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Speech Watermarking Using Logarithmic Approach

M. Naga Mani[1], T. Ganga Lakshmi[2]

Assistant professor, Dept. of ECE, SRK Institute of Technology, Vijayawada, India[1]

UG Student, Dept. of ECE, SRK Institute of Technology, Vijayawada, India [2]

ABSTRACT: The rapidly growing field of digitized transmission of audio, video and image has been urged the need of security and integration of data. Watermarking is a technique providing data integrity and authentication. To obtain robustness, the process of watermarking is done in frequency domain. To transform the cover signal and speech signal into frequency domain Discrete Cosine Transform (DCT) and Exponential Transform are used respectively. Then the transformed speech signal is embedded into the cover signal and a complex signal is obtained. During the decoding process the original cover signal and speech signals are obtained by applying inverse DCT and Logarithm to the complex signal. The implementation of this paper is done in MATLAB.

Keywords: Discrete Cosine Transform, Data Security, Frequency Domain, Integrity, Speech Watermarking.

I.INTRODUCTION

Watermarking is a way of concealment or planting the data/information given into the data but not its presence known by the human senses such as sight and hearing, but able to deal with processing of signals. The signals which are to be transmitted securely are known as watermark signals and signals which carry the watermark signals are known as cover signals. Based on the data we are watermarking, we have different types of watermarking techniques. Among those image watermarking, audio watermarking. Speech watermarking, Text watermarking are the familiar types. Speech watermarking is a technique used to transmit the speech signals securely from one place to the other. In this paper a music signal is used as a cover signal to transmit the speech securely.

Based upon the perceptual levels of humans watermarking can be classified as visible or invisible. In visible image watermarking the watermark is recognised by the other unauthorised persons also whereas in invisible watermarking it is not possible for the unauthorised people to recognise the watermark. Similarly in speech watermarking also we can have audible and inaudible watermarking techniques. Here in this paper we are presenting an inaudible speech watermarking technique. Watermarked signal will resemble a noise for unauthorised persons.

II. NEED FOR SPEECH WATERMARKING

1. Authentication: While transmitting important information from one point to other such as a password for accessing an account security must be provided. Authentication is needed to access such data. Watermarking is used to provide some means to the authorised users for securely transmitting the data.
2. Perceptibility: The watermarked signal should be imperceptible for the unauthorised users and must be easily extracted by the authorised users.
3. Speed: As watermarking can be used for real time applications, the watermark embedding and extraction processes must be fast enough to handle those applications.
4. Reliability: Watermarked signal must be robust against intentional and unintentional attacks. The detection rate of watermark should be perfect whether the watermarked signal have been attacked or not
5. Capacity: A user should be able to change the amount of data to be watermarked based on the application. But There is a trade-off between information capacity of a watermark signal and its quality. The quality of the signal will be degraded if more information is embedded.

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III. GENERAL WATERMARKING MODEL

Every watermark model consists of four parts. They are

i. Watermark Signal
ii. Cover signal
iii. Embedder/Encoder and
iv. Decoder

The watermark signal is the original message signal which can be a secret password. Cover signal or host signal or carrier signal is the signal with long duration than the watermark signal and is used to carry the watermark signal securely in it. Watermark signal and cover signal are the two inputs of the embedder block and its output is the Watermarked signal which is a complex signal. In the embedder some of the samples of cover signal are replaced with the samples of cover signal. At the decoder the watermark signal is extracted from the complex signal. But the cover signal will be distorted and hence is lost. Block diagram of general watermark model is shown in figure 1.

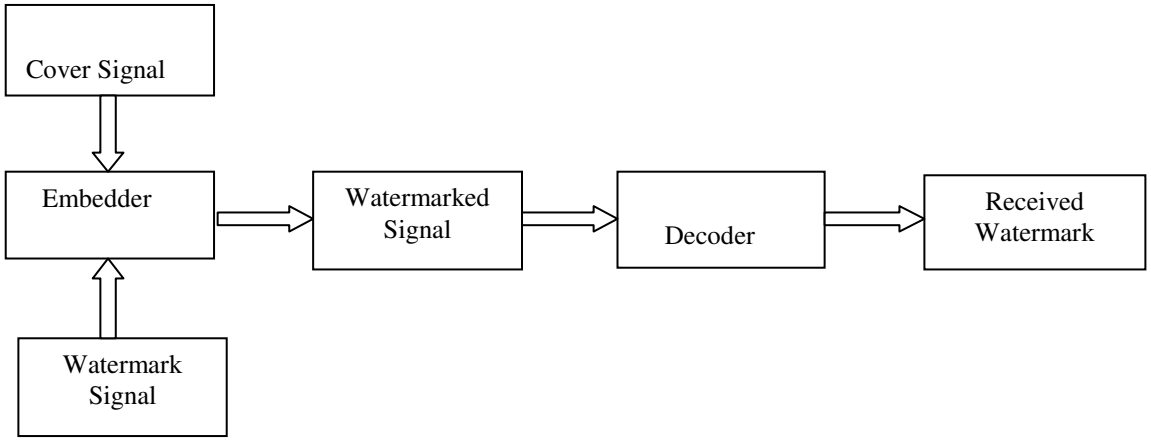

Fig. 1 General Watermark Model

IV. WATERMARKING USING LOGARITHMIC APPROACH

In this section we will observe the process of converting a simple watermark signal of short duration into a complex signal of long duration. There are two steps involved in this process. They are

i. Generating Complex signal
ii. Reproducing the original watermark signal.

a.) Algorithm for Generating Complex Signal:

i. An audio signal of long duration and high frequency is considered. This is known as a cover signal.
ii. Speech which is to be transmitted securely is considered. Its duration and frequency are less than the cover signal.
iii. DCT is applied over the cover signal and Exponential is applied over the watermark signal.
iv. The transformed speech is embedded into the cover signal.
v. Thus a complex signal is generated.

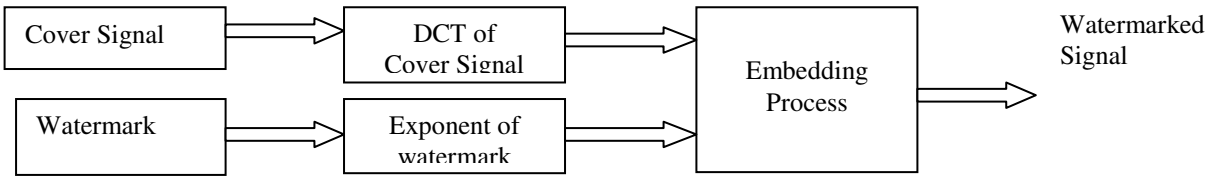

Fig. 2 Watermark Embedding Process

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b.) Algorithm for Recovering Original Watermark Signal:

i. IDCT is applied to the complex signal at the receiver.

ii. Now from the signal obtained the samples of watermark signal are obtained.

iii. Log transformation is applied to the obtained samples and hence the original watermark is obtained.

Block Diagram of the watermark extraction process is shown below:

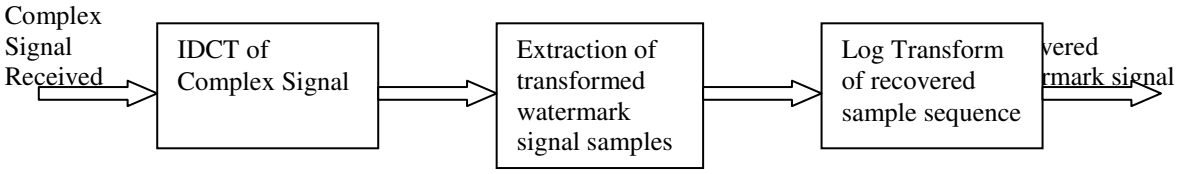

Fig. 3 Watermark Extraction Process

V. RESULT AND DISCUSSION

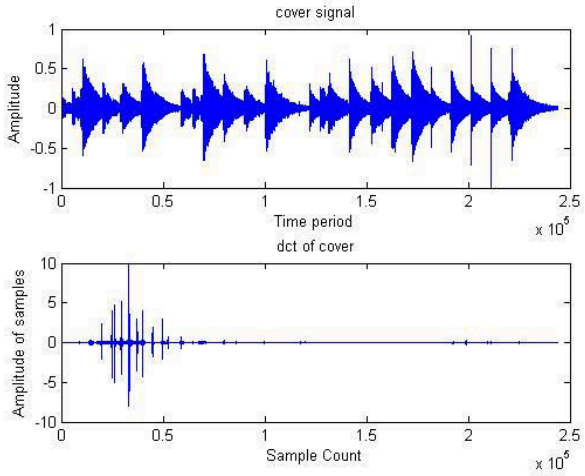

Fig. 3 Cover Signal and DCT of Cover Signal

In fig. 3 the cover signal of long duration with high frequency is shown in the upper part. DCT is applied to the signal considered. In this paper music signal is considered as the cover signal.

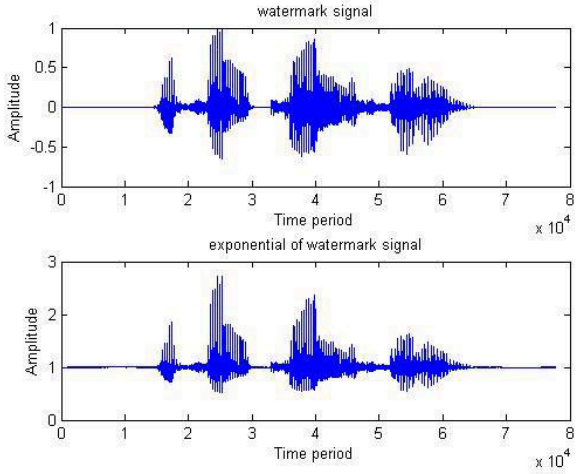

Fig .5 Watermark Signal and transformed Watermark Signal

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In fig. 5 Watermark Signal of short duration with frequency lower than the cover signal is shown in the upper part. Transformed watermark signal is shown in the lower part of the figure.

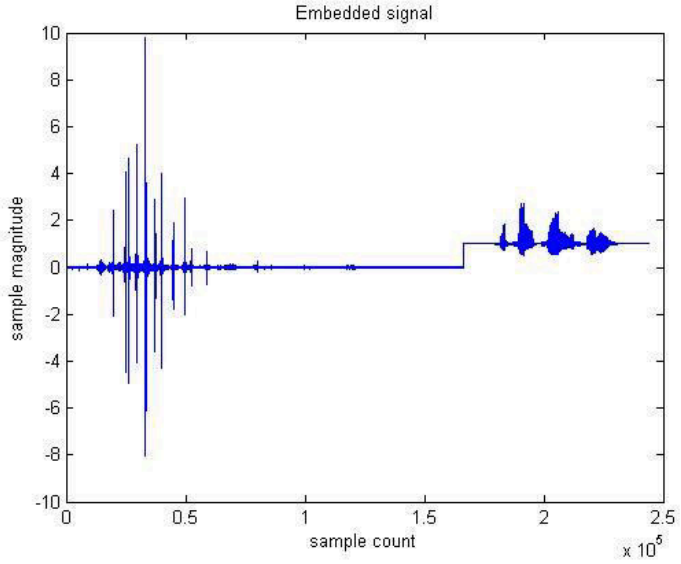

Fig. 6 Complex Watermarked Signal

Fig. 6 shows the complex watermarked signal, which is obtained by embedding the transformed watermark signal and the transformed cover signal. The complex signal resembles as a noise signal for the intruders.

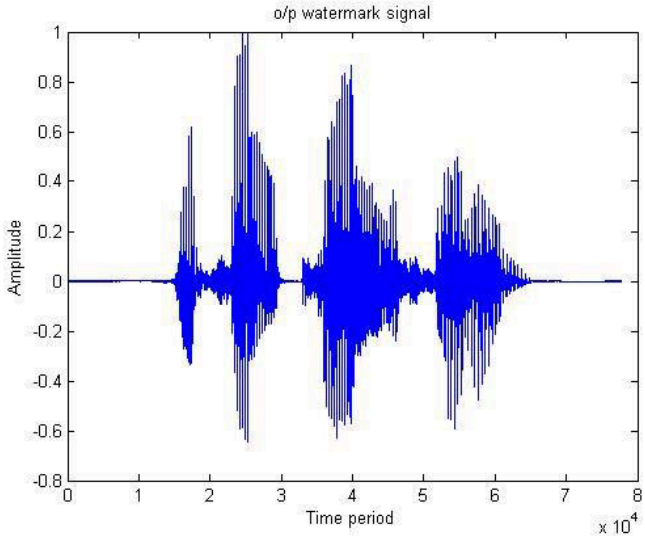

Fig. 7 Recovered Watermark Signal

Fig. 7 shows the watermark signal recovered from the complex signal by applying the logarithmic function on the complex signal.

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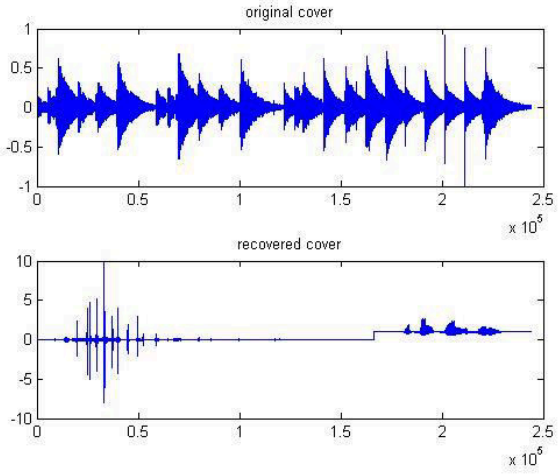

Fig. 8 Recovered Cover Signal Compared with the original cover signal.

From fig. 8 we can observe that the recovered signal and the original cover signal are entirely different. The cover signal is lost totally and it becomes as a noise signal.

VI.CONCLUSION

In this paper a simple technique for performing speech watermarking is implemented by using logarithmic approach. Experimental results show that the original watermark and the recovered watermark are the same which shows that the watermark signal is transmitted securely without loss. But the cover signal is lost and cannot be recovered at the receiver.

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BIOGRAPHY

Naga Mani Mendu did her M.Tech. in Systems and Signal Processing(SSP) at Lakireddy Bali Reddy College of Engineering. At present she is working as an Assistant Professor in SRK Institute of Technology, Vijayawada. Her areas of interest include Telecommunications, Signal processing and Speech Processing.

Ganga Lakshmi Tiriveedhi has completed her BTech. in ECE at SRK Institute of Technology, Vijayawada. Her areas of interest include Communications, Signal processing.