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Extending Capacity Still Maintaining Originality of Audio Signal" Using LSB Audio Steganography Technique

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Abstract: Audio steganography results from the prevailing presence of audio signals as information vectors in our human society. Many audio steganography techniques are in existence but with limitation like low hiding capacity and imperceptibility. Hence a new technique invented which will increase hiding capacity by twice amount when read at depth of 16 bits per sample and by four times when read at the depth of 8 bits per sample. Even though hiding capacity has increased, originality of stego audio cover signal is maintained. Two methods are discussed as 1 LSB and 2 LSB.
Keywords: Audio Steganography, LSB, 2 LSB, Text Intelligibility Index.

I. INTRODUCTION

Steganography is the art and science of writing hidden messages in such a way that no one, apart from the sender and intended recipient, suspects the existence of the message. The word steganography is of greek origin and means "covered writing" from the Greek words steganos means "covered or protected", and graphy means "writing". Covers can be of different types including image files, audio and video, text and IP data gram. Several methods of audio and video data hiding have been proposed and demonstrated whether in time domain as well as in frequency domain. Due to lack in hiding capacity of existing text-based steganography, a new technique is proposed to hide larger quantity of data using speech as a medium cover. Terms used in the process of steganography are cover/ carrier / envelope or also known as vessel which carries hidden text, Embeddor, stego key and Extractor.[1]

II. RESEARCH PROBLEM

Many more audio steganography techniques are in uses which have some drawbacks like low data hiding capacity, accurate extraction and imperceptibility. If data hiding capacity is increased which will lost originality of audio cover signal. Hence a new technique is developed which will make balance between these two things i.e. even though data hiding capacity increased by two or four times of conventional rate originality of audio cover is maintained. And data extracted at receiver side is correctly recovered how much bulky text data may be. As sampling frequency increases data hiding capacity also increases. Paper covers the study of effect of changing sampling frequency on text data hiding capacity and changing the no of text bit hidden in an audio file.

III. RELATED WORK

Nedeljiko Cvjic, Tapio Seppanen has worked on increasing the capacity of LSB-based audio steganography technique. It uses threesteps for embedding message into 4 LSBs per sample, which in turn increases embedding capacity by 33% but when listening test is carried out perceptual transparency reduces. [10]

Dr. H.B.kekre, Archana Athawale, Swarnalata Rao, Uttara Athawale has worked on information hiding in audio signals. Author presents the two novel methods. One considering parity of the digitized sample cover and other is considering X-OR operation on LSB and next to LSB bit. [9]

K.P.Adhiya & Swati A. Patil has worked on hiding text in audio using LSB based steganography. Proposed algorithm uses the characteristic as, some alphabets & numbers have similar first 4 bits and different last 4 bits. Any number & alphabets can be represented by the last 4 bits & adding either 0 or 1 at 1st position. Thus the char is represented by 5bit. [7]

Padamashree G, Venugopala R.S. worked on audio steganography & cryptography using LSB algorithm at 4th & 5th LSB layer. Proposed method in this paper embeds the encrypted secret message using public key cryptographic algorithm RSA into the 4th& 5th layer of audio file [5].

S.S.Divya, M. ram Mohan Reddy has worked onhiding text in audio using multiple LSB steganography and providing security using cryptography. The author proposes two novel approaches of substitution technique which improves capacity of cover audio

for embedding. Message bits are embedded into multiple and variable LSBs. This method utilize up to 7 LSBs for embedding data [3].

IV. MATERIALS AND METHODS / OUR APPROACH

A proposed method embeds text data in audio cover. For embedding it is based on Least Significant Bit insertion method, where the LSB bit of audio data sample is replaced by bit of the text to be embedded. But the proposed technique is different from conventional audio steganography techniques. It does not uses well known cryptographic algorithms like RSA,GA algorithms, a special coding technique is used which will convert textual information into binary bits as described next.The message to be embedded is first converted to decimal then converted to binary using ASCII coding . After words it is converted to matrix whose rows are equal to total no of character to be embedded and with 8 columns. Then that matrix is converted to column matrix, where text to be embedded comes in a column format sequentially. Then each bit of column matrix is embedded into LSB bit position of each audio data sample.

Here we use two techniques i.e. LSB and 2 LSB techniques in first technique LSB bit of Audio data is replaced by bit of text data to be hidden. And in case of 2 LSB techniques, LSB position and next to LSB position bits are changed by the consecutive two text bits. That is two bits of text data are embedded per sample. Here audio file is read at the depths of 8 bits per sample format.

For experimentation different audio files are collected with different frequencies like 8 KHz, 16 KHz, 44.1 KHz, 48 KHz. That audio covers are read at the depth of 8 bits per sample. And data hiding capacity in each case is studied with corresponding SNR values. Also the results are obtained for two techniques like 1 LSB and 2 LSB techniques and comparisons are made depending upon Hiding capacity and SNR values obtained

A. Encoding Algorithm and Decoding Algorithm:

For 1LSB and 2 LSB techniques same embedding and extracting procedure is there. Only change is in case of 1 LSB method, 1 bit is embedded at LSB bit position where as in case of 2 LSB 2 bits are embedded per sample at LSB and next to LSB bit positions. And while extracting also 1 bit from LSB position in 1LSB method and two bits from LSB and next to LSB bit position in 2 LSB methods are extracted.

B. Embedding Algorithm

1) Read .WAV audio file as cover file read header, total count size and data samples. Copy all header information since it is required to form stego signal.
2) Input the text that is secret message to be embedded in a cover audio signal.
3) Convert the characters of the text into decimal then into binary bit and forms coded text by coding technique.
4) Find size of message. That is length of the message, which is required to transmit at extractor side. So that the message length is known at extractor side.
5) Select audio sample after 44^{th} byte, since first 44 bytes contain header information. Then first hide key and then length of the message to be embedded.
6) After embedding key and message length, converted coded text is embedded in .WAV samples. Coded text bit are embedded at wave data samples using LSB algorithm. That is single bit of coded text is embedded at LSB position of a data sample that is a single bit into whole byte of audio.
7) Repeat the above step still the whole message will be embedded in audio file.
8) Create a new .WAV file by copying header information of cover file and text embedded wave samples. Thus the stego audio is generated.

C. Extracting Algorithm

1) Read the stego file i.e. covers audio after embedding.
2) Read wave file & separate the header information from data samples. After separating, wave data samples are read for extracting further information.
3) Read the next stego sample & extract key from audio samples if key matches then go for extracting hidden message otherwise display message as ‘Key doesn’t matches Invalid receiver’.
4) After extracting key and length of the message that is also hidden in a audio signal is extracted.
5) Select all stego data samples and store all LSB position bits in array.

6) Divide the array into number of rows and columns, convert binary hex and then into ASCII character.

7) Display the secret message extracted from the stego audio signal.

For calculating hiding capacity audio signals of 1 sec are considered, sampled at different frequencies and reading the wave at the depth of 8 bits per sample. The results obtained are as follows:

Sr. No.	Cover sampled at frequency	Maximum bits hidden per second	SNR	Text intelligibility index(TII)
1	8 kHz	33.3kbps	24.5767	100%
2	16 kHz	66.7kbps	27.9352	100%
3	44.1kHz	184 kbps	21.3139	100%
4	48 kHz	195kbps	7.5437	100%

Table1.Results for 1 LSB technique for data embedded in an audio cover at depth 8 bits per sample

Sr. No.	Cover sampled at frequency	Maximum bits hidden per second	SNR	Text intelligibility index(TII)
1	8 kHz	66.616kbps	17.2555	100%
2	16 kHz	133.488kbps	17.382	100%
3	44.1kHz	368.408kbps	14.0195	100%
4	48 kHz	390.880kbps	0.8567	100%

Table 2:Results for 2 LSB techniques for data embedded in an audio cover at depth 8 bits per sample

Sr. No.	Cover sampled at frequency	Maximum bits hidden		SNR		Text intelligibiliy index(TII)
		1 LSB	2 LSB	1 LSB	2 LSB	
1	8 kHz	33.3kbps	66.616kbps	24.5767	17.2555	100%
2	16 kHz	66.7kbps	133.488kbps	27.9352	17.382	100%
3	44.1kHz	184 kbps	368.408kbps	21.3139	14.0195	100%
4	48 kHz	195kbps	390.880kbps	7.5437	0.8567	100%

Table 3: Comparison of 1 LSB and 2 LSB techniques when audio read at the depth of 8 bits per sample

D. Summary

1) For 1 LSB technique when audio samples read at the depth of 8 bits per sample format hiding capacity increased by more than four times as that of conventional LSB technique.

2) For 2 LSB technique when audio samples read at the depth of 8 bits per sample format hiding capacity increased by more than eight times as that of conventional LSB technique.

3) If SNR values considered when reading at the depth of 8 bits per sample are low, but still the stego signal generated are well perceived.

4) While comparing 1 LSB and 2 LSB techniques results, hiding capacity increases by more than double amount, still SNR values are not reduced by that much amount.

V. CONCLUSION AND FUTURE WORK

The new method developed for obtaining audio steganography technique satisfies the entire objective of the steganography such as high hiding capacity, impermeability, and accurate extraction. Text intelligibility Index (TII) shows 100% correct data extraction at receiver side which will prove correct extraction of embedded text at receiver side. The stego signal is well perceived in each case with extended very high data hiding capacity. The proposed algorithm has given very good results as compared with the results obtained by the other researchers [5, 7].

When text is embedded in a audio by reading the wave data samples at the rate of 8 bits per sample hiding capacity increases more than four times as that of conventional LSB technique. For example if audio sampled at F_s 16 KHz then hiding capacity is 16 Kbps for conventional LSB technique. Whereas our 1 LSB techniques hides up to 66.7Kbps when read at 8 bits per sample.

2 LSB techniques increase data hiding capacity by 8 times when read at depth of 8 bits per sample. For example if audio signal is sampled at 48 KHz then it have a capacity of 390.880 Kbps for 8 bits per sample.

Aim of the proposed method is achieved which is shown in table 3. As data hiding capacity increases SNR value decreases, but results in table 3 shows double data hiding capacity is obtained with low reduction in SNR value. For example if audio sampled at the rate of 8 KHz, 1 LSB technique hides maximum of 33.3kbpsdata in an audio of duration 1 sec with SNR value as 24.5767, whereas 2 LSB techniques hides up to 66.616kbpsof data with SNR value as17.2555. Here data hiding capacity increases by more than twice amount but SNR value is not decreased by that much amount.

Even though SNR values are low in some cases for example when cover audio signals are read at the depth of 8 bits per sample format SNR values are low for both methods 1 LSB and 2LSB. But the originality of the stego audio signal is maintained which is tested by taking leasing test.

Still the hiding capacity can be improved by using some other techniques.

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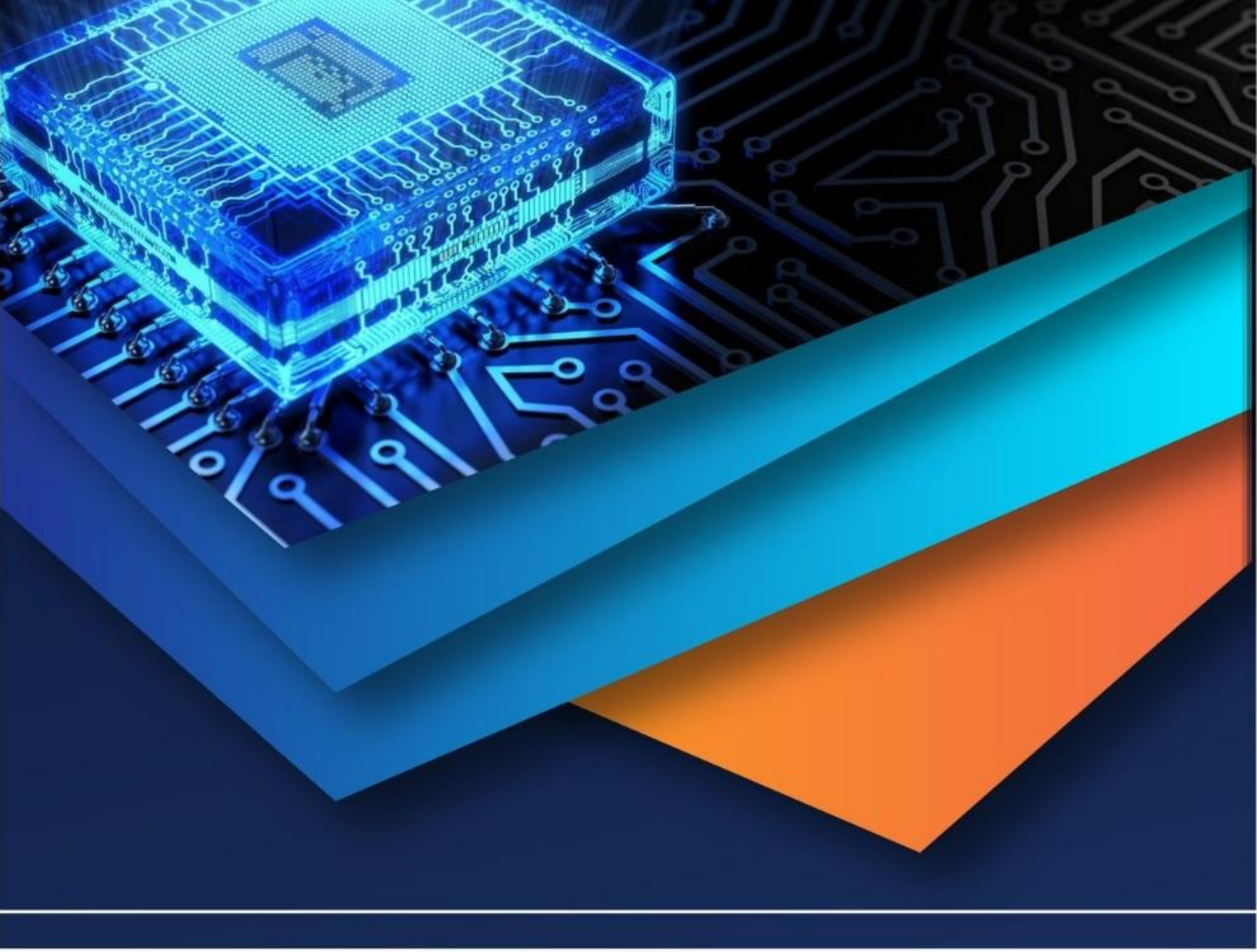

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