ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 4, Issue 2, March 2015

A DWT-HAAR based audio watermarking algorithm

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***Abstract*— Audio watermarking is the process of adding the information into audio files in such a way that the hidden information can be used to recognize the owner of the file as well as the quality of the audio signal will not be hampered. Many algorithms for audio watermarking have been proposed and have been used. In this paper, an improved DWT-HAAR based audio watermarking will be introduced.**

***Index Terms*— DWT, DCT, HAAR, SVD.**

I. INTRODUCTION

In the recent years with the development of internet technology it is very easy to access the unauthorized digital or multimedia information. For the protection of multimedia unauthorized information watermark technique is used. In this process embedding any information in a signal is very difficult to remove. A watermark is a unique electronic identifier typically used to identify ownership of copyright [2]. Watermarking has become increasingly important to enable copyright defense and tenure verification. Digital watermarking is a technique by which copyright information is embedded into the host signal in a way that the hidden information is imperceptible and robust in opposition to intentional and unintentional attacks. Because of the sensitivity of the Human Auditory System in contrast with the Human visual system, the audio watermarking is a difficult process due to the fact that the human ears are sensitive to the high frequency and this is the reason why very few institutions are working on audio watermarking system [1][2]. The audio watermarking techniques can be of two types- frequency domain or time domain techniques. Although time based techniques are easier to implement but they are less robust in comparison to the frequency based techniques [4]. Example of time domain techniques is LSB(Least Significant bit) and examples of frequency domain techniques are DFT, DCT, DWT etc.,

II. RELATED WORK

In 2013, Lalitha et al.[6] proposed a DWT-Arnold transform based audio watermarking algorithm. After various subjective and objective test, it has been concluded that this technique is quite robust against many attacks and quality of the audio is preserved as well.

Yan yang et al.[1] in 2009 gave a novel audio watermarking algorithm. This Algorithm uses DCT transform. The audio signal after decomposition is subjected to DCT and the watermark is embedded in AC DCT coefficient . The algorithm is robust against many attacks. In 2012, Elshazly et al.[4] proposed an algorithm which uses DWT along with mean quantization. In this, the encrypted image is embedded in the low frequency component of the transformed audio signal. After the blind extraction, the performance is evaluated. The algorithm is quite robust against malicious attacks.

Lalitha et. al.[7],in 2011, proposed an algorithm which uses DWT-SVD technique of audio-watermarking. The DCT-SVD has been compared with DWT-SVD as well. The DWT-SVD algorithm proves to be more robust than DCT-SVD algorithm.

Ghobadi et al.[5] gave an algorithm which uses LSB method. It is a blind audio watermarking technique tamper detection and prevention technique.

Singhal et al.[3] in 2011 proposed an algorithm which uses multilevel wavelet decomposition along with DCT and SVD methodology. This algorithm proves to be highly robust as the intruder cannot guess the level of decomposition performed on the audio file.

In 2009, Wang et al.[9] proposed a blind watermarking algorithm which proves to be quite robust against the attacks which can be both common signal processing attacks and de-synchronization attacks. The effectiveness of

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the proposed system is due to the audio statistics characteristics as well as synchronization code which is made possible by a three step process—segmentation of audio signals and further segmentation of audio segments into two segments, embedding of synchronization code in first segment and then finally performing DWT on the two sections cut out of second segment. Wei FOO et. al.[10] gave an adaptive algorithm for audio watermarking which uses echo hiding method. Advantages of the multiple echo hiding as well as single echo hiding have been discussed. Nikmehr et. al.[8] proposed a method of audio watermarking which uses both DWT and DCT. The segments produced as a result of the segmentation of the original audio signal further are divided into two sections. The synchronization bits are embedded into DWT coefficients of the first section whereas the watermark bits are embedded into the DCT coefficients of the second section The DCT coefficients are produced after performing DWT on the second section. This algorithm shows a very good resistance to the attacks. In the subsequent section, a blind watermarking algorithm has been proposed which uses DWT-HAAR transformation.

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III. GAPS IN THE LITERATURE

- DCT quantizes the data; hence the original data is lost. Therefore, quality is adversely affected.
- DWT shows better robustness and inaudibility as compared to DCT but BER in DWT can be more as compared to DCT.
- The complexity and computational overhead of some of the earlier algorithms is quite large.

DWT-HAAR can solve the problems faced in both the methods. DWT-HAAR produces lesser BER and does not affect the quality of signals. NCC is much better in case of DWT-HAAR, PSNR is higher and MSE is less in case of DWT-HAAR.

IV. PROPOSAL OF METHODOLOGY

The improved algorithm will be developed in Matrix Laboratory (MATLAB) platform. The proposed watermarking system contains two blocks—Audio watermarking embedding block and Audio watermarking extraction block.

A. Audio Watermarking embedding block

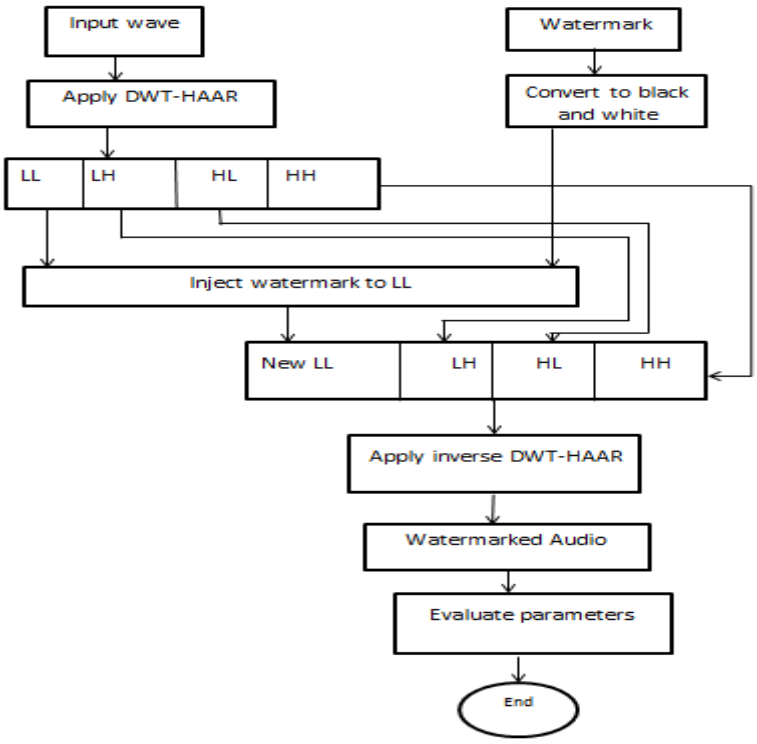

Fig.1 Block Diagram for Watermark embedding process

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Step1: Input the audio signal to be watermarked.

Step 2: Apply DWT-HAAR on the original audio signal to produce LL, LH, HL and HH sub-bands.

Step 3: Convert the watermark image to black and white.

Step 4: Inject the watermark into LL sub-band of the transformed audio-signal.

Step 5: The modified LL sub-band will be combined with the other sub-bands.

Step 6: Inverse DWT-HAAR operation will be applied to get the watermarked audio signal.

Step7: Different parameters related to the watermarked audio signal will be evaluated

B. Audio watermarking extraction block

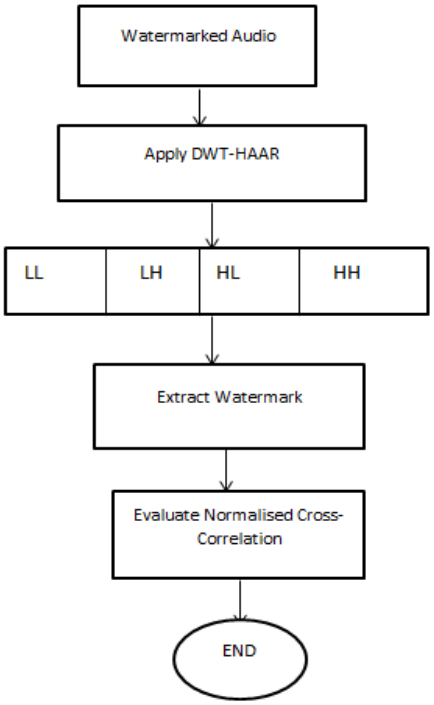

Fig. 2 Block diagram for watermarking extraction process

Step 1: Input the watermarked audio.

Step 2: Apply the DWT-HAAR on the watermarked audio signal.

Step 3: The signal will be decomposed to produce LL, LH, HL, HH sub-bands.

Step 4: The watermark image will be extracted.

Step 5: The extracted image will be compared with the original image to evaluate the Normalized Cross-correlation to check if any attacks have been made on the audio signal.

V. CONCLUSION

Every year, the music industry is loosing millions of dollars due to illegal copying and usage of audio files. Audio watermarking plays a role of savior in this case. It is process where an identifier or watermark is embedded into the

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audio file. This identifier can be used to recognize the actual owner as well as can provide the protection to the audio.

To overcome the problems faced in case of earlier mentioned algorithms, a DWT-HAAR based algorithm will be taken into consideration. With this improved algorithm, certain parameters such as Bit error rate, Signal to Noise Ratio, Mean Squared Error and Normalized Cross Correlation will be evaluated and the obtained results will be compared to the algorithms which are using DWT and DCT

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