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A DCT BASED WATERMARKING METHOD FOR COPYRIGHT PROTECTION

Miss Nidhi G. Gupta[1], Dr. S. A. Ladhake[2]
[1] (M.E. Scholar), [2] Principal
Department of Computer Science and Engineering
Sipna College of Engineering and Technology
Amravati, Maharashtra, India.

Abstract: Digital watermarking is an important role for protecting digital contents from unauthorized copying .This paper proposes a new audio watermarking method based on Discrete Cosine Transformation (DCT) for copyright protection. In our proposed watermarking method, the original audio is transformed into DCT domain. The absolute values of DCT coefficients are divided into an arbitrary number of segments and the energy of each segment is calculated. Watermarks are then embedded into the selected peaks of the highest energy segment. Watermarks are extracted by performing the inverse operation of watermarking embedding process. Simulation results indicate that our proposed watermarking method is highly robust against various kinds of attacks such as noise addition, cropping, re-sampling, re-quantization, MP3 compression, and echo.

Keywords: Ccopyright protection, Digital Watermarking, Discrete Cosine Transform (DCT), Sound Contents, audio signal.

I. INTRODUCTION

The rapid development of internet and digital information revolution cased significant changes in the global society, ranging from the influence on the world economy to the way people nowadays communicate: [1].

Digitizing of multimedia data has enabled reliable, faster and efficient storage, transfer and processing of digital data. It also leads to the consequence of illegal production and redistribution of digital media. Digital watermarking is identified as a partial solution to related problems which allow content creator to embed hidden data such as author or copyright information into the multimedia data [2]. In cryptographic techniques significant information is encrypted so that only the key holder has access to that information. Once the information is decrypted the security is lost. Information hiding is unlike cryptography, message is embedded into digital media, which can be distributed and used normally. Information hiding doesn't limit the use of digital data. Within past few years several algorithms for embedding and extraction of watermark in audio sequence have been published [3-7]. Almost all audio watermarking algorithms work by exploiting the perceptual property of Human Auditory System (HAS). The simplest visualization of the requirements of information hiding in digital audio is possible via a magic triangle [3]. Inaudibility, robustness to attacks and the watermark data rate are in the corners of the magic triangle. In order to satisfy the requirements of magic triangle, watermarks are seen embedded in Fourier domain [4], time domain [5], sub-band domain [6], and wavelet domain [7] and by echo hiding. Audio watermarking should meet the following requirements: (a) Imperceptibility: the digital watermark should not affect the quality of original audio signal after it is watermarked (b) Robustness: the embedded watermark data should not be removed or eliminated by unauthorized distributors using common signal processing operations and attacks (c) Capacity: capacity refers to the numbers of bits that can be embedded into the audio signal within a unit of time (d) Security: security implies that the watermark can only be detectable by the authorized person. All these requirements are often contradictory with each other. However, it should satisfy the important properties such as imperceptibility and robustness.

II. DCT TECHNIQUE

The DCT transforms have been extensively used in many digital signal processing applications. DCT is a useful tool of linear algebra with several applications in image compression, watermarking and other areas of signal processing.

III. RELATED RESEARCH

During the past decade, with the development of information digitalization and internet, digital media increasingly predominate over traditional analog media. However, as one of the concomitant side-effects, it is also becoming easier for some individual or group to copy and transmit digital products without the permission of the owner.

The digital watermark is then introduced to solve this problem. Covering many subjects such as signal processing, communication theory and Encryption, the research in digital watermark is to provide copyright protection to digital products, and to prevent and track illegal copying and transmission of them.

Watermarking is embedding information, which is able to show the ownership or track copyright intrusion, into the digital image, video or audio. Its purpose determines that the watermark should be indivisible and robust to common processing and attack.

Currently the digital watermarking technologies can be divided into two categories by the embedding position spatial domain and transform domain watermark. Spatial domain techniques developed earlier and is easier to implement, but

is limited in robustness, while transform domain techniques, which embed watermark in the host's transform domain, is more sophisticated and robust. With the development of digital watermarking, spatial techniques, due to their weakness in robustness, are generally abandoned, and frequency algorithm based on. Another tendency in watermarking is blind extraction, which means the host is not need when extracting the watermark; otherwise it is hard to avoid the

IV. PROPOSED METHOD OF WATERMARKING DCT METHOD

In this section, we give an overview of our basic watermarking method which consists of watermark embedding process and watermark detection process. In this implementation, a watermark consists of a sequence of real numbers **X**= {x1, x2, x3,..., xn}. We create a watermark where each value of xi is chosen independently according to N (0, 1) where N (μ, _2) denotes a normal distribution with mean μ and variance.

A. Watermark Embedding Process:

The proposed watermark embedding process is shown in Figure 1.

1. The embedding process is implemented in the following seven steps:
2. The original audio signal is transformed into DCT domain to calculate the DCT coefficients.
3. Absolute values of the DCT coefficients are divided into an arbitrary number of segments.
4. Energy of each segment is then calculated. Mathematically, the energy is calculated using the mathematical equation.
5. Find the most prominent peaks from the highest energy segment using a peak detection algorithm.
6. The watermark is then embedded into the selected N peaks of the highest energy segment, where N is the length of watermark. This ensures that the watermark is located at the most significant perceptual components. When we insert the watermark X into V to obtain V', we specify a scaling parameter _, which determines the extent to which X alters V.
7. Insert back the modified peak into the highest energy segment of absolute DCT coefficients and transform these absolute coefficients to real DCT coefficients.
8. Apply an inverse Discrete Cosine Transformation (IDCT) to the real DCT coefficients to Obtaining the watermark audio signal.

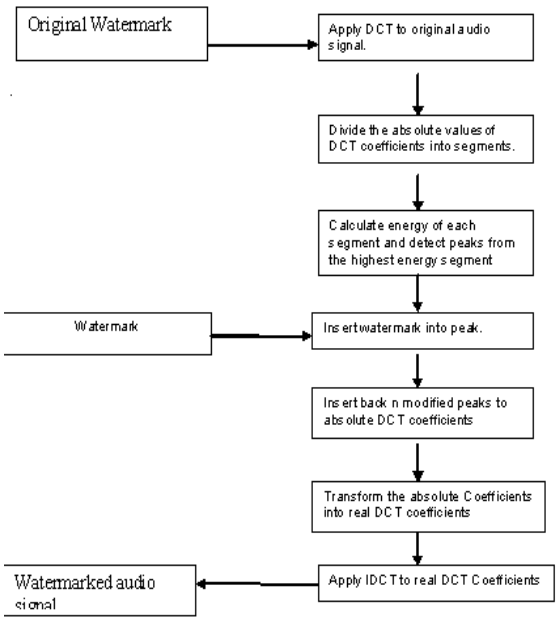

Fig. 1. Watermark embedding process

B. Watermark Detection Process

The detection process is implemented in the following three steps:

1. The attacked watermarked audio signal is transformed into DCT domain.
2. Extract the highest prominent peaks from the absolute DCT coefficients which are located at the same position in the embedding process above.
3. The watermark sequence * * * * * 1 2 3, , ,..., n X = x x x x is then extracted by performing the inverse operation .

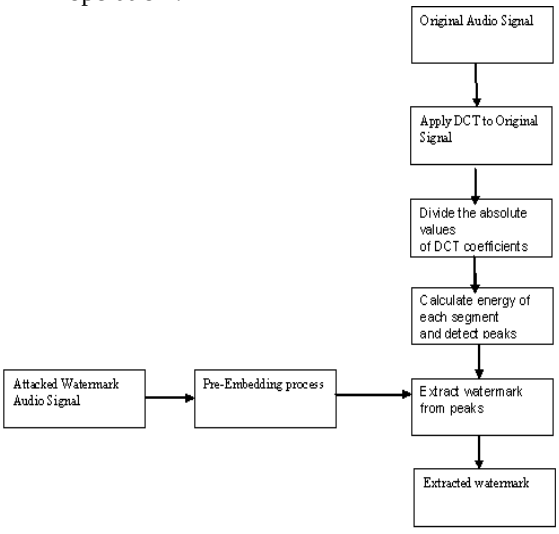

Fig. 2. Watermark detection process

V. EXPERIMENTAL RESULT AND DISCUSSION:

A. Imperceptibility Test

Informal listening using head set reveals that the watermark embedded into the original audio signal using the proposed watermarking method does not affect the quality of the sound, which ensures the imperceptibility of the embedded watermark. Table 1 shows the SNR results of the proposed watermarking method for different values of our proposed method achieves SNR values ranging from 13 dB to 24 dB for different watermarked sounds.

B. Robustness Test

The robustness of a watermarking method is defined as the ability of watermark detector to extract the embedded watermark after common signal processing operations and attacks. Robustness is measured in terms of the similarity function. Table shows the performance of our proposed method in terms of similarity when no attack is applied to four different types of watermarked audio signals In order to test the robustness of our proposed method, six different types of attacks, summarized in Table, were performed to the watermarked audio signal..

Attacks	**Description**
Noise addition	Additive white Gaussian noise (AWGN) is added to the watermarked audio signal
Cropping	We removed 10% samples from the beginning of the Watermarked signal and then replaced these samples by original signal.
Re-sampling	The watermarked signal originally sampled at 44.1 kHz is resample at 22.050 kHz, and then restored by sampling again at 44.1 kHz.
Re-quantization	The 16 bit watermarked audio signal is quantized down to 8 bits/sample and again re-quantized back to 16 bits/sample.
Echo	Decay factor of 25% and the delay time of 100 Milliseconds are applied to the watermarked audio signal.

Table 1. Attacks used in this study for the watermarked sound

VI. CONCLUSION

In this paper, we have presented a new watermarking method in DCT for copyright protection of audio data. In most watermark hiding techniques, the watermark is hidden in the audio either in the spatial or frequency domain. The audio will suffer a certain degree of distortions for the embedment. The proposed DCT method for copyright protection scheme does not physically alter the host audio. This technique indicate that our proposed DCT watermarking method shows strong robustness and data will secure or protected from unauthorized accessing users or against several kinds of attacks such as noise addition, cropping, resampling, re-quantization, MP3 compression, and echo attack . These results demonstrate that our proposed watermarking method can be a suitable for audio copyright protection. Results from the experimental testing on the several different attacks showed that the recovered watermarks are visually clear, robust and imperceptible.

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