Digital Audio Watermarking- A Survey

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Abstract

With the increasing usage of digital multimedia, the protection of intellectual property rights problem has become a very important issue. Digital watermarking is now drawing attention as a new method of protecting multimedia content from unauthorized copying. Over the past two decades, many digital watermarking algorithms have been developed, each with its own advantages and disadvantages. The main aim of this paper is to present a survey report of recently done work in audio watermarking fields.

Keywords: Digital Audio Watermarking, DWT, PSNR

I. INTRODUCTION

Technological advances in computing, communications, consumer electronics and their convergence have resulted in phenomenal increases in the amount of digital content that is being generated, stored, distributed, and consumed. In terms of a solution to the financial losses incurred from unauthorized copying, content owners predominantly turn to cryptography, which is one of the most commonly used methods of protecting digital content. In the cryptography process, the content is encrypted prior to the delivery to the consumer, and then a decryption key is provided only to those who have purchased legitimate copies of the content. However, cryptography does not offer a robust solution to content piracy. For example, a pirate could purchase the encrypted content legitimately and then use the decryption key to produce and distribute copies of the content illegally. In other words, once decrypted, the content has no further protection. Thus, there is a strong need for an alternative or complement to cryptography. In terms of the solution to the problems encountered with cryptography, watermarking has been proposed as it has potential to offer more robustness. It can protect the digital content during its normal usage because the copyright information is placed within the digital content in such a way that it cannot be removed. This unique feature of watermarking makes it one of the most promising techniques for digital content protection, which has been the motivating factor behind much of the research in the last two decades.

However, these advantages of digital media formats over analogue transform into disadvantages with respect to copyright management, because the possibility of unlimited copying without a loss of fidelity has led to a considerable financial loss for copyright holders. In our work audio watermarking is the target area because of high digitally spread content of audio, music etc. The algorithm process must possess some characteristics like imperceptibility, exact detection etc. To match these, our work will be evaluated on the basis of peak signal to noise ratio (PSNR) and normalized cross correlation (NCC).

In this paper we have studied many research and survey papers related to audio watermarking. We tried to collect the papers of years 2012-2015 so that latest work in it can be surveyed. In next chapters of this paper we have presented the report of our survey with conclusion and references.

II. LITERATURE SURVEY

The audio watermarking has been a hot research area for protection of digital sound content. Many researchers have suggested algorithms for that. Some has also done a good survey of previous work done. That helps fellow researchers to work forward. In [1] Komal ET. Al presented a survey report on various audio watermarking algorithms. They divided the work into three main categories: spread spectrum algorithm, amplitude modification, and replica method, dither watermarking and self-marking method. As per the author the spread spectrum method has the problem of synchronisation and time consumed is higher whereas replica is good for synchronisation but echo handling is worst. Amplitude modification method needs large channel capacity and introduces noise too. Overall self-marking method is good for synchronisation and robust for watermarking. Ali Al-Haj [2] in his paper proposed solution for shortcomings of spread spectrum method is overcome by combining it with singular value decomposition for high rate of robustness. To make it more robust the watermark bits are inserted diagonally into wavelet transformed input audio signals and a controlling gain parameter is introduced. This method also improves the payload capacity. Another author Khalid A. Darabkh [3] also did similar work using DWT and SVD algorithm but the methodology adopted is different from [2]. Although results are not checked on same datasets in both papers yet method adopted in [2] seems better as it insert the watermark bits in blocks to input DWT transformed audio. Yekta Said Can et.al [4] also used spread spectrum audio watermarking method. The advantage of this method is blindness. This method does not need the original audio file to extract watermark. Results are checked after addition of white Gaussian noise in the signal and these seems promising. Same blindness

issue was raised by Hwai-Tsu Hu [5]. The proposed scheme in [1] utilized the flexibility of discrete wavelet packet transformation (DWPT) to approximate the critical bands and adaptively determines suitable embedding strengths for carrying out quantization index modulation (QIM). The singular value decomposition (SVD) is employed to analyze the matrix formed by the DWPT coefficients and embed watermark bits by manipulating singular values subject to perceptual criteria. To achieve even better performance, two auxiliary enhancement measures are attached to the developed scheme. Performance evaluation and comparison are demonstrated with the presence of common digital signal processing attacks. Experimental results confirm that the combination of the DWPT, SVD, and adaptive QIM achieves imperceptible data hiding with satisfying robustness and payload capacity. Moreover, the inclusion of self-synchronization capability allows the developed watermarking system to withstand time-shifting and cropping attacks. Prayoth Kumsawat [6] discussed the audio watermark embedding problem and solution using genetic algorithm optimisation is proposed. The optimisation is done to tune the embedding depth of watermark to increase the cross correlation between extracted and original audio message & reduction of dis-similarity between extracted and original watermark image. The testing results of the watermarked audio quality and watermark robustness with various watermark attacks showed that method can improve the performance of the watermarking process such that the better watermarked audio quality and watermark robustness are achieved. Mehdi Sadeghzadeh [7] also used the GA to insert the watermark bits to audio signal but he added a layer of security to watermark message to by encrypting it. Adding in the line of optimisation algorithms for audio watermarking Hong Peng et.al [8] used multi objective particle swarm optimisation. The evaluation parameter and objective function used was PSNR (peak signal to noise ratio). The paper quoted following two advantages of the method: (i) it can avoid the difficulty of determining optimal weighted factors in the existing single- objective watermarking schemes; (ii) Pareto-optimal solutions can offer the flexibility to select optimal parameters for satisfying different application demands. Observing the use of iterative algorithms in watermarking and their effective performance Hsiang-Cheh Huang [9] presented a paper with comparison of many bio inspired iterative algorithms for information hiding and presented a survey report of more than 80 papers. Hongqin Shi [10] again used the combination of DWT-SVD algorithms but added the chaos with circulation to make it more secure to attackers. The results are tested by adding various noises and method came out as promising one. The proposed scheme takes advantage of image scrambling and blocked with circulation to improve the robustness and security of current watermark schemes. The perceptual quality and the watermarking capacity are greatly improved by this way. The original image is not needed during the extraction and detection procedure. So this algorithm also lies in the category of blind watermarking. Similar DWT-SVD algorithm was used by Huan Zhao [11]. In [12] Sartid Vongpraphip also followed the concept introduced in [7]. Now the genetic algorithm is replaced by adaptive tabu search (ATS) algorithm. But unlike PAPR as objective function this paper suggested its own with two tuning parameters as weighting factors. Krishna Rao Kakkirala [13] used a combination of DWT-SVD and one borrowed technique from cryptography i.e. secret sharing. The advantage using secret sharing in audio watermarking is that it will make the watermark robust to both cryptographic and compression attacks. The simulation results show that the new technique is robust against different attacks such as compression, noise, sampling rate conversion etc. N.V.Lalitha [14] introduces the discrete cosine transform (DCT) along with DWT and SVD and compared the performance with DWT-SVD and DCT-SVD. Work in [15][16][17] followed the similar pattern of using combined DWT-SVD.

III. CONCLUSION

Digital watermarking schemes can prove to be a valuable technique for copyright control of digital material. Available studies on audio watermarking are far less than that of image watermarking or video watermarking. However, during the last decade audio watermarking studies have also increased considerably. Those studies have contributed much to the progress of audio watermarking technologies. This paper surveyed those papers and presented some of the important techniques used for digital audio watermarking.

We have noticed that the majority of researchers are dependent upon the spread spectrum method for watermarking but due to its synchronization problem it is used with combination of singular value decomposition which is further seen as a problem which need an optimised value for various parameters. Bio inspired algorithms later became the choice of researchers to test with DWT-SVD.

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