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Sound steganography for hiding encrypted information using DCT algorithm

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ABSTRACT

The paper present an algorithm for data encryption to provide more data secure. Where this technique combine steganography and biometric characteristic. Biometric characteristic processed and enter to Qr-code generator to provide encrypted key. This key used with the DCT steganography technique to hide the encrypted data. This algorithm tested and all the result validate the success of this algorithm to hide information and make it undetectable.

Key word: DCT, audio file, biometric, PSNR.

1. Introduction

Biometric security system used the biometric characteristics to provide more level of secure. Where the biometric characteristic describe any physiological or logical characteristic that can be used to identify the human. Biometric characteristic like DNA, fingerprint, eye retina, etc. Increase the need for this type of system back to main reason which the user need for secure ways that provide more security to protect his data and information from any threat. The biometric characteristics can be used with steganography technique to hide information. Where the steganography work to make the hiding massage undetectable. Many researchers work in this field where Researcher [1] presented a technique that used one dimensional Walsh coding watermarking (binary biometric image) and it inserted in the DCT blocks of a digital in gray scale still image. Researcher [2] presented an algorithm that combine Discrete Wavelet transformation (DWT) and Discrete Cosine Transformation (DCT) for Audio Steganography. The researcher [3] presented a security system that combine data hiding and biometrics for protecting biometric data where DWT and DCT used for embedding and extracting the secret data.

2. Steganography techniques

There are many methods to embedding data in multimedia files. Where it can be classify in two direction spatial domain for example LSB and frequency domain for example DWT, DCT etc... In each of them have some characteristic like computation cost, robustness, capacity…etc., where this paper focus on method that hiding large amount of information with security munity and more acceptable invisibility.

2.1 Discreet Cosine Transform DCT

It is a transformation technique that is used in many application like science or engineering. It widely used to convert information (signal, image) from spatial domain to frequency domain.
1D-DCT is used to embed bits in each (1xn) DCT frame of host signal. The calculating method for 1D-DCT &1D-IDCT is [4][5][6]:

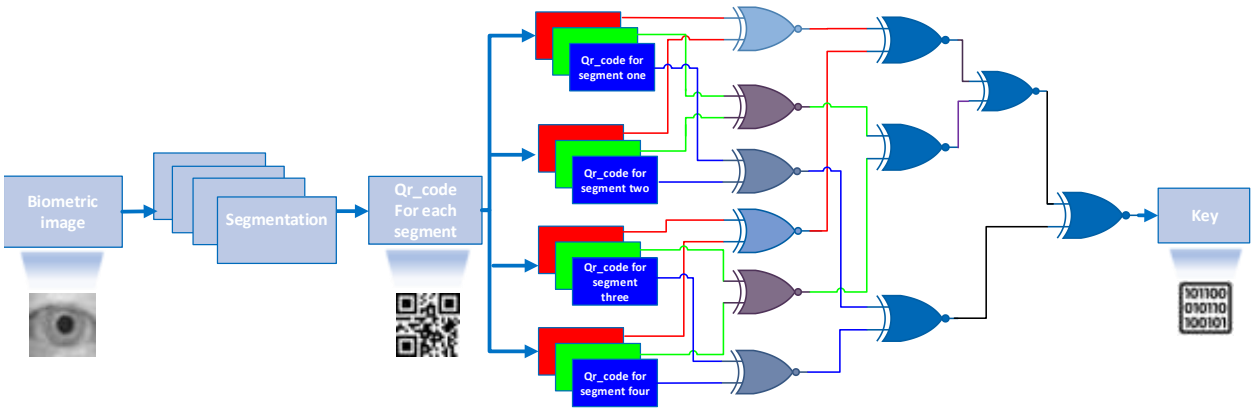
$$c(u) = a(u) \sum_{x=0}^{N-1} f(x) \cos\left[\frac{(2x+1)u\pi}{2N}\right] \quad \text{.....1}$$

$$f(x) = \sum_{u=0}^{N-1} a(u)\, c(u) \cos\left[\frac{(2x+1)u\pi}{2N}\right] \quad \text{.....2}$$

$$a(u) = \begin{cases} \sqrt{\frac{1}{N}}, & u = 0 \\ \sqrt{\frac{2}{N}}, & u \neq 0 \end{cases} \quad \text{.....3}$$

3. Algorithm works

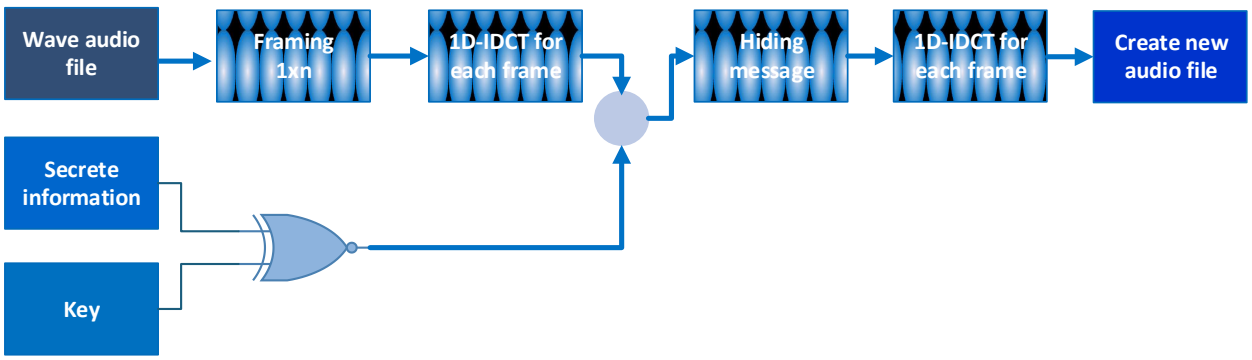
The suggested algorithm in this works divided into three steps: in first step the secret key generated. Which is used to encrypt the data that will hide in host signal. This step used the idea of human biometric.it implemented by (image) which is segment into 4-segments each of which enter to the Qr_code generated. the Qr_code generator generate QR_code image [7] that is color image (R, G, B).the color image convert into series of binary numbers and inters to the (XNOR) gates as shown in the Block diagram (1) the output of this step implement the secret key .



Block diagram (1) for key generation

The second step in this algorithm inform the hiding step which implemented as fallow and showing in Block diagram (2):

1- Read the audio file (WAV) and then framing it into number of frame with length (1xn). The n value in rang (3...8).
2- Each frame transformed by 1D-DCT.
3- The secret information will Encrypted by XNOR the message with the key that generated from the first step in the algorithm work.
4- embedded one bit of encrypted data in each frame.
5- Evaluate 1D-IDCT for each frame.
6- Repeat step (4-5) until the end of encrypted data.
7- embedded string length and frame size in the creating new (WAV) audio file.
8- Evaluate PSNR.

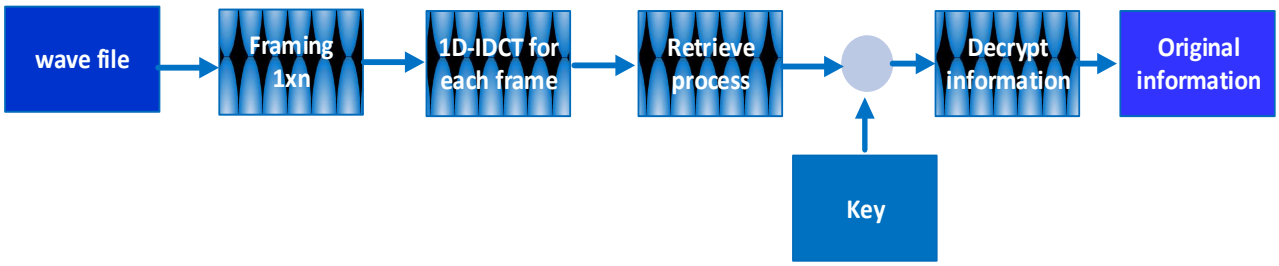


Block diagram (2) information hiding

The final step in this algorithms inform the extraction step for the secret message which is implemented as fallow and showing in Block diagram (3):

1-Read the (WAV) audio file.
2-Extract string length and frame size from the audio file.
3-Divide the audio file into no. of frames with size (1 x n).

4-Convert each frame to 1D-DCT and extracting one bit from each frame.
5-Repeat step (3-4) until the number of bit equal to string length.
6-Decode the output of previous step by using secret key.
7-Display the retrieve massage and evaluate correlation value.



Block diagram (3) information extracting

4. Result

To evaluate the performance of this work we use peak signal to noise ratio (PSNR) to determine the quality of the audio file and correlation (r) to evaluate the robustness [6][8].

$$PSNR = 10 \log_{10}\left(\frac{MAX^2}{MSE}\right) \text{.....4}$$

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(W[i] - X[i])^2 \text{.....5}$$

$$r = \frac{\sum_{i=1}^{n}((W[i]-\bar{W})(X[i]-\bar{X}))}{\sqrt{\sum_{i=1}^{n}(W[i]-\bar{W})^2 \sum_{i=1}^{n}(X[i]-\bar{X})^2}} \text{.....6}$$

Where W,X is the original audio file and audio file containing encrypted massage, $\bar{W}, \bar{X}$ is the mean value of vector audio file W,X .

After applying this algorithm on no. of audio files (wav) with different frame size (1x8, 1x7, 1x6, 1x5, 1x4, 1x3) the result is shown in the table (1, 2, 3, 4)

Table (1)

Frame size	PSNR	Massage length (bit)	correlation
1×8	42.7209	4104	1
1×7	42.2297	4104	1
1×6	41.2328	4104	1
1×5	41.2643	4104	1
1×4	41.0079	4104	1
1×3	39.0350	4104	1

Table (2)

Frame size	PSNR	Massage length(bit)	correlation
1×8	39.9227	1024	1
1×7	39.8303	1024	1
1×6	39.6988	1024	1
1×5	39.7822	1024	1
1×4	39.7177	1024	1
1×3	39.6901	1024	1

Table (3)

Frame size	PSNR	Massage length (bit)	correlation
1×8	44.3283	5080	1
1×7	43.9274	5080	1
1×6	43.4614	5080	1
1×5	43.2500	5080	1
1×4	43.2169	5080	1
1×3	42.4552	5080	1
1×8	44.7788	5336	1
1×7	44.3219	5336	1
1×6	43.7850	5336	1
1×5	43.5655	5336	1
1×4	43.5272	5336	1
1×3	42.6743	5336	1

Table (4)

Frame size	PSNR	Massage length (bit)	correlation
1×8	46.8238	1072	1
1×7	46.6768	1072	1
1×6	46.5060	1072	1
1×5	46.4507	1072	1
1×4	46.4526	1072	1
1×3	46.4225	1072	1
1×8	42.7287	4096	1
1×7	42.4969	4096	1
1×6	42.2098	4096	1
1×5	42.0721	4096	1
1×4	42.0550	4096	1
1×3	41.5086	4096	1

5. Conclusions

The paper suggested an algorithm for message encrypted and hiding. The message encrypted by secret key. Where it generating depend on human biometric and Qr_code. Also the encrypted message hide inside audio file using 1D-DCT. The suggested algorithm tested on deferent audio file with deferent frame size. Where it validate through peak signal to noise ratio (PSNR) and correlation. All the result (as shown in the result table) shows that the algorithm can encrypt and retrieve the secret message. As a result of this, the algorithm validate the capability for encrypt and hiding message effectively.

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