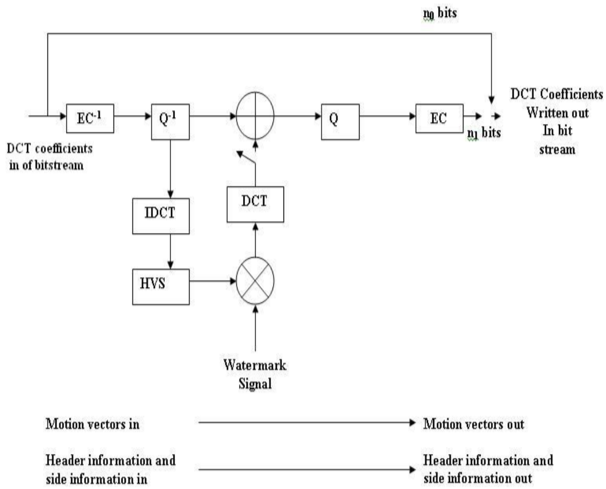

Figure 4: Generic scheme for watermarking of compressed Video [33]

Other approaches in MPEG domain found in [34] [35] [36] [37].

2.2 Other Approaches in Water Marking

2.2.1 Singular Value decomposition (SVD) Watermarking

SVD is a technique which is used in the image compression techniques and also used in watermarking applications. PCA is one of the popular approach used by most of the pattern recognition systems. The backbone of this approach is the statistical measure under the Eigen value and Eigen faces. First SVD is performed and then obtained singular values are modified to embed the watermark data. After embedding the watermark data, extraction of the content is done by applying pseudo-inverse SVD on the watermarked content. SVD can be used separately in the watermarking, but it is usually done in hybrid approaches of watermarking. Examples based on SVD with other hybrid approaches are found in [38] in the DCT domain, [39] with neural networks, [40] with wavelet transformation, [41] in DWT domain. SVD is a relatively complex approach in terms of computation so to reduce this complexity with watermarking, apply SVD to the entire image. To obtain the singular values follow the following statements.

Suppose M is an m×n matrix whose entries comes from some filed K. K can be real number or complex number field. In the next step, apply factorization using the following equation.

$$M = U \sum V^*$$

In this equation U is an m×n unitary matrix over K and ∑ is a diagonal matrix with nonnegative real numbers. Take n×n as a conjugate transpose of the n×n unitary matrix V. This factorization is called singular value decomposition of matrix M. From this diagonal entries of ∑ are known as singular values of M. Further, these singular decomposition values are used with other approaches to embed the watermark in the digital data. The main significance of this approach is the projection stage so that the actual areas will be identified where the contents will be stored. To identify these areas, the clustering approach will be implemented.

Techniques which include SVD decomposition include [42] [43] [44].

2.2.2 Histogram Based Reversible data Hiding Approaches

The histogram based approach is primarily used for steganalysis and for steganography applications to embed the secret data into digital media. Using this scheme data is shifted using histogram into the cover images. Methods based on this approach shifts the data bits and then embed the secret data in between neighbour bits of the original content. Hidden messages are estimated by measuring the differences between the histograms.

Ni et.al. [45] Proposed a robust histogram base reversible data hiding technique which recovers the original image without any distortion. This algorithm utilizes the zero or the minimum points of the histogram of an image and slightly modifies the grayscale pixel values to embed data into the image. It can embed more data than many of the existing reversible data hiding algorithms. This algorithm is applied to image watermarking and for steganography purposes. Their proposed algorithm for data hiding is using the following steps:

- First, they took a gray scale image of mxn size, where grayscale values x ∈ [0, 255].
- Based on these grayscale values histogram (x) is generated. After generation of histogram , maximum and minimum points are calculated. Maximum points are denoted as H(a) where a∈ [0,255] and minimum points are H(b) where b∈ [0,255].
- In the next step if the minimum point H (b) > 0 then record the gray scale pixels values b and set H (b) =0.
- Without loss of generality, assume a < b. Move the whole part of the histogram H(x) with x ∈ (a, b) to the right by 1 unit. This means that all the pixel grayscale values (satisfying x ∈ (a, b) are added by 1.
- Scan the image, once meet the pixel (whose grayscale value is a), check the to-be-embedded bit. If the to-be-embedded bit is "1", the pixel grayscale value is changed to a+1. If the bit is "0", the pixel value remains a.

Using this embedding algorithm data was stored in the cover media pixels and by reversing this algorithm data extraction was performed. The main feature of histogram based data hiding is that after embedding data, the original histogram peak will disappear and shows a concave shape in the peaks which is known as pair effect phenomenon. Figure 5 shows that histogram peaks and its adjacent bin decreases after data embedding. For loss less recovery these peaks and zero (Minimum) points are key parameters [46].

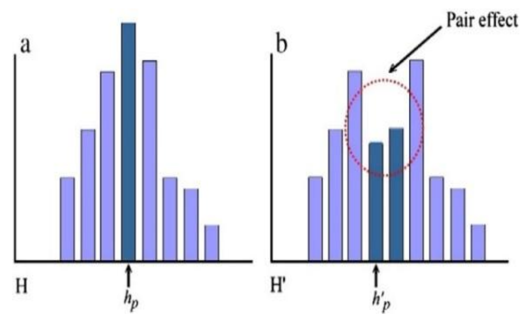

Figure 5: Example of pair effect of histogram: (a) cover-image and (b) stego-image.

Generally, natural images maintain good continuity and because of this adjacent values of histograms are very close. Because of this reason stego-image histogram generates pair effect. A work based on histogram based approach are found in [47] [48] [49] [50] [51].

2.2.3 Visual Cryptography Based Watermarking

Visual cryptography is an encryption technique for data hiding in images in such a way that decryption became impossible without the correct key. It was first introduced by A Shamir & Naor [52]. This technique divides the image into shares which are used for data hiding in the host signal. The output image from this technique contain random pixels and extraction of data without embedding shares is not possible. Every pixel of the input image is divided into blocks, if we are divided into two parts, then one contains the white and another contains the black block. Combining these blocks generates a binary image. According to Naor. M algorithm each pixel of the binary image is divided into 2*2 pixels as shown in figure 6. The obtained result from this is an M×N image into 2M*2N sharing images. More work using this technique exists on images in the literature.

B.SaiChandana [53] performed a work on images," A New Visual Cryptography Scheme for Color Images". In this paper, Author proposed a visual cryptographic system which can be used to hide the original image information from an intruder or an unwanted user. The images can be in any standard format. The encrypted image is sent to the destination through the network and then the image is decrypted. Author used symmetric key cryptography. Experimental results indicate the proposed method is a simple, practical and effective cryptographic system. Houmansadr et.al. [54] performed a work," A Digital Image Watermarking Scheme Based on Visual Cryptography". An image watermarking scheme based on the visual cryptography is proposed in this paper. The owner's mark which can be a visible logo is split into two share-images using a VSS scheme. One of the shares is embedded into the host image whereas the other is kept as the system's secret-key to be used in the watermark detection process.

Singh proposed a video watermarking scheme using this VC. They implemented this scheme with scene change detection in the DWT domain. "They proposed the idea to use different parts of a single watermark in different scenes of a video for generation of the owner's share from the original video based on the frame mean in the same scene and the binary watermark, and generation of the identification share based on the frame mean of probably attacked video" [55].

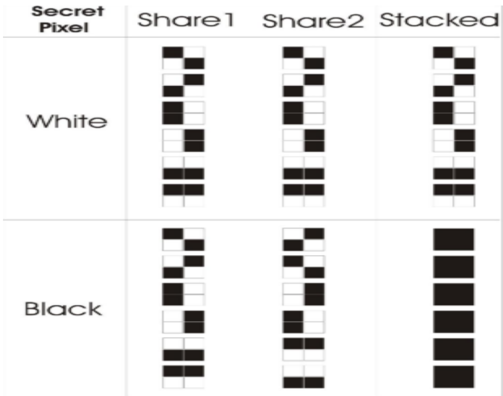

Figure 6: A 2*2 VSS scheme using 2*2 pixels

More work using visual cryptography for video watermarking found in [56] [57] [58] [59].

3. DISCUSSION

In this paper, previous works in the field of watermarking are discussed. Background overview in this field shows that many watermarking approaches exist for image and video data. Nearly all the approaches either use random frames or all frames of video to embed the data.

This paper also focuses on a steganography technique for images known as histogram based reversible data hiding. This is a powerful technique for hiding data into images for steganalysis. But instead of steganography domain researchers can also implement it with other techniques to make a proof concept with video watermarking. Some of the existing approaches use classifiers to differentiate between the cover and stego objects. But this will increase the computational complexity. Another approach results shows that they are robust against certain attacks and proves the data authenticity and fidelity of the content.

4. CONCLUSION

The literature work shows that there are many watermarking techniques exist which provide robustness and authenticity of the digital data. From this work LSB is the least used technique while wavelet based techniques are highly robust and resistant to compression, noise with minimum degradation in the quality of video. After reviewing all the techniques we can also conclude that hybrid approaches are more robust compared to other techniques. Good watermarking techniques are robust against spatial and geometrical transformations. Future work is to analyse various performance evaluation parameters for video data.

5. REFERENCES

[1] P. P. W. Chan, M. R. Lyu and R. T. Chin, "Copyright Protection on the Web: A Hybrid Digital Video Watermarking Scheme," in ACM, New York, USA, 17-18 May 2004.

[2] G. G. C. Gopika V Mane, "Review Paper on Video Watermarking Techniques," International Journal of Scientific and Research Publications, vol. 3, no. 4, pp. 1-5, April 2013.

[3] Y. Liu, Digital video watermarking robust to geometric attacks and compressions, Ottawa, Canada: A thesis submittted to the fullfilment of of the requirement for the degree of Doctorate of Philosophy, 2011.

[4] V. K. Agrawal, PERCEPTUAL WATERMARKING OF DIGITAL VIDEO USING THE VARIABLE TEMPORAL LENGTH 3D-DCT, Kanpur, India: A Thesis Submitted for the Degree of M. Tech. at IIT Kanpur, June 2007.

[5] R.Lancini, F.Mapelli and S.Tubaro, "A ROBUST VIDEO WATERMARKING TECHNIQUE IN THE SPATIAL DOMAIN," Zadar, Croatia, June 2002.

[6] R. v. Schyndel, A. Tirkel and C. Osborne, "A Digital Watermark," Austin, Texas, USA, Nov. 1994.

[7] F. Hartung, J. Su and B. Girod, "Spread Spectrum Watermarking: Malicious Attacks and Counterattacks," San Jose (CA), USA, January 1999.

[8] R. Wolfgang and E. Delp, "A Watermarking Technique for Digital Imagery: Further Studies," Las Vegas, USA, July 1997.

[9] T. Kalker, G. Depovere, J. Haitsma and M. Maes, "A Video Watermarking System for Broadcast Monitoring," San Jose, USA, Jan 1999.

[10] G. C. Langelaar, I. Setyawan and R. L. Lagendijk, "Watermarking Digital Image and Video Data: A State-of-the-Art Overview," IEEE SIGNAL PROCESSING MAGAZINE, pp. 20-46, 2000.

[11] H. Kinoshita, "An image digital signature system with ZKIP for the graph isomorphism," Lussane,Switzerland, Sept. 1996.

[12] A. B. Dehkordi, S. N. Esfahani and A. N. Avanaki, "Robust LSB Watermarking Optimized for Local Structural Similarity," 19th Iranian Conference on Electrical Engineering (ICEE), pp. 1-6, May 2011.

[13] T. Aura, "Invisible communication," in Proc. HUT Seminar on Network Security, Espoo, Finland, Nov 1995.

[14] R. v. Schyndel, A. Tirkel and C. Osborne, "A digital watermark," Austin, TX, Nov. 1994.

[15] J. Huang and Y. Q.Shi, "Embedding strategy for image watermarking in DCT domain," in Asia-Pacific Conference on Communications,Beijing, China , vol. 2 , pp. 981-984, Oct. 1999.

[16] M. N. Deshpande and D. A. rajurkar, "Robust DCT based Video Watermarking algorithms for Assorted Watermarks," Dalian, 2010 .

[17] Z. Yan-Shuo and W. Li-feng, "DCT-Based Video Watermarking Transcoding Technique," Harbin, Dec. 2007.

[18] C.-H. Yang, H.-Y. Huang and W.-H. Hsu, "An adaptive video watermarking technique based on DCT domain," 8th IEEE International Conference on Computer and Information Technology, 2008. CIT 2008. Sydney, NSW , pp. 589 - 594, July 2008.

[19] Y. Liu, X. Chen and P. Zhou, "The domain block video watermarking scheme based on video sequences' characteristics and DCT," Melbourne, Australia, July 2012.

[20] J. Li and A. Sui, "A Digital Video Watermarking Algorithm Based on DCT Domain," Harbin, June 2012.

[21] S. Patel, A. Katharotiya and M. Goyani, "A Survey on Digital Video Watermarking," International Journal of Comp. Tech. Appl., vol. 2, no. 6, pp. 3015-3018, Dec. 2011.

[22] S. A. Rathorel, S. Gilanil, A. Mumtaz, T. Jameell and A. Sayyed2, "Enhancing Invisibility and Robustness of DWT based Video Watermarking scheme for Copyright Protection," Karachi, July 2007.

[23] H. Liu, N. Chen, J. Huang, X. Huang and Y. Q. Shi, "A Robust DWT-Based Video Watermarking Algorithm," Phoenix-Scottsdale, AZ, 2002.

[24] S. A. Al-Taweel and P. Sumari, "Robust video watermarking based on 3D-DWT domain," Singapore, Jan. 2009.

[25] T. Tabassum and S. M. Islam, "A digital video watermarking technique based on identical frame extraction in 3-Level DWT," Chittagong, Dec. 2012.

[26] P. Campisi, "Video watermarking in the 3D-DWT domain using quantization-based methods," Shanghai, Nov. 2005.

[27] MBarni, B. F and P. A, "Improved wavelet based watermarking through pixel wise masking," IEEE Transactions on Image Processing, vol. 10, no. 5, pp. 783 - 791, May 2001.

[28] M. Barni, F. Bartolini, D. Rosa and A. Piva, "Optimum decoding and detection of multiplicative watermarks," IEEE Transactions on Signal Processing, vol. 51, no. 4, pp. 1118-1123, April 2003.

[29] J. Su, "Fundamental performance limits of power-spectrum condition compliant watermarks," In: Proceedings of SPIE, vol. 3971, pp. 314-325, 2000.

[30] Liu and Zhao, "A new video watermarking algorithm based on 1D DFT and Radon transform," IEEE Signal Processing, vol. 90, no. 2, p. 626–639, Feb. 2010.

[31] F. Deguillaume, "Robust 3D DFT video watermarking," In: Proceedings of SPIE, vol. 3657, pp. 13-124, 1999.

[32] T. Kalker, J. Huitsma, M. Mues and G. Depovere, "HOW TO ACHIEVE ROBUSTNESS AGAINST SCALING IN A REAL-TIME DIGITAL WATERMARKING SYSTEM FOR BROASCAST MONITORING," Proceedings International Conference on IEEE Image Processing, vol. 1, pp. 407-410, 2000.

[33] F. Hartung and B. Girod, "Digital Watermarking of MPEG-2 Coded Video in the Bitstream Domain," IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP-97 in Munich, vol. 4, pp. 2621 - 2624, Apr. 1997.

[34] Z. Sakr and N. D. Georganas, "An MPEG-4 XMT scene structure algorithm for authentication and copyright protection," 14th International Workshop on Research Issues on Data Engineering: Web Services for e-Commerce and e-Government Applications, 2004. Proceedings. , pp. 48 - 55, March 2004.

[35] M. Taniguchi, "Scaling detection method for watermarked MPEG content," IEEE International Conference on Image Processing, ICIP 2005. , vol. 1, pp. I - 225-8, Sept. 2005.

[36] B. Girod, "The efficiency of motion-compensating prediction for hybrid coding of video sequences," IEEE Journal on Selected Areas in Communications, vol. 5, pp. 1140-1154, Aug. 1987.

[37] P. fin and H. H. Yu, "A semi-fragile watermarking system for MPEG video authentication," Orlando, FL, USA, May 2002.

[38] H. Wang, L. Z, M, S.-H. Sun, T. Simos and P. G, "A Blind Video Watermarking Algorithm Based on SVD in the DCT Domain," AIP Conference Proceedings, pp. 360-364, 2008.

[39] X. Zhao, J. Peng and Y. Xi, "The research on digital watermarking algorithm Based on neural networks and singular value decomposition," Shanghai, July 2011.

[40] Y. Wang and T. Li, "Digital watermarking algorithm based on singular value decomposition and wavelet transformation," Xiamen, March 2012.

[41] L. Zhang and A. Li, "Robust Watermarking Scheme Based on Singular Value of Decomposition in DWT Domain," Shenzhen, July 2009.

[42] D. Wu, W. Kong, B. Yang and X. Niu, "A fast SVD based video watermarking algorithm compatible with MPEG2 Standard," Springer, Soft Computing, vol. 13, no. 4, p. 375–382, June 2008.

[43] J. Kaufman and M. Celenk, "Digital Video Watermarking using Singular Value Decomposition and 2D Principal Component Analysis," In: 2006 International Conference on Image Processing, IEEE, pp. 2561-2564, 2006.

[44] L. Rajab, T. Al-Khatib and A. Al-Haj, "Video Watermarking Algorithms Using the SVD Transform," European Journal of Scientific Research, vol. 30, no. 3, p. 389–401, 2009.

[45] Z. Ni, Y.-Q. Shi, N. Ansari and W. Su, "Reversible Data Hiding," IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, vol. 16, no. 3, pp. 354-362, March 2006.

[46] D.-c. Lou, Chou and Chao-Lung, "Active steganalysis for histogram-shifting based reversible data hiding," optics communication, Elsevier, vol. 285, no. 10, pp. 2510-2518, 2012.

[47] H.-W. Yang, I.-E. Liao and C.-C. Chen, "Reversible data hiding based on grayscale value histogram with optimal multiple pairs of crests and troughs," Chiang Mai, Jan. 2009.

[48] A.Lavanya and V.Natarajan, "Data hiding using histogram modification of difference in medical images based on block division," Chennai, Tamil Nadu, April 2012.

[49] W. Hong, C.-W. Shiu and T.-S. Chen, "A High Quality Histogram Shifting Based Embedding Technique for Reversible Data Hiding," Kaohsiung, Nov.2008.

[50] R. Naskar and R. S. Chakraborty, "Histogram-bin-shifting-based reversible watermarking for colour images," Image Processing, IET , vol. 7, no. 2, Mar. 2013.

[51] b. H. L. C. a. c. Z. Zhenfei Zhaoa, H. Luo, Z.-M. Lu and J.-S. Pand, "Reversible data hiding based on multilevel histogram modification and sequential recovery," AEU - International Journal of Electronics and Communications, Elesivier, vol. 65, no. 10, pp. 814-826, Oct. 2011.

[52] M. Naor and A. Shamir, "Visual Cryptography," Advances in Cryptology Eurocrypt'94 Proceedings, Springer-Verlag, vol. 950, pp. 1-12, 1995.

[53] S. B.SaiChandana, "A New Visual Cryptography Scheme for Color Images," International Journal of Engineering Science and Technology, vol. 2, no. 6, pp. 1997-2000, 2010.

[54] A. Houmansadr and S. Ghaemmagham, "A Digital Image Watermarking Scheme Based on Visual Cryptography," [Online]. Available: http://www.cs.utexas.edu/~amir/papers/IST05.pdf. [Accessed 10 May 2013].

[55] T. R. Singh, K. M. Singh and S. Roy, "Robust Video Watermarking Scheme Based on Visual Cryptography," Trivandrum, Nov. 2012.

[56] S. Ghaemmaghami and A. Houmansadr, "A Novel Video Watermarking Method Using Visual Cryptography," Islamabad, 2006.

[57] A. Vashistha, R. Nallusamy, A. Das and S. Paul, "Watermarking video content using visual cryptography and scene averaged image," Suntec City, July 2010.

[58] Y.-B. Xing and J.-H. He, "A NEW ROBUST COPYRIGHT PROTECTION SCHEME FOR DIGITAL IM AGE BASED ON VISUAL CRYPTOGR APHY," Qingdao, July 2010.

[59] C.-S. Hsu and S.-F. Tu, "Digital Watermarking Scheme with Visual Digital Watermarking Scheme with Visual," Hong Kong, Mar. 2008.