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Digital Watermarking System based on Bit Stream Formatting of Audio Signal

San Ohnmar Kyaw[1], Cherry Kyaw Win[2], KhinMyoKyi[3]

Faculty of Computer Systems and Technologies, University of Computer Studies, Meiktila
Faculty of Computer Systems and Technologies, University of Computer Studies, Meiktila
Faculty of Computer Systems and Technologies, University of Computer Studies, Taungoo
sanohnmarkyaw@ucsm.edu.mm, cherrykyawwin@ucsmtla.edu.mm, khinmyokyi@ucstaungoo.edu.mm

Abstract:

This study explores the distributive characteristics of bit stream formatting to enable watermarking in audio files. In the proposed scheme, watermark data are embedded in the encoding process of MP3 signal. The part2_3_ length variable contains the number of main_data bits in the MP3 bit stream. With a hiding key, the watermark cab be embedded into the audio file which encode the bits as its parity bit by replacing the bit of watermark. In the process of watermark extraction, the watermark can be correctly extracted from the part2_3_length of MP3 bit stream with hiding key. The proposed scheme are tested by using the various attack of signal processing operation, such as MP3 compression and adding Gaussian noise. The result reveals the proposed audio watermarking have the better performance in audio quality and robustness.

Keywords—*watermarking,part2_3 length, MPEG*

I INTRODUCTION

Digital watermarking is the process that imperceptibly watermarks, the multimedia product with a specific watermark for the purpose of content authentication, data monitoring and tracking, and copyright protection. With the tremendous growth of the World Wide Web that initiated in the decade before the year 2000 leads to the economic aspects of providing multimedia enterprise via the Internet. Regarding the digital networks for distributing the media contents as a commercial product, Digital watermarking becomes one of the accomplishments for the purpose of conserving the ownership rights.

Nowadays multimedia data (such as audio, image, and video) are normally stored in digital form, which can be replicated and modified by general users. The widespread use of Internet and wireless networking has made the distribution of multimedia data much easier than ever before. The tendency is further accelerated by a proliferation of smart phones and portable devices in recent years.

People around the world keep creating and spreading much multimedia data each day. Unfortunately, the illegal use of multimedia data is also rampant in digital age. Protection against intellectual property infringement increasingly becomes an important issue. Digital watermarking technology has been considered a promising means to resolve this issue. It is a technique of hiding proprietary information in multimedia data and later extracting such information for purpose of copyright protection, content authentication, ownership verification, etc.

The aim of the study is to develop the audio watermarking system based on bit stream formatting of audio signal. The hiding process takes place at the heart of the Layer III encoding

process namely in the bit streamformatting. The proposed system to modify the parity bit of the part2_3_length variable contains the number of main_data bits in the MP3 bit stream. This paper is organized as follow, section 2 describes the

proposed system of audio watermarking and section 3 show the strength and weakness of the system. Some of the related methodology explains in section 4 and discussion parts are shown in section 5.

II PROPOSED MPEG WATERMARKING SYSTEM

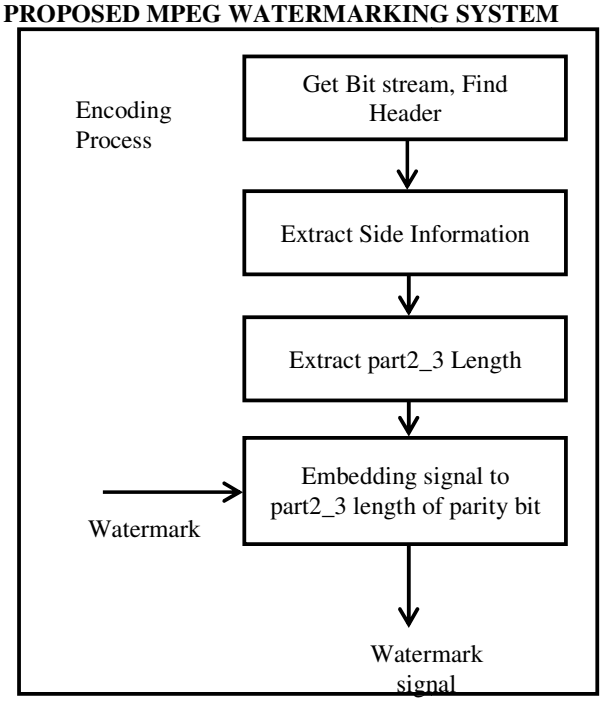


Fig. 1. Proposed framework of audio watermarking

Digital watermarks could enable the content owners or service providers for tracking the content left in the authorized distribution path as they can identify the authorized recipient of the content.

Audio watermarking system will hide information in MP3 files during the encoding process. Fig. 1 shows MP3 encoding process that is some parts of audio watermarking system. The hiding process takes place at the heart of the Layer III encoding process namely in the bit stream formatting. The part2_3_length variable contains the number of main_data bits in the MP3 bit stream. We encode the bits as its parity bit by changing the bit of watermark. Only randomly chosen part2_3_length value are modified; the selection is done using pseudo random bit generator. Fig. 2 describes the fundamental steps of the proposed system.

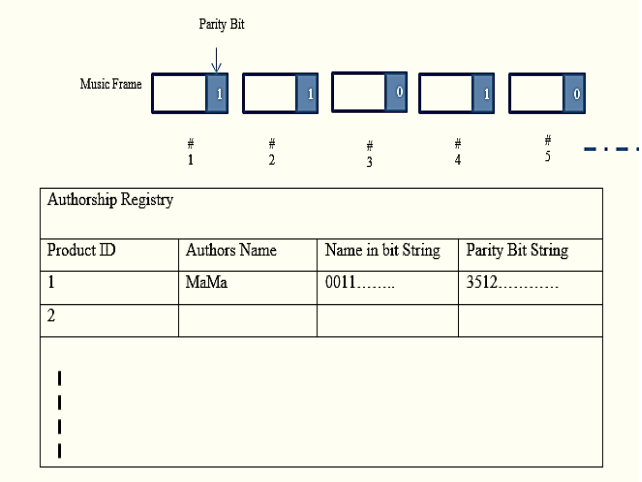


Fig. 2. Step by step procedure of audio watermarking

The documentation for this structure was generated from MP3 signal.
Frame::sideinfo::granule::channel::part2_3_length

III SWOT ANALYSIS 0FPROPOSED SYSTEM

SWOT Analysis is a useful technique for understanding the proposed systemStrengths and Weaknesses.

A. Strengths

- Within MP3 encoding process
- Embedding signal to part2_3 length of parity bit
- Very high watermarking data rate
- Ability to enforce copyright protection of products
- take advantage of opportunities and leverage/deal with threats and risk (upgrade to standard product)

B. Weakness

- Complexity of each watermarking scheme is higher (using many steps in watermarking)
- Less experiment perform by using a commercialized watermarking
- Window platform software

IV METHODOLOGY

MPEG-1 Audio Layer 3, or MP3 audio, is a pervasive digital format. Designed by the Moving Picture Experts Group (MPEG), MP3 uses a lossy

form of audio compression to greatly reduce the size required to store audio information. MP3 files are created by using an encoding application to transform an audio track into an MP3. Using MP3 audio encoding, the size of an audio file can be reduced to about $1/10^{th}$ of the size of the same file with no compression. Information that can be found in the frame header includes:

- The frame sync block that enables the program that decodes the MP3 files to synchronize the bit stream with the MP3 file
- The MPEG Audio version ID and Layer descriptor that is used to encode the MP3 file
- Indicator bits to specify the presence of a cyclic redundancy check, padding bits, and copyright
- Audio information, including bitrate index, and stereo/mono channel mode

A. Bit stream Formatting

Below the Fig. 3 describes the layout of a MP3 frame. Each block in the diagram indicates a size of 1 bit.

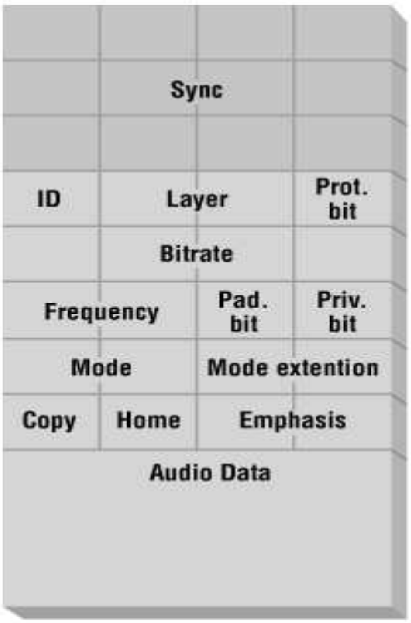


Fig. 3. MP3 frame Structure

Each frame in a MP3 bit stream is further split into 2 granules. The side information for each granule in a frame contains information needed to decode the main data. Table describes the component fields along with the size in bits for the side information. The size represents the requirements in single channel mode as well as the double that would be needed in dual channel mode.

V RESULTS AND DISCUSSION

This section will describe the watermark embedding and extraction process in detail. Within the watermark embedding process, divide the original audio file into a number of non-overlapping frames and each frame has the parity bit of part2_3 length. The watermark can be embedded into the original audio file by using pseudo random bit generator as a secret hiding key. Fig. 3 (a) shows the signal of original audio file and (b) describes the watermarked signal of audio file. Which are implemented by using Matlab programming.

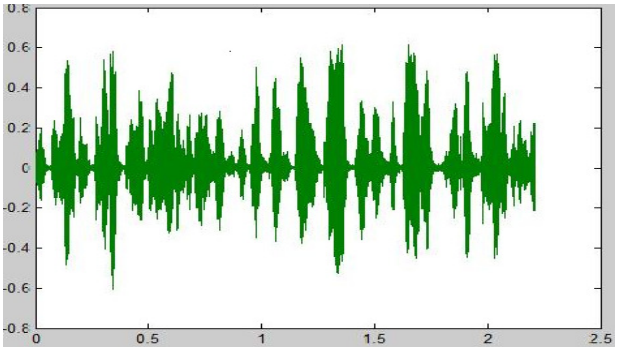
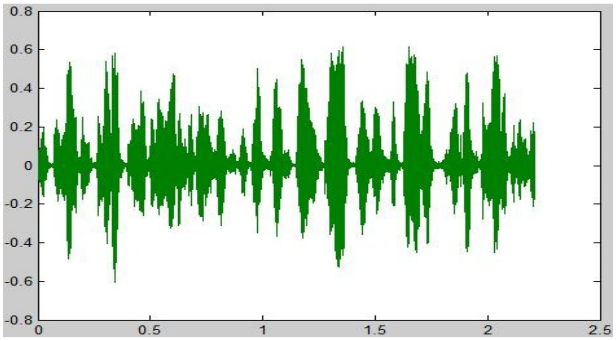


Fig. 3 (a) Original audio signal



(b) Watermarked audio signal

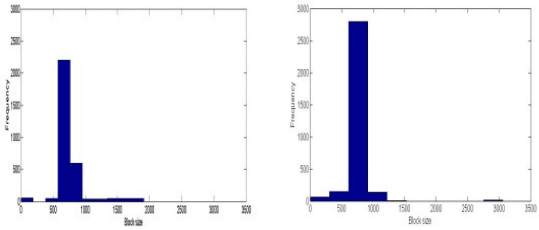
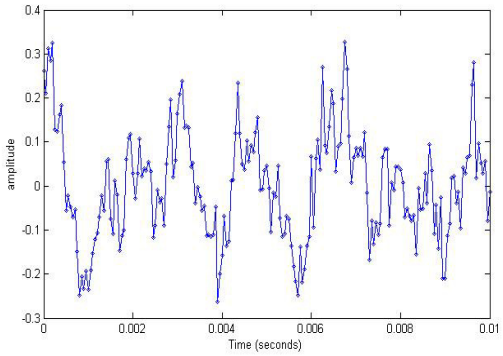


Fig. 4. Histogram analysi of original audio signal and watermarked audio signal

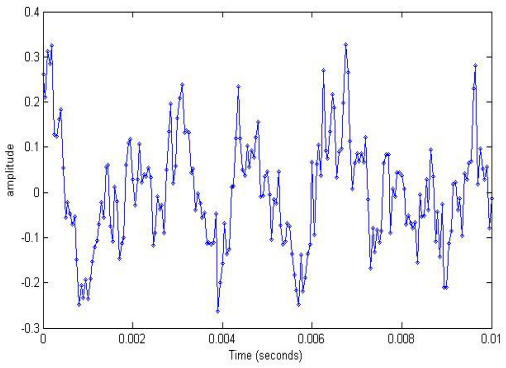
It can be seen that part2_3_length of watermarked signal are slightly changed from the original signal. Block size between 500 and 1000, secret signature or authorized message are embedded in this frame because block size is highly increased at nearly 3000 frequency. Therefore, frame with embedded message can be estimated by analyzing the part2_3_length value.

A. Robustness and Performance Analysis

Noise addition happens to transmitted signals on various communication channels. Due to increased noise level and changed sample values the watermarked receiver may not be able to extract all the embedded information correctly which relevance the adding noise ratio. As a consequence this approach use very little noise amplitudes therefore keeping the SNR above 20dB and minimizing the influence on the audio quality. Fig. 5 (a) shows an example of noise signal has been added to a block of the audio signal. Fig. 5 (b) where the original signal is shown as a solid curve and the audio signal including the noise is shown as dotted curve.



(a)



(b)

Fig. 5. Analysis of Gaussian noise in original and watermarked signal

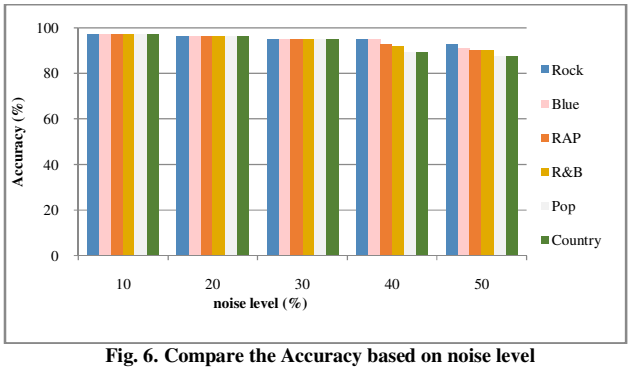


Fig. 6. Compare the Accuracy based on noise level

Fig. 6 describe the analysis of noise addition with different audio files (rock, blue, rap, R&B, pop, country).

According to this analysis, increased the noise ration, the accuracy of extraction results are varied and degradation.

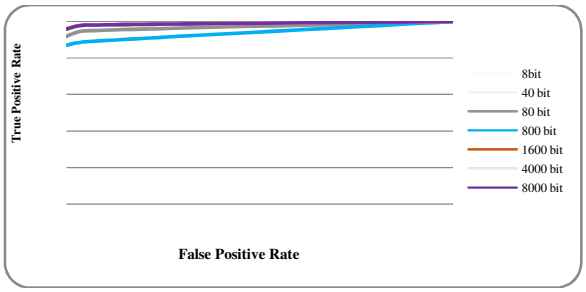


Fig. 7. ROC curve analysis based on different bit stream hiding

Receiver operating characteristic (ROC) curve is applied to measure the productiveness of the proposed system. Figure 7 shows the ROC curves

that have different detection threshold. Detection accuracy is nearly 95% at false positive rate of 0.2%.

VI CONCLUSIONS

The proposed audio watermarking is a technique in which extra information is added to the data for securing the MP3 data from unauthorized use. Watermarks can be utilized as evidence for proving the ownership. This created the problem of protecting the intellectual copyrights of multimedia data. Evaluation analysis for this study showed that in above 30% of noise level, the performance accuracy still remained over 85%. The experimental result revealed that the proposed audio watermarking system is useful for identifying the origins of different multimedia files and resolving ownership disputes.

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