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Digital Watermarking in Audio Using Least Significant Bit and Discrete Cosine Transform

Priyanka Pattanshetti [1], Prof.Shabda Dongaonkar [2], Prof. Sharmila Karpe [3]

ME student ,Dept of Computer Engg, G.H.Raisoni College of Engineering, University of Pune,Pune, Maharashtra

Abstract-In recent era it has grown to be important to protect the digital media content like audio using technique Discrete Cosine Transform (DCT) and Least Significant Bit (LSB). In our proposed system image and audio are embedded into audio file and while extraction we get the embedded, video or image. It has been observed that the digital media are hacked and its copyright is being misused to their own, even if it is the work of others. To protect from this malicious use we are proposing the digital audio watermarking d content. The technique used is Discrete Cosine Transform which divides the image and audio file into parts and applies the protection and Least Significant Bit divides the bits into binary and applies the protection. This system gives the double protection to the media content and it cannot be hacked.

Keywords- Audio signals, audio watermarking, DCT, LSB, copyright.

I. INTRODUCTION

The recent development of digital media has increased. The nasty users can copy and store the digital media like audio, video, image without any loss of conformity. This has to be protected from the malicious use.

The people using the internet download the audio files from various websites and they modify the work as their own copyright. This has become an large issue today in the internet world. The protection is being vanished and the immoral use is done.

To protect this Digital Audio Watermarking is used. This technique protects from nasty users and provides copyright, robustness, security to digital contents. The audio watermarking is technique of embedding and extraction procedures. In embedding process the content like audio, video or image is embedded into a original file which is to be secured. The extraction procedure allows us to extract the content but the file is being still protected.

There are about some properties that satisfy the need for effective watermarking applications.These are

Inaudible- The digital watermark is embedded into audio data as it should not be audible to human ear.

Security- A system is believed to be protected if the cracker cannot take away the watermark applied without having the knowledge of embedded algorithm, detector and composition of watermark. Only the authorized users can access it.

Verifiability- It can be used to check the object is protected i.e. copyright-protected and identify the authenticity and control of illegal copying

Robustness- It is the capability to deal with the copyright information of digital works, the embedded watermark can refuse to accept the common editing process, processing the image and lossy compression. Also after attacks the watermark cannot be damaged and can be still detected to offer certification. For example filtering, noise, compression, cropping, A/D-D/A conversions, geometrical or non-geometrical attacks etc.

Fragile- Fragile watermarking is used for mainly integrity protection which is very sensitive to the changes of the signal. We can determine tampered data in accordance with the state of fragile watermarking.

Semi fragile- It is proficient in managing changes made to watermarked image such as addition of lossy compression (i.e. noise).

Constant Bit-rate- The amount of watermark data may be securely embedded within the host signal per unit space or time.

For solving the data security the watermarking techniques are introduced to provide security of information. In recent years the watermarking techniques have been introduced to focus on images and video clips but audio watermarking is more complicated that video and image watermarking. [4]

Here are two key reasons so as audio watermarking has become complicated.

First, the **Human Auditory System** (HAS) has larger sensitivity than the Human Visual System (HVS) since human ear is capable of detecting the amplitude and frequency changes of the signal.

Second, the duration and size of the audio signal are very shorter than a video clips and image files and this information reduces the audio signal quality.

Discrete Cosine Transform

The discrete cosine transform (DCT) is well known technique for audio and image watermarking. The DCT breaks the image into spectral sub bands (small parts) considering the image and audio quality. The DCT is similar to Discrete Fourier Transform because it transforms the spatial domain to frequency domain. (fig 1)

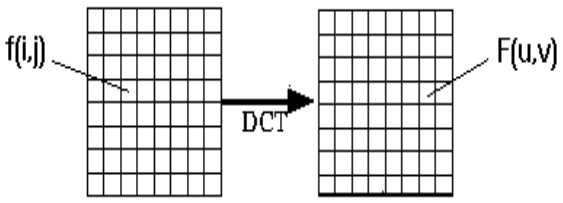

Fig 1. DCT

Least Significant Bit

Least Significant Bit embedding 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.

II. LITERATURE SURVEY

Tejash Lad,Kaushal Doshi ,[1] Audio watermarking is used to hide copyright information without affecting the original quality of audio signal. Embedding and Extraction in DCT domain.

M. O Agbaje , A.T Akinwale and A.N Njah ,[2] in this paper the view of work done on various digital audio watermarking using discrete wavelet transform (DWT) and discrete cosine transform (DCT) with chaotic watermarking towards carrying out investigation for real life application.

Prabhishek Singh, R S Chadha , [3] has described the detail study watermarking definition, concept and contributions into this field such as categories of watermarking process that is of which method of watermarking be used.

M. L. Mat Kiah, B. B. Zaidan, A. A. Zaidan, A. Mohammed Ahmed and Sameer Hasan A- Bakri, [4] has proposed a background for audio watermarking using various methods like low- bit encoding, phase coding, spread spectrum technique etc.

Cheng-Yaw Low, Andrew Beng-Jin Teoh, Connie Tee [5] has proposed LSB-DWT scheme from the perspective of watermark imperceptibility and robustness. He validated the performance of LSB-DWT scheme against JPG compression, low pass filtering, median filtering, noise addition, scaling, rotation and cropping based on visual inspection, PSNR and watermark distortion rate. From experiment, LSB-DWT scheme shows remarkable immunity against the deliberate attempts to deteriorate the signature code.

Bhuvnesh Kumar Singh[6] has proposed audio watermarking has the capability to deal with the copyright of watermark depends on the method used for audio.

Pooja Dabas , Kavita Khanna[7], has analyzed that the digital watermarking techniques having the powers and limitations. According to the result table the LSB technique has less security. Although the embedding and extraction takes less time to execute.

Abdullah Bamatraf, Rosziati Ibrahim [8] this paper proposed a digital watermarking scheme is LSB based, with the fourth and third LSB in the grayscale image. Once embedded secret data into 3^{rd} and 4^{th} LSB in the image in determine coordinates, we get the watermarked image. Therefore, this digital watermarking algorithm can be used to hide data inside image.

Kamini Pawar, S. K. Parchandekar [9] This paper proposes Zero Watermarking scheme solves these problems successfully. Compared with the traditional audio watermarking algorithms, the proposed scheme introduces no audio quality degradation and can solve the challenge between robustness and imperceptibility perfectly. The multi-resolution characteristic of DWT, the energy compression characteristic of DCT and the steady sign of certain DWT-DCT coefficients with absolute value are combined to extract important features which are used to generate the secret key and used for watermark recovery.

Yatish Y. Jani, Yagnesh J. Parmar[10] In this technique in the audio file the bits used as watermark are inserted. First inserted into all frames in such a way that it should not affect the original audio file. This easy and more robust can handle more amount of data can be used as watermark.

III. IMPLEMENTATION DETAILS

A. Embedding Procedure

This process is to insert the image into audio file using proposed techniques i.e. LSB and DCT. The LSB converts the image into binary bits and DCT divides the image and audio file into equal parts and applies the security key using AES. Inputs for the embedding procedure are image and audio file. Select the image which you want to insert as a watermark in audio file.

1. Select the image (".bmp", ".jpg", ".gif", —.tif") file to embed.
2. Select the audio (".mp3", ".wav") file in which to be embedded.
3. Divide the image into binary bits and apply LSB.
4. Divide the image and audio file to equal parts.
5. Image is divided into 2D DCT form because it has height and width.
6. Audio is divided into 1D DCT form because it is in waves form.
7. Apply DCT on each divided frame on image and audio.
8. Apply 1D DCT on audio and 2D DCT on 2D DCT.
9. Embedding is done successfully for audio file.

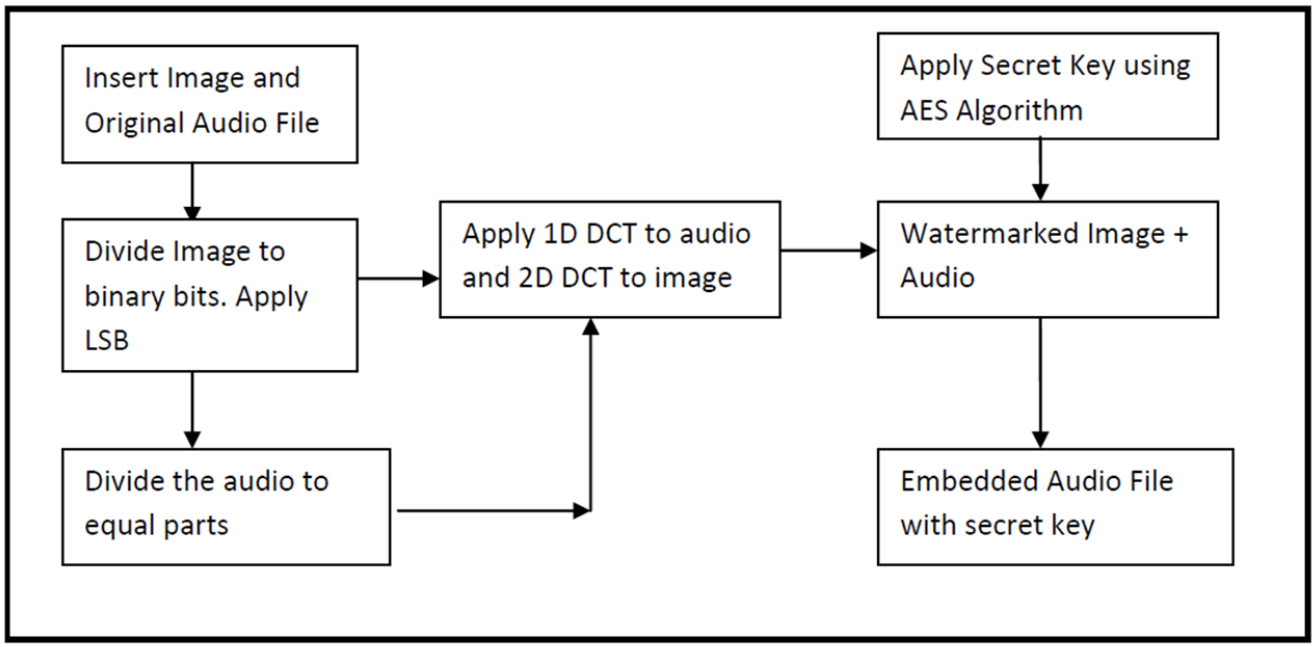

Fig 2. Embedding procedure

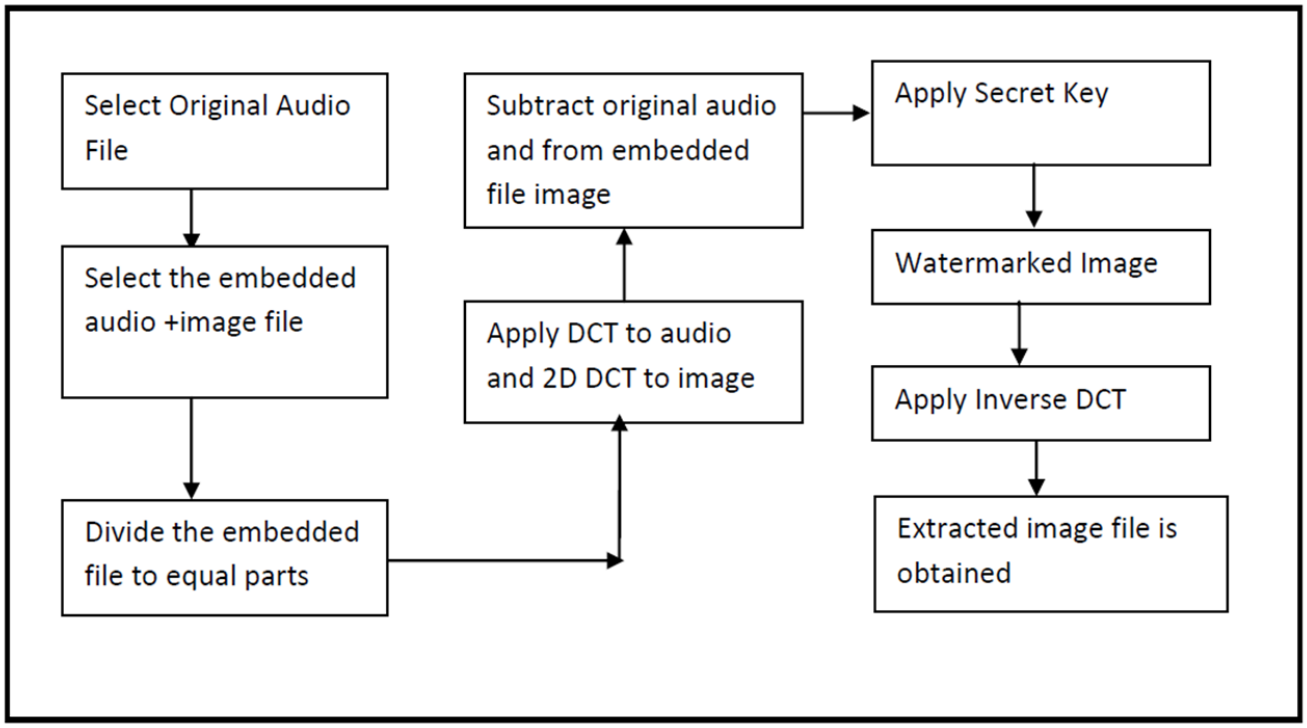

Fig 3. Extraction Procedure

B. Extraction Procedure

This process is to extract the image from the audio file using proposed techniques i.e. LSB and DCT. Input provided is the original image and the embedded file i.e. audio + image with secret key provided.

1. Select the original audio file to extract.
2. Select the embedded file audio + image.
3. Divide the embedded file to equal parts.
4. Apply DCT on both file image and embedded file.
5. Subtract the original audio file from embedded file.
6. Extract using secret key.
7. We get the watermarked image.
8. Apply inverse DCT.
9. We get the extracted image file from audio.

IV. MATHEMATICAL MODEL

The DCT basic operation is as follows:

- The image inputed is of N by M pixels ;
- F (I, J) is the intensity pixel of row I and column J
- F(u,v) is the coefficient DCT in row UI and column VJ of the DCT matrix.
- For image (and video), the DCT input is usually an 8 * 8 (or 16 * 16) array of integers.
- The image array contains the each window's of image respective to color band pixel levels.

The popular domain for audio processing is that of the DCT - Discrete Cosine Transform technique or we can say it as DCT technique. In DCT watermark the data bits are extended over the host signal so that the robust is increased on the embedded signal. This technique we are using in our proposed work. In this technique we say even components are present so using DCT embedding gives better result against various attacks. The technique expressions are described as follows

For a 1-D discrete signal with the length of *N*, Discrete cosine transform is described as

$$C(m) = a(m)\sum_{n=0}^{N-1} f(n)\ \left[\frac{(2n+1)M}{2N}\right] \quad \ldots(1)$$

Where m=0, 1, 2,...N-1

Reverse DCT function for 1-D signal is described as follows

$$f(n) = \sum_{n=0}^{N-1} a(m)c(m)\frac{(2m+1)n}{2N} \quad \ldots(2)$$

In both the equations above m=0, 1,2,...N-1
Whereas

$$a(m) = \begin{cases} \frac{1}{N}, & if\ m = 0 \\ \frac{2}{N}, & if\ m\ !\ = 0 \end{cases}$$

In our proposed work we give an effectual audio watermarking technique that gives the higher level of security and increases robustness and imperceptibility of the watermark. Proposed work is divided into two parts one is embedding procedure and extraction procedure.

V. RESULTS

The proposed system is developed in Java AWT Swing programming. The result is being depicted below. The figures contain original image, original audio, result displayed using (Mean Square Error) MSE, Signal to Noise Ratio (SNR), Peak Signal Noise Ratio (PSNR).
These are the inputs provided to the embedding procedure.

Fig 4. Original Image

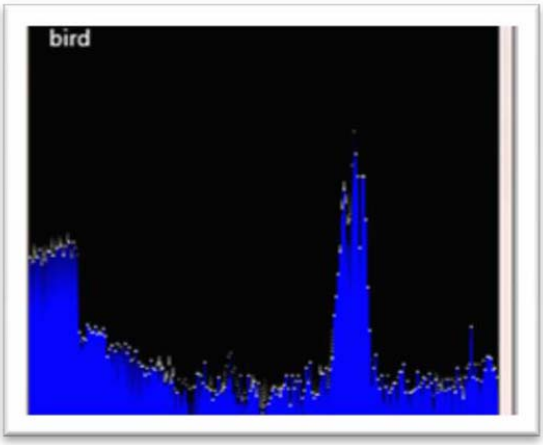

Fig 5. Original Audio

The result after inserting image into audio is

VI. CONCLUSION

In the proposed method the digital audio watermarking is given high security using the LSB and DCT technique which protects form the attacks of the unauthorized users. We have used two procedures for watermarking one is embedded watermarking and extraction watermarking. The Results obtained are compared with previous system.

Future work will focus to find the possibility of organizing still more security and improving the results.

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