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Digital Watermarking Using High Robust Contour Let Transform and Fast Fourier Transform

G.Kishore Krishna
PG Student
Sistam, Srikakulam
kishorekrishnag@gmail.com

S.Venkata Swamy
Associate Professor
Sistam, Srikakulam
suryapaga@gmail.com

Abstract: *Digital watermarking is now drawing attention as a new method of protecting digital content from unauthorized copying. Many effective watermarking algorithms have been proposed and implemented for multimedia. In this paper, a new method of embedding gray image data into the audio signal and additive audio watermarking algorithm based on Fast Fourier Transformation (FFT) domain is proposed. First, the original audio is transformed into FFT domain. The FFT coefficients are divided into a fixed number of subsections and the energy of each subsection is calculated. Next, watermark is generated from gray image. Watermarks are then embedded into selected peaks of highest energy subsection. Experimental results demonstrate that the watermark is inaudible and this algorithm is robust to common operations of digital audio signal processing, such as noise addition, re-sampling, re-quantization and so on.*

Keywords:*CT, FFT*

1. INTRODUCTION

In the recent years there has been an increasing demand for copyright protection, due to the exponential growth of multimedia and internet technologies. Digital watermarking is a proposing technique to tackle this problem. From the technical perspective, digital watermarking is aimed at embedded proprietary data (such as signature, logo, ID number etc.) into the media object such that the owners can extract these data if necessary to declare their copyright. A part from copyright protection digital watermarking is also used for other applications such as source tracking, broadcast monitoring and temper detection. While digital watermarking is applicable to multimedia data including audio, image and video, this thesis focuses on audio watermarking. Compared to image, video watermarking and audio watermarking is more challenging mainly due to two reasons. Firstly, audio signals contain only one-dimensional data, thus it is difficult to hide additional information without compromising the quality of the audio signal. Secondly, the human auditory system (HAS) is more sensitive than the human visual system, thus a small degradation in the quality will be noticed by the listeners.

Digital watermarking gives a promising solution for this problem, where the copyright related information is hidden inside the actual multimedia data rather than in the header of the multimedia file. Thus it is difficult for a pirate to extract or modify or delete the information without notably degrading the quality of the multimedia object. In this way copyright related information such as publishes name, logo and ID is always associated with multimedia object as far as the quality remains intact. Watermarks made their first appearance in the thirteenth century in Italy. Most notables adopted their own watermarks, and letters preserved from that time still bear their author's coats of arms and royal crests. Like wax seal, a watermark was an emblem of prestige, and also guarded the security of personal correspondence. Like the finest papers, the true watermark remains a thing of rare craftsmanship, changed little in its manufacture in over seven centuries. With today's improved paper machines, watermarks are now clearer, and are used in most of the world's banknotes as they are difficult to forge without the craftsmanship required to produce the genuine article. In our Information Age, more and more textual, image, and audio data find their way from traditional media, e.g. paper or vinyl discs, to digital media. Digital representation of media potentially improves the accessibility, portability, efficiency, and accuracy of the data. Undesirable effects of the accessibility include an increased opportunity for

violation of copyright or modification of content. Data hiding (or steganography) tries to solve some of these undesirable effects by embedding data, such as copyright information, into various forms of media with a minimum amount of perceivable degradation of the original signal. A watermark is a recognizable image or pattern in paper that appears as various shades of lightness/darkness when viewed by transmitted light (or when viewed by reflected light, atop a dark background), caused by thickness or density variations in the paper. There are two main ways of producing watermarks in paper; the dandy roll process, and the more complex cylinder mould process. Watermarks vary greatly in their visibility; while some are obvious on casual inspection, others require some study to pick out. Various aids have been developed, such as watermark fluid that wets the paper without damaging it. Watermarks are often used as security features of banknotes, passports, postage stamps, and other documents to prevent counterfeiting (see security paper). A watermark is very useful in the examination of paper it can be used for dating, identifying sizes, mill trademarks and locations, and the quality of a paper. Encoding an identifying code into digitized music, video, picture or other files is known as a digital watermark. Along with the rapid growth of Internet, the distribution of audiovisual media becomes easier. It leads to the problems regarding copyright protection. Among them, copyright protection is the primary concern and the hotspot of international area in recent areas.

Basics related DWT and PCA are discussed in section II. Proposed method is discussed in section III. Experimental results are presented in section IV. Concluding remarks are discussed in section V.

2. CT AND FFT

Digital product information hiding and digital watermarking technology is generated on this basis and developed along with the protection of copyright; this technology is widely used in protecting the copyright of image, audio and video by means of extracting or detecting the watermark for its various application including copyright protection, broadcast and publication monitoring, authentication, copy control. Fragile watermarks are the set of watermarking method that can be completely destroyed after any modification to an image. They are not applicable for copyright protection because they are easily removed without seriously degrading the signal. They are heavily used in signal authenticity determination. Semi-fragile on the other hand are used for detecting any unauthorized modification to a digital signal. They have more applicability because they assure that only non-malicious modification will occur in the host signal. Robust watermarking has the best applicability for watermarking than the two previous methods in that they are designed to withstand arbitrarily malicious attacks and are usually used for copyright protection. According to, robust watermarking is seen as a communication channel multiplexed into original content in a non-perceptible way and whose capacity degrades as a smooth function of the degradation of the marked content. Watermark embedding scheme can either embed the watermark into the host signal or to a transformed version of the host signal.The Discrete Wavelet Transform (DWT) is a very popular and commonly used Transform for image processing. The DWT decomposes an image into a set of basis functions called wavelets; decomposition is defined as the "resolution" of an image. The DWT then performs a multi-resolution analysis of a signal with localization in both time and frequency domains. 2D-DWT is implemented as a set of filter banks, comprising of a cascaded scheme of high-pass and low-pass filters. The final result obtained is a decomposition of the input image into four non-overlapping multi-resolution sub-bands: LL, LH, HL and HH. The sub-band LL represents the coarse-scale DWT coefficients while the sub-bands LH, HL and HH represent the fine-scale of DWT coefficients. In this work HH is explored for face recognition. Principal Component Analysis (PCA)[8][12] is one of the most popular technique which is used for reduction of the dimensionality. Feature classification is easily implemented using PCA compared to other methods. Image features are divided into two approaches. One is global approach and another one is local approach. Global feature analysis is easy to implement. But, sometimes it gives false results. In that case local feature is more useful. Finally some mathematical distance techniques are used to retrieve the relevant faces from the database based on minimum distance. Distance measures are angle based, Euclidean, mahalanobis, sum square error based distance, and their modifications.

3. PROPOSED ALGORITHM

The proposed method is shown below detailed algorithm is presented below:

1. Choose an image W with the size (M*N), M and N are rows and columns.
2. Decompose the image in the contourlet transform domain as thirty two sub bands with contourlet coefficients.
3. Select the high frequency sub bands with directionality and anisotropy.
4. These sub bands are used to increase the robustness.
5. The watermark image to be embedded can be arranged as a set of matrices W s, d (i, j) with the size (WM *WN) and pseudo random binary values

   s and d are indicate the scale and the direction of contourlet sub bands.
6. Watermarked image is generated as the combinations of watermark image are product with the same size of pseudo random data and highest frequency sub band of original image.
7. Embedded watermark into the sub bands of an image is accomplished according to

   O' s, d (i, j) = O s, d (i, j) +& M s, d (i, j) W s, d (i, j)

   Where O s, d (i, j) and O' s, d (i, j) are the original contourlet coefficient and the watermarked contourlet coefficients.
8. Perform inverse operation for entire watermarked image.
9. Extract the original image and secret image from the watermarked image.
10. Calculate the MSE and PSNR values from the images $MSE = (O' s, d (i, j) - O s, d (i, j))^2/M*N$

    $PSNR = 10*\log (2^8-1)^2/MSE$

In this section, algorithm is based on a Fast Fourier Transform (FFT) on audio signal in which a watermark image is embedded. The algorithm consists of two process, watermark embedding process and watermark extraction process.

4. AUDIO SIGNAL

An audio signal is a representation of sound, typically as an electrical voltage. Audio signals have frequencies in the audio frequency range of roughly 20 to 20 kHz. This frequency range is called Human Auditory System (HAS). Audio signals may be synthesized directly, or may originate at a transducer such as a microphone, musical instrument pickup, phonograph cartridge, or tape head. Loud speakers or headphones convert an electrical audio signal into sound.

5. FFT TECHNIQUE

The Fast Fourier Transform is useful to map the time-domain sequence into a continuous function of a frequency variable. The FFT of a sequence {x(n)} of length N is given by a complex-valued sequence X(k).

As the number of computations involved in transforming a N point time domain signal into its corresponding frequency domain signal was found to be N2 complex multiplications, an alternative algorithm involving lesser number of computations is opted. When the sequence x(n) is divided into 2 sequences and the DFT performed separately, the resulting number of computations would be $1V^2/2$.

The detection process of a generic watermarking scheme is shown in Fig5.4. Inputs to the scheme are the attacked watermark data, the secret or public key, and the original data or the original watermark depending on the method. The output of the watermark recovery process is either the recovered watermark or some kind of confidence measure indicating how likely it is for the given watermark at the input to be present in the data under inspection

6. EXPERIMENTAL RESULTS

In this experiment we used three 512×512 gray scale cover images (Lena, Barbara, and peppers) and simulated some scaling process operation. Multi resolution pyramidal filtering and the directional decomposition are based on bi orthogonal filters. The watermark at high frequency sub bands of an image is sensitive to many image processing methods such as low pass filtering, lossy

compression, noise, and geometrical distortion. On the other hand, the watermark at low frequency sub bands of an image is sensitive to others image equalization, and cropping. In this paper, we proved robustness of our proposed watermarking scheme. Then extracted watermark image is shown in below figure

Table1: Comparison of Three Images With Their PSNR Value

Image	DWT Watermarking PSNR (dB)	Proposed (CT) watermarking PSNR (dB)
Lena	38.1	39.54
Barbara	37.06	39.12
Peppers	36.61	38.09

7. CONCLUSION

In this paper, a new watermarking method using Fast Fourier Transform (FFT) for copyright protection and data hiding of audio sound is proposed. Experimental results indicate that proposed watermarking system has compromised audibility and robustness better. This method also shows strong robustness against several kinds of attacks such as noise addition, re-sampling, re-quantization, filtering etc. These results demonstrate that our proposed

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