International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 09, September-2016

Robust Bit Modification based Audio Watermarking

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***Abstract*- In this paper watermark is embedded into audio signal by modifying the samples data with the watermark key. An unvoiced and voiced data with payload equal to 16000 Hz is used for the simulation. Under different noise adding conditions the performance of the system is evaluated. Also in this paper performance of the algorithm is analyzed by varying the bit modification location of the 8 bit sample from LSB to MSB. MATLAB is used for the simulation purpose.**

Keywords- Payload; watermark key; LSB; MSB; voiced; unvoiced.

I. INTRODUCTION

With the development of information technology, transmission of information is increasingly carried out via the Internet for efficiency and convenience. These advantages, however, may lead to infringement of intellectual property rights. Because of this issue, identification of ownership of the copyright has become an important issue in modern society. Digital watermarking technology is a feasible method to alleviate this problem. The core of this technique is to imperceptibly hide a small amount of information – watermark – in digital audio, images, or video that is to be transmitted. The hidden watermark or other information can be extracted to authenticate the ownership and other details from the received signal.

Some of the key criteria of a watermarked signal are that the watermark is undetectable and unalterable. In addition, the perceptual quality of the watermarked signal is not noticeably degraded. Over the past decades, watermarking techniques have seen a huge progress with many different methods developed for image and audio signals. Audio watermarking algorithms generally fall into two categories: time domain and frequency or other transform domain algorithms. Time domain algorithms directly insert the watermark into the audio signal; on the other hand, frequency-domain algorithms embed the watermark based on modifying the frequency coefficients, for example [1]. In this paper, a bit modification method for audio watermarking of speech in time domain is proposed.

Note that audio watermarking is more challenging than an image watermarking technique due to wider dynamic range of the HAS in comparison with human visual system (HVS).Human ear can perceive the power range greater than 109 : 1 and range frequencies of 103 :1. In addition, human ear can hear the low ambient Gaussian noise in the order of 70 dB. However, there are some useful features such as the louder sounds mask the corresponding slow sounds. This feature can be used to embed additional information like a watermark. Further, HAS is insensitive to a constant relative phase shift in a stationary audio signal, and, some spectral distortions are interpreted as natural, perceptually non-annoying ones.

Cvejic, T. Seppänen described a two-step audio bit modification method with a very large payload capacity [2]; the large payload, however, can cause changes in the watermarked audio to be easily perceived by the human auditory system (HAS) and also detected by objective measurement techniques such as Enhanced Modified Bark Spectrum Distortion (EMBSD) [3, 5, 6]. Another high capacity bit modification technique employing empirical mode decomposition [4] suffers from low robustness in retaining embedded watermark.

Section II in this paper deals with the bit modification method and its embedding and extraction process. Section III shows the simulation results and section IV deals with the performance analysis of nit modification method under different conditions.

II. BIT MODIFICATION.

Bit Modification is simple strategy of watermarking. It embeds the data into the cover message so that it cannot be detected by visual eyes. This method works by replacing bits with secret message. It is possible by changing some bits with secret message. It is embeds data into image on any bit-plane. This reduces the variations in colors that embedding creates. For example embedding into the first bit plane change the value by 1. Similarly for second bit plane it changes the value by 2. This process is followed for all the bits.

A. Embedding Procedure

- Select the image (".bmp", ".jpg", ".gif", —.tif") file to embed.
- Select the audio (".wav") file in which to be embedded.
- Divided the audio into segments and convert the samples into 8 bit data.

International Journal of Engineering Research & Technology (IJERT)
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Vol. 5 Issue 09, September-2016

- Convert the image data into binary data i.e., 1's and 0's.
- Select the bit index which is to be modified and the replace the bit value in the sample by image binary data.
- Reconstruct the segmented audio data and convert it to analog format.

figure 1 show the complete embedding procedure.

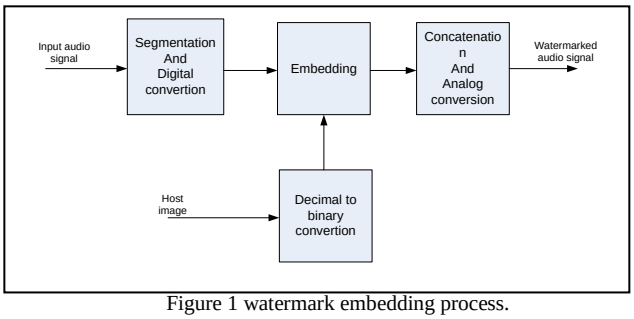

Figure 1 watermark embedding process.

B. Extraction process

- The received watermarked audio signal is divided into segments.
- Watermarked inserted segment is selected and the audio samples are converted to 8 bits.
- From the index i location which is used in the transmitter part to embedded information is selected and the information from that location is collected.

Figure 2 show the block diagram of extraction process.

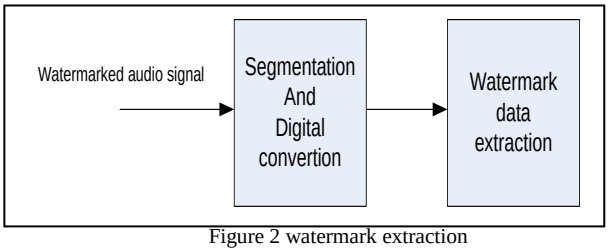

Figure 2 watermark extraction

III. SIMULATION RESULTS

An audio data with payload of 8000 Hz is selected. Audio data in time domain is shown in figure 3. A 50x50 logo shown in figure 4 is used for the watermarking.

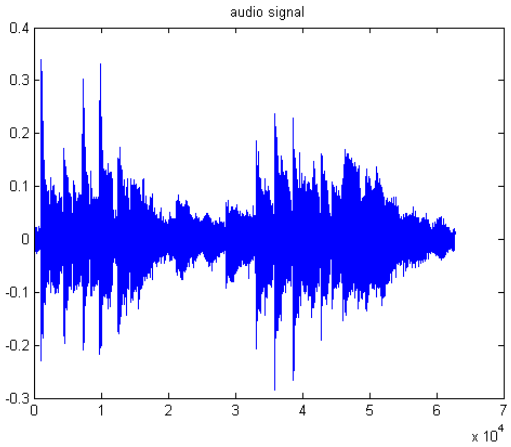

Figure 3 audio signal

Figure 4 watermark logo

Figure 5 shows the watermarked audio signal. Here least significant bit is selected for the watermark embedding purpose.

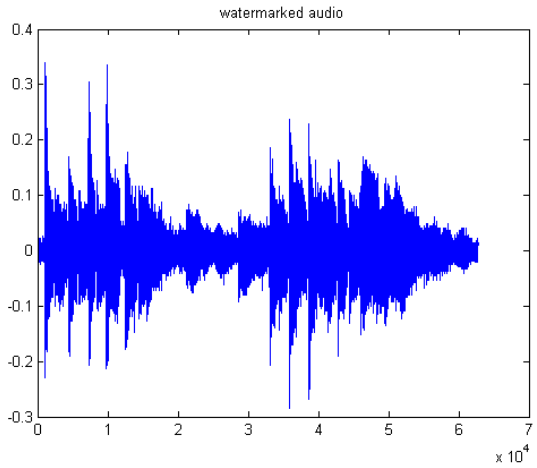

Figure 5 watermarked audio

figure 6 shows the received watermarked signal at the receiver side through AWGN channel with SNR 60dB.

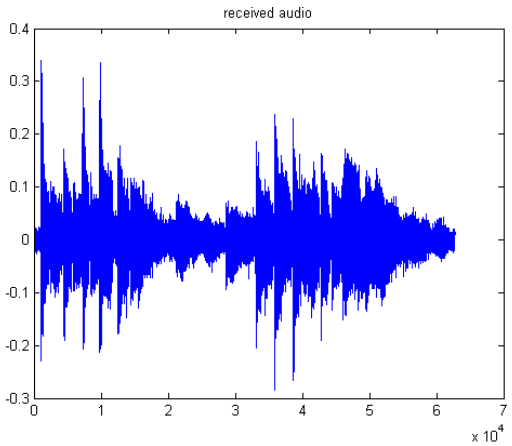

Figure 6 received audio signal.

Figure 7 shows the extracted watermark from the received audio signal.

International Journal of Engineering Research & Technology (IJERT)
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Figure 7 extracted watermark.

Figure 8 shows the watermarked audio signal when the watermark is inserted at MSB.

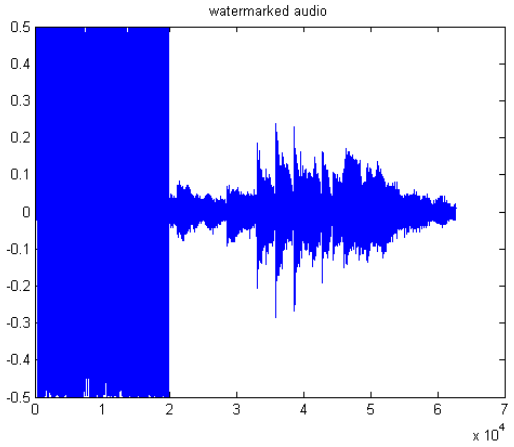

Figure 8 watermarked signal with MSB modified.

from the above figure clearly states that as bit modification moves from LSB to MSB the change can be visualized.

IV. PERFORMANCE ANALYSIS.

A. SNR Vs BER:

Bit error rate is used to analyze how exact the embedded watermark can be extracted. BER is given by

*Error rate= ((total pixels-error pixels)/(total pixels))*100*

Table 1 SNR vs. BER with fixed index

SNR(dB)	BER
55	0.1296
57	0.1136
59	0.0728
61	0.0284
63	0.0068
65	0

From the above table 1 it is shown that As the SNR of the channel increases error rate of the system decreases vice versa.

B. Modification index Vs BER

Under fixed SNR with bit modification location varying from LSB to MSB the performance of the system is shown in table 2

Table 2 Modification index Vs BER with SNR equal to 55dB

Bit index	BER
1	0.1332
2	0.1044
3	0.0656
4	0.0404
5	0.02
6	0.0172
7	0.0097
8	0.004

If the index of the bit modification moves from LSB to MSB sensing of the change in audio signal increases to human auditory system for a given SNR. At the same time BER decreases as index change from LSB to MSB.

V. CONCLUSION.

A method of embedding watermark and other information on an audio signal in time domain has been proposed. In this method, amplitudes in the voiced or unvoiced regions of speech are modified at a selected bit index in accordance with key-based information bits. In this paper performance of the method is examined under varying SNR and bit index.

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International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 09, September-2016

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