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DWT-SVD Based Visual Cryptography Scheme for Audio Watermarking

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Abstract: *Secured access to the Internet and data resources has a high impact in defense system. This dependency has brought many threats to information security. As aresult, reliably secure mechanisms are required to protect most untold and blueprint of defenseinformation against vulnerabilities like ID spoofing and unauthorized access to top most system of country. In this paper, we proposed algorithm based on audio watermarking using DWT-SVD algorithm with visually crypted image message. The army people may have access to listen radio and communicate through walkie talkie which is audio format data. In proposed work we are hiding visually crypted image massage in audio file which may decrypted by proving shared image and extracted watermark image without affecting original audio. We did comparative analysis of various attacks on audio file after watermarking and calculated robustness and SNR value to support out work.*
Keywords*- SVD, DWT, VC, SNR, Robustness, Audio watermarking*

I. Introduction

Visual cryptography is a cryptographic technique which allows visual information (pictures, text, etc.) to be encrypted in such a way that decryption becomes a mechanical operation that does not require a computer. One of the best-known techniques has been credited to Moni Naor and Adi Shamir, who developed it in 1994. They demonstrated a visual secret sharing scheme, where an image was broken up into n shares so that only someone with all n shares could decrypt the image, while any n1 shares revealed no information about the original image. Each share was printed on a separate transparency, and decryption was performed by overlaying the shares. When all n shares were overlaid, the original image would appear. Applications that take full advantage of such simple yet secure scheme[1]. Audio Watermarking is a watermarking technique in which left and right channel of audio file is modified based on watermark object (visually crypted image). Discrete wavelet transform is used to find lowest frequency region of audio file. After that lowest frequency part (LL) region may processed with singular vector decomposition (SVD). Low frequency region having least information of object so we can modify singular part of decomposed vector for embedding the watermarked bit.

II. Visual Cryptography with Dwt-SVD Audio Watermarking

1.1 Visual Cryptography

Visual Cryptography Scheme (VCS) is an encryption method that usescombinatorial techniques to encode secret text message. The idea is to convert the text massage into an image and encode this image into 'N' twilight images. Thedecoding only requires only selecting some subset of these 'N' images, making intensity of hidden part of them, and stacking them on top of each other. In this Paper,we will provide the readers an overview of the basic VCS constructions, as well asseveral extended work in the area for audio watermarking purpose. In addition, we also review several techniques with improved VCS (by selecting Exor and Exnor operation in random manner) that take full advantage of such simple yet secure scheme.The simplest Visual Cryptography Scheme is given by the following setup. Asecret image consists of a collection of dark(0) and bright(1) pixels where each pixel isprocessed independently. To encode the secret, we divide the original image into n modifiedversions (referred as shares) such that each pixel in a share now subdivides into *m* darkand bright sub-pixels. To decode the image, we simply pick a subset S of those n sharesand copy each of them onto a transparency. If S is a "qualified" subset, then stackingall these transparencies will allow visual recovery of the secret.

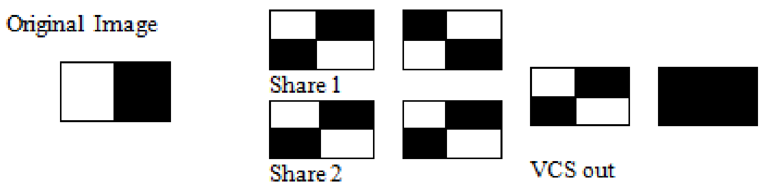

Fig. 2.1 VCS scheme[1]

Figure 2.2 provides anexample of such construction. Suppose the secret image "GCET Engineering College" is divided into 4 shares,which is denoted by Ǿ={1,2,3,4} and that the qualified sets are all subsets of {1,2},{2,3} and {3,4}.Then the qualified sets are exactly the following:
 qual = {{1,2},{2,3},{3,4},{1,2,3},{2,3,4},{1,3,4},{1,2,3,4}} ………(2.1)

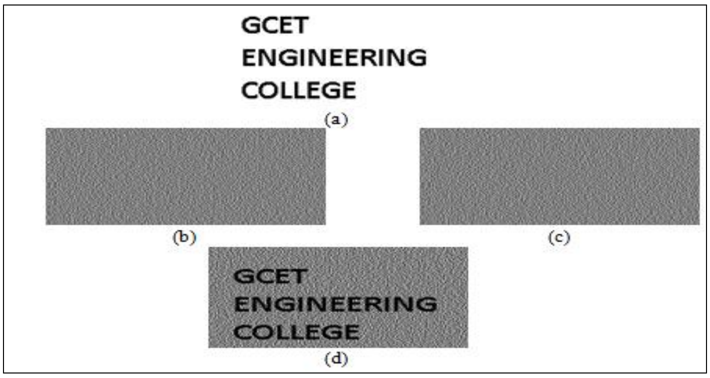

Fig 2.2 (a) Original Image (b),(c) Generated Shared image after VCS, (d) Recovered image from generated shares

1.2 Audio Watermarking with SVD-DWT

The DWT will be used to find extreme low frequency region so after embedding least number of audio content may be unaffected. In our paper , we proposed 3 level DWT for better imperceptible and robustness. The four level DWT is shown in Fig. 2.3.

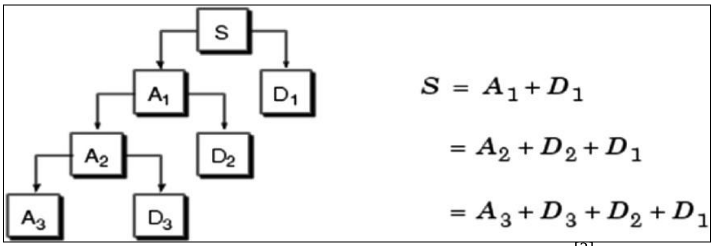

Fig. 2.3 Three Level DWT decomposition [2]

SVD is used to find singular vector of decomposed dwt vector. Proposed work is changing diagonal s value of s matrix to embedded watermark image bit (after VCS).

Table 2.1 S matrix formation

S11	0	0	0
0	S22	0	0
0	0	S33	0
0	0	0	S44

III. Proposed Work

The proposed system having two basic parts, first one is Visual Cryptography of Secrete image and the will forward for audio watermarking.

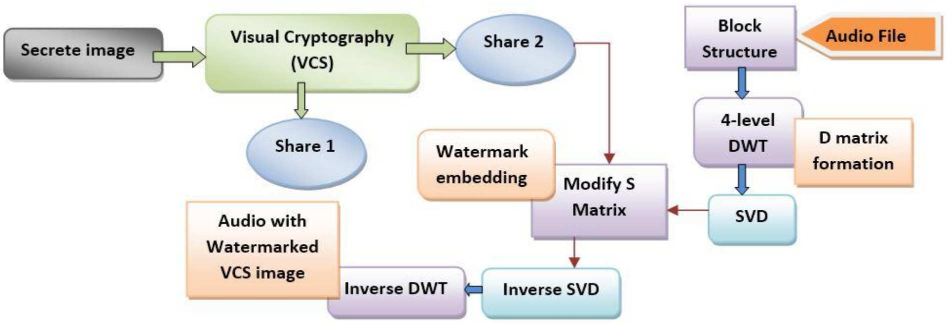

Fig 3.1 Watermark Embedding System.

In Embedding system, secrete image will firstly have processed for visual cryptography scheme, based on VCS scheme share 1 and share 2 of secrete image is available for next procedure. Each share part in now independently processed with Audio watermarking method based on improved DWT-SVD algorithm (proposed by Al. Haj) with slight modification in extraction part.
The audio file is rearranging in to finite block structure for processed with discrete wavelet transformation(DWT). In proposed work, 4-level DWT was processed to get less informative part of audio signal in terms of most low frequency part of audio file so after watermarking main audio file is least changed will reflect best SNR. Components of DWT is now processed with Singular vector decomposition (SVD) to obtain S matrix. Modification of S matrix is taken place based on watermarked image bits (algorithm 1). Last step of algorithm is to take inverse SVD and then Inverse DWD to obtain audio watermarked file with secrete visually encrypted image. {both share images are passed through this process}

Algorithm 1 (Embedding Procedure) for both share1 & share2

I. Input Secrete image
II. Apply VCS system to get Share1(s1) & Share2(s2)& reform images in to vector form. (1x N)
III. Take Audio file (Mx2)- Left and RightChannel Part { [a,s]=audioread('name.mp3').
IV. Divide Audio file in to finite blocks (15000 sample value/block taken)
V. Find DWT of selected block. ([da,db]=wavedec2(block)) and reform D matrix. [3]
VI. Process D matrix for SVD decomposition. ([U, S, V]=svd(D)].
*VII. Modify S value based on watermark image bits i.e. Snew= Wn + α * S (Wn: Image bit n, α: intensity of watermark)*
*VIII. Find inverse SVD (U * Snew * V^T) and its inverse DWT(waverec).*
(Final Audio File with Watermarked Image).

To get Encrypted image back we have to segregate audio file which we got after embedding process. Fig. 3.2 is related with segregation of watermarked audio.

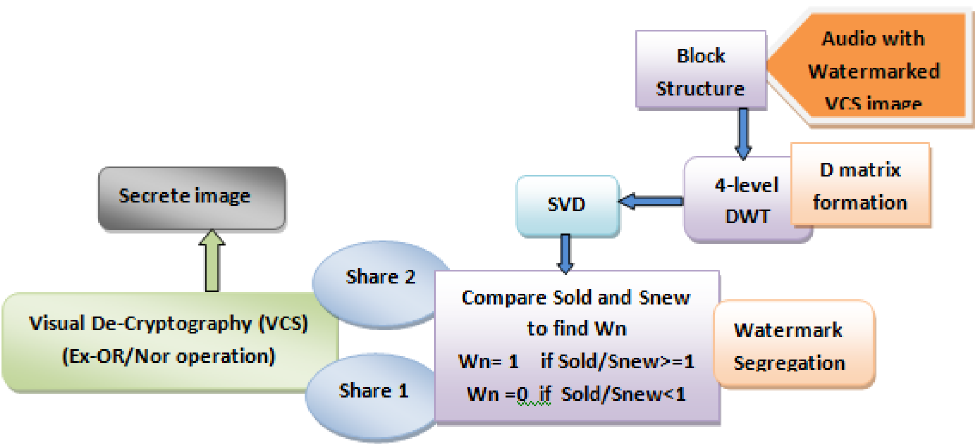

Fig 3.2 Watermark Segregation/Extraction System.

The Watermarked audio file is firstlydivided in to finite block for processing for discrete wavelet transformation. The formatted D matrix is now processed for SVD decomposition for watermark extraction process. Based on New S matrix value and old S(S vector of Extraction process), we may find watermarked image bits(Wn) by implementing equation 3.1.

$$Wn = 1, \text{if } \frac{Sold}{Snew} \geq 1 \qquad (3.1)$$

$$Wn = 0, \text{if } \frac{Sold}{Snew} < 1$$

We can get both shares using same process and both shares are now passed through visual DE cryptographic process by use of Ex-OR or Ex-NOR gate operation based on defined schemes. Output of that process is our hidden secrete image behind audio file.

Algorithm 2 (Segregation/Extraction Process)

I. *Input watermarked audio file.*
II. *Divide Audio file in to finite blocks (15000 sample value/block taken)*
III. *Find DWT of selected block. ([da,db]=wavedec2(block)) and reform D matrix.* [3]
IV. *Process D matrix for SVD decomposition. ([U, Snew, V]=svd(D)].*
V. *Find Wn value based on Equation 3.1.*
VI. *Reshape Wn (1 x N) vector into Matrix Image for display. (both shares)*
VII. *Do Ex-Oring or Ex-Nor operation using both shares which reforms original image.*

IV. Results And Discussion

Robustness and SNR value is calculated based on Equation 4.1 and 4.2 [3]

$$SNR(db) = 10\log_{10}\frac{\sum_{i=1}^{n} A^2}{\sum_{i=1}^{n} (A - A^{'})^2}; A = originalAudio, A' = WatermarkedAudio \qquad (4.1)$$

$$\rho(Wn, Wn') = \frac{\sum_{i=1}^{n} Wn_i Wn'_i}{\sqrt{\sum_{i=1}^{n} Wn_i^2}\ X \sqrt{\sum_{i=1}^{n} Wn'^2_i}}; Wn = OriginalWatermarkbit, Wn' = ExtractedBit \qquad (4.2)$$

For results and comparative analysis, we had considered so many attacks like ECHO, Cropping and Amplifying on watermarked audio file. Table 4.1 shows comparative analysis of such attacks with robustness and SNR values.

Table 4.1 Comparative analysis of Robustness value and SNR for Different attacks.

Attacks	$\alpha = 0.1$	$\alpha = 0.2$	$\alpha = 0.3$
Cropping	ρ = 1 , SNR= 76.7	ρ = 1, SNR= 68.7	ρ = 1, SNR= 66.90
Amplify	ρ =1, SNR= 78.9	ρ = 1. SNR= 78.9	ρ = 1, SNR= 65.29
Echo	ρ = 0.95. SNR= 72.9	ρ = 0.95. SNR= 68.57	ρ = 0.95, SNR= 64.19
Bass Boost	ρ = 0.96, SNR= 73.2	ρ = 0.96. SNR= 68.86	ρ = 1, SNR= 64.11
AWGN Noise	ρ = 1, SNR= 74.2	ρ = 1, SNR= 68.29	ρ = 1, SNR= 60.19
Random Noise	ρ = 1, SNR= 70.1	ρ = 1, SNR= 67.69	ρ = 1, SNR= 62.45

4.1 Results

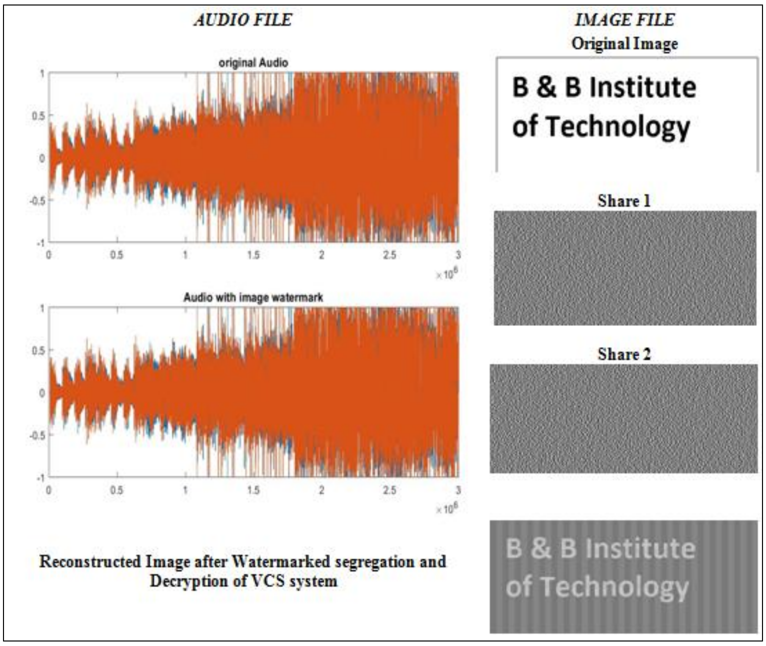

Fig. 4.1 Results of DWT-SVD based Audio watermarking image (VCS output) and Reconstruction

V. Conclusion

Digital Audio watermarking has its own advantages to protect copyright content on internet or elsewhere. Our Aim in this proposed work is simply focused on defense system for military protected, surveillance area to communicate in secured and safe manner. Hiding digital text / image data in audio file is more challenging as audio file is vector format and image is matrix (array structure). In further security, we deploy visualcryptography concept in DWT-SVD based robust method for perfect & secured communication system for army. Beauty of this algorithm is one can send encrypted message via radio broadcasting without any special military equipment. We have checked robustness and SNR value for all attacks with comparative analysis. In future one can focus on improvement of visual cryptography algorithm along with DWT-SVD Algorithm.

References

Journal Papers:

[1] F. Liu, C.K. Wu, X.J. Lin , Color visual cryptography schemes,IET Information Security, 2(4), 2008, 151 – 165.
[2] Ali Al-Haj, An imperceptible and robust audio watermarking algorithm, *EURASIP Journal on Audio, Speech, and Music Processing (Springer journal),* 2014.
[3] Khalid A. Darabkh, Imperceptible and Robust DWT-SVD-Based Digital Audio Watermarking Algorithm, *Journal of Software Engineering and Applications, 7,*2014, 859-871.
[4] M. Naor and A. Shamir, Visual cryptography II: improving the contrast via the cover base, in "Security Protocols*", M. Lomas, ed., Lecture Notes in Computer Science* ,1189 ,1997,, 197-202.
[5] K Bhat, I Sengupta, A Das, An adaptive audio watermarking based on the singular value decomposition in the wavelet domain. *Digital Signal Process.* 20, 2010, 1547–1558.
[6] M Hsieh, D Tseng, Y Huang, Hiding digital watermarks using multiresolution wavelet transform. *IEEE Trans. Ind. Electron.m 48(5)*,2001, 875–882.