IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 12, Issue 5, Ver. II (Sep.- Oct. 2017), PP 14-19
www.iosrjournals.org

Invisible Digital Audio Watermarking using DWT-DCT based Transform

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Abstract: *Watermarking is a process of inserting a secret message into a digital data for copyright protection. The digital data may be image, audio, video etc. Here, we have done invisible digital audio watermarking using a gray scale image as watermark. To provide security of original audio and for ownership protection such invisible digital watermarking technique is used. Here, the audio watermarking is based on DWT-DCT based Transform. To improve the performance of the audio the cyclic code is used as error correcting code and the Arnold Transform is also used. Hence, when the audio signal is copied then the hidden information is also carried in the copy. The performance of watermarked audio is calculated using Bit Error Rate (BER).*
Keywords: *DWT-DCT based transform, Arnold Transform, Error Correcting code, BER (Bit Error Rate).*

Date of Submission: 12-10-2017 Date of acceptance: 28-10-2017

I. Introduction

Digital watermarking is an important method for copyright protection and ownership identification in multimedia applications. The watermarking is widely used to protect copyrights of multimedia data contents. Digital watermarking is a process of embedding a message in the multimedia data such as; image, audio and video etc. The watermarking tries to hide a message related to the actual content of the digital signal. To remove or to change watermark is very difficult. Hence, the data of owner remain safe and secure. Thus, to prove ownership or copyrights of data watermark is extracted and verified. A technique to prevent piracy and illegal copying of data known as Digital Watermarking.

II. Copyright Protection

The copyright protection is needed to protect the designed data by the owner. Hence, the data is not copied from the original and if copied then it can be identified through these invisible digital watermarking. So, the copyright protection is needed. The copyright protection is very much necessary for the security level of data.Now, a day the copyright protection of data is more demandable due to control the illegal copy of data sets such as; image, audio and video data content. Digital watermarking protects from the copyrights where the monetary lost to the owner is reduced [9].

III. Invisible Watermarking Technique

The technique in which the watermark is invisible is known as invisible watermarking technique. In such a technique, the embedded watermark is not visible to human eye. Such, a technique is more secure than visible watermarking technique. The watermarking process includes embedding and extraction stages. Both the embedded and extracted method were invisible. Where, several transform methods like Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT), combined DWT-DCT, Singular Value Decomposition (SVD), Faster Fourier Transform (FFT) were used for watermarking[5]. To control duplicate copy of data such copyrighted security method has been used with the help of invisible digital watermarking [6]. So, the watermarking algorithms have been proposed in last few years which ensures the security of the watermark signal and authenticity of the original signal [7]. Also spread spectrum audio watermarking techniques has been implemented for audio files [8].

IV. Proposed Scheme

The audio watermarking is done based on different watermarking techniques. The audio watermarking techniques are of two types. Such as, time-domain techniques and frequency-transform domain techniques [10]. Here, we have performed the invisible digital audio watermarking technique using frequency domain analysis.

Audio Watermark Embedding Procedure:

In audio watermark embedding first an audio file is taken as host audio and an image is taken as watermark. The watermark image is converted to gray scale image. Then the image is scrambled by Arnold Scrambling algorithm.

Where, an Arnold key is inserted for watermark. After that to improve the error correction encoding is done by using cyclic code. Which results the perfect recovery of watermark. But the proper recovery of watermark depends on the size of image taken for watermarking. Then watermarked strength factor alpha (α) i.e; the percentage of watermark is added into the audio. Finally, DWT-DCT based transform is done and the watermarked audio is obtained. The audio watermarking is done using frequency domain analysis,

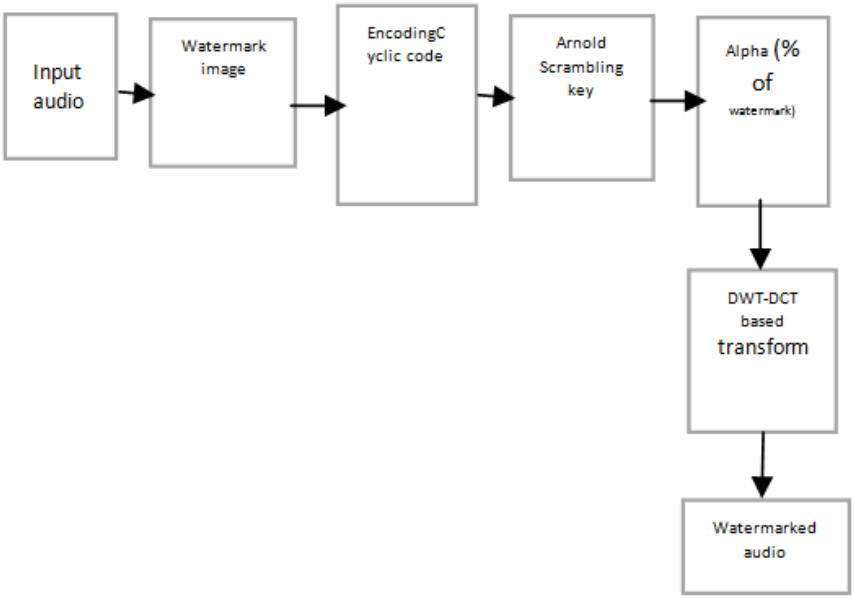

Figure 1: Audio Watermark Embedding

Audio Watermark Extraction Procedure:

Similarly, in the extraction process again inverse IDWT-IDCT based transform is performed. Then Inverse Scrambling algorithm is used to recover the original audio. The Cyclic code is decoded and the watermark is extracted from the watermarked audio signal. Hence, the watermark image is extracted and the original audio signal is also recovered. Finally, the quality of original audio (Host audio) and watermarked audio is checked.

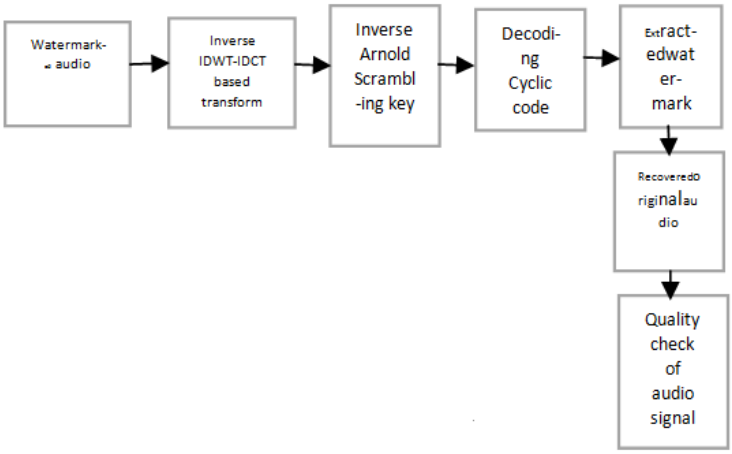

Figure 2: Audio Watermark Extraction

V. Experimental Results And Analysis

Here, a .wav file has been taken and an image.jpg has been taken from as watermark image. Then the image was converted in to gray scale image, after that scrambling is performed on that image and then the image was inserted in to the .wav audio file. The invisible audio watermarking has been performed in MATLAB through MATLAB Programming. By using MATLAB the following results were obtained. Also, in table 1 the % of watermark and Bit Error Rate (BER) is calculated and their respective graph is also plotted.

Results:

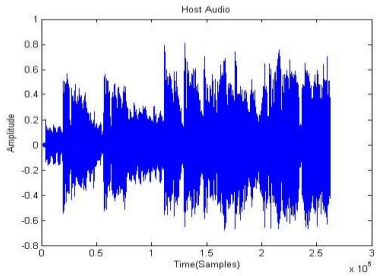

Figure 3: Host .wav file

Figure 4: Original Image

Figure 5: Watermark image

Figure 6: Gray Scale watermark image

Figure 7: Enter Key

Figure 8: After Enter Key

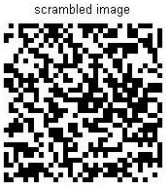

Figure 9: Scrambled image

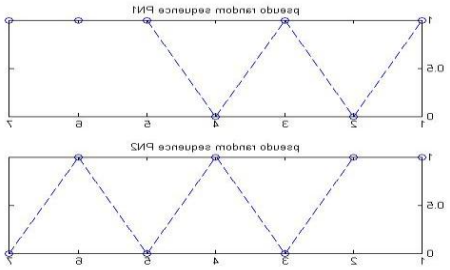

Figure 10: Pseudo Random Sequence PN1

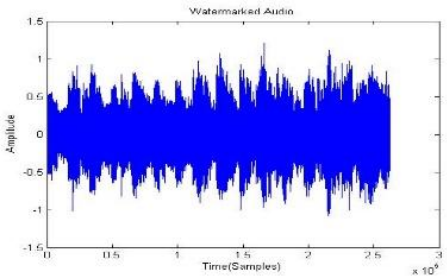

Figure 11: Watermarked Audio

Figure 12: Inverse scrambled image

Figure 13: Extracted Watermark

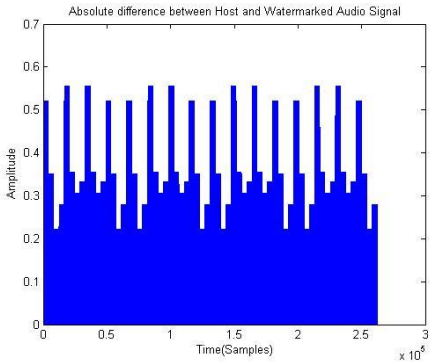

Figure 14: Absolute difference between Host and Watermarked Audio Signal

SI NO.	% of Watermark	Bit Error Rate (BER)
1.	0.4	127
2.	0.08	86
3.	0.076	73
4.	0.025	64
5.	0.009	49

Finally, the Bit Error (BER) has been calculated and the graph has been plotted between the percentage (%) of watermark and bit error rate (BER).

In digital transmission, the bit error rate (BER) is calculated to measure the performance which depends on the number of bit errors per unit time. The bit error ratio is the number of bit errors divided by the total number of transferred bits during a specific interval. BER is given by;

$$\text{BER in \%} = \frac{BER}{No.of\ bits} * 100 \quad \text{..... [1]}$$

The robustness of invisible watermarking method is defined as the ability of watermark detection to extract the embedded watermark after common signal processing operations and attacks [3]. Here, the robustness is measured in terms of Bit Error Rate (BER).

Table No. 1 (Audio Bit Error Rate (BER) Result)

Graph:

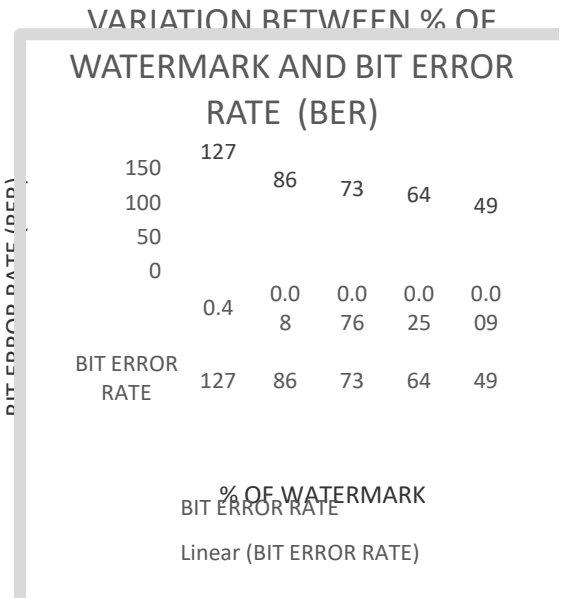

Figure 4.82: Variation between % of watermark and Bit Error Rate (BER)

In the invisible audio watermarking DWT offers multi-resolution analysis in frequency domain. Whereas, DCT provides energy compaction of audio signal. Where, the length of the watermark is decided according to there must be minimum audio bits to form minimum number of blocks for embedding watermark. In case of audio signal, we can embed as much as size of watermark image [2]. Here, we conclude that by using DWT-DCT based algorithm in invisible audio watermarking that poses good audio quality with approximate Bit Error Rate (BER) with high level of security as Arnold Scrambling key is used for ownership protection. But, the watermark image is little bit degraded after removed from the watermarked audio of watermark image taken from.jpg image. At the time of watermark extraction the bit error rate is calculated.

VI. Comparisons

(Comparing of different % of embedding watermark)

There are some values are taken for calculation of % of audio watermark. According to that the invisible digital watermarking is done.As, the amount of added percentage of watermark is very less, hence the bit error rate can be obtained by the addition of percentage of watermark in to the audio file. The bit error rate varies as per the variation in percentage of watermark. The bit error depends on the percentage of watermark added into the audio file.

VII. Application Of Watermarking In Various Fields

The digital watermarking has various applications. Such as;

Copyright Protection: Copy control is a very promising application for watermarking. In this application, the watermarking can be used to prevent the illegal copying of songs, images, movies by embedding a watermark in them, that would instruct watermarking in a compatible DVD or CD writer to not write the song or more because it is an illegal copy.

Source tracking:Such method has been used to detect the source of copied movies. Where the different recipients get differently watermarked content.

Television Broadcasting: Broadcast monitoring also watermarking technique is able to track when a specific video is being broadcast by a TV station.

VIII. Conclusion And Future Work

Here, we conclude that in the invisible watermarking using secret image in audio is as much as secure from copyright or piracy.In audio watermarking the Arnold Scrambling key is used for secure of audio data. Hence, now a day the invisible digital watermarking is widely used.Such invisible digital audio watermarking is used to protect audio files from duplicate copy. By adding different key value, the bit error rate isalso different.The future work can be implemented using OTP (One Time Password) to access an audio file for more secure of original audio. Such a method can be implemented when the audio file is sent to a specific person or specific organization. So, that the designed watermarked audio data will be more secure.

Reference

[1] **Subir, Dr. Amit M. Joshi,** 'DWT-DCT based blind audio watermarking using Arnold Scrambling and Cyclic Codes', International Conference on Signal Processing and Integrated Networks (SPIN), 978-1-4673-9197-9 © 2016 IEEE.

[2] **Prof. Sujit M. Deokar, Bhaveek DhaigudeSubir,** 'Blind Audio watermarking based on Discrete Wavelet and Cosine Transform', 2015 International Conference on Industrial Instrumentation and Control (ICIC) College of Engineering Pune, India, May 28-30, 2015, 978-1-4799-7165-7/15 © 2015 IEEE.

[3] **Mohammad Ibrahim Khan, Md. Iqbal Hasan Sarker, Kaushik Deb, Md. Hasan Furhad,** 'A New Audio watermarking method based on Discrete Cosine Transform with a gray image', International Journal of Computer Science and Information Technology (IJCSIT), Vol 4, No. 4, August 2012.

[4] **Yugandhara H. Wankhede, Prof. Samadhan D. Mali** 'Data hiding technique using Audio watermarking', International Journal of Engineering and Computer Science, Volume 4, Issue 3, March 2015, Page No. 11109-11112.

[5] **Krishna rao kakkirala, Srinivasa Rao Chalamala, Bala Mallikarjuna Rao G TCS Innovation Labs, TATA Consultancy Services, Hyderabad, India,** 'DWT-SVD based blind Audio watermarking scheme for copyright protection', 978-1-4799-3903-9/14 © 2014 IEEE.

[6] **Aman Chadha, Sandeep Gangundi, Rishabh Goel, Hiren Dave, M. Mani Roja,** 'Audio watermarking with error correction', International Journal of Advanced Computer Science and Applications, Vol. 2, No. 9, 2011, Page No. 113-118.

[7] **Jeebananda Panda1, Indu Kumari2, Nitish Goel3**, 'Digital Watermarking of Audio in Time Domain Multiple Bit Plane based on Chaotic Scrambling', International Journal of Innovative Research in Computer and Communication Engineering (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 3, March 2015.

[8] **Neha Baranwal1 and Kamalika Datta2**, 'Comparative Study of Spread Spectrum Based Audio Watermarking Techniques', IEEE-International Conference on Recent Trends in Information Technology, ICRTIT 2011, 978-1-4577-0590-8/11/$26.00 ©2011 IEEE-MIT.

[9] **Krishna Rao Kakkirala, Srinivasa Rao Chalamala, Bala Mallikarjunarao Garlapati**, 'AnAudio/SpeechWatermarkingMethodforCopyrightProtection', 2015 Third International Conference on Artificial Intelligence, Modelling and Simulation.

[10] **Ali Al-Haj1, Ahmad Mohammad1 and Lama Bata,** 'DWT–Based Audio Watermarking', The International Arab Journal of Information Technology, Vol. 8, No. 3, July 2011.

IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) is UGC approved Journal with Sl. No. 5016, Journal no. 49082.

Prof. Devasis Pradhan. "Invisible Digital Audio Watermarking using DWT-DCT based Transform." IOSR Journal of Electronics and Communication Engineering (IOSR-JECE), vol. 12, no. 5, 2017, pp. 14–19.