The Use Of Discrete Cosine Transformation(DCT) In Information HidingProcess

استخدام تحويل الجيب تمام المتقطع في عملية اخفاء المعلومات

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Abstract

In the current internet community, secure data transfer is limited due to its attack made on data communication. So more robust methods are chosen so that they ensure secured data transfer. One of the solutions which came to the rescue is the audio hiding to ensure secure data transfer between the source and destination.

The basic idea behind this research is to provide a good, efficient method for hiding the data from hackers and sent to the destination in a safer manner. Though it is well modulated software it has been limited to certain restrictions. The quality of sound depends on the size of the audio which the user selects and length of the message. Though it shows bit level deviations in the frequency chart, as a whole the change in the audio cannot be determined.

Frequency Transformation is a mathematical equation that mapping the image data from the spatial domain to the frequency (spectral) domain , where all the pixels in the input domain contribute to each value in the output domain with one – to – one correspondence between the pixels**.** Information hiding involves transmitting secret messages through seemingly innocuous files. The goal is that not only does the message remain hidden, but also that a hidden message was even sent .Discreet cosine transformation (DCT) is used as one of frequency transformation type and use it to hide the secrete manage (Audio) inside the carrier (image) , after converting the Audio into a stream of bits . these bits will be embedded inside the image using one of information hiding algorithms and use DCT as one of frequency transformation .

الخلاصـة :-

التحويل الترددي هي عمليات رياضية تقوم بتحويل الصورة من الحالة الرقمية الى حالة الترددات (frequency) الغرض من هذه العملية العمل على الصورة بصيغة عددية numerically وبأستخدام احد انواع التحويل وهي التحويل الجيب التمام المتقطع (Discrete Cosin Transformation) وسنستفاد من هذه التحويلات في عمل الاخفاء المستخدم وذلك من خلال تحويل ال object embedded وهو الرسالة الصوتية المراد اخفاءها وتحويلها الى مجموعة من الbytes ومجموعة bits وتقوم بأخفائها داخل الصورة بعد ان تحول الى التحويل الترددي .والنتائج كانت مشجعة حيث تم ادخال صورة وتطبيق الناتج عليها .

في هذا البحث قمنا بإضمار صوت داخل صورة بعد تحويل كل من الصوت والصورة إلى مصفوفات رقمية ثنائية (۰,۱), حيث أننا قمنا باستخدام برنامج Matlab حيث مكننا من تحويل الصوت إلى مصفوفة من عمود واحد و N من الصفوف من الأرقام الثنائية مكونه من 8 bit. وتحويل الصورة إلى ثلاث مصفوفات متعاقبة إبعادها $n \times m$ من الأعداد الثنائية (۰,۱) مكونه من 8 bit حيث المصفوفة الأولى تمثل اللون الأحمر والمصفوفة الثانية تمثل اللون الأخضر والمصفوفة الثالثة والأخيرة تمثل اللون الأزرق ولما كان اللون الأزرق هو أقل الوان الطيف ترددا فأن قيمته العددية ستكون قليلة مما يمكننا من إضمار الصوت داخل اللون الأزرق ومن ثم إعادة الصورة إلى حالتها السابقة وذلك بعد تحويلها من الشكل الرقمي إلى الصورة الاعتيادية. مع ملاحظة أنه يجب أن تكون $N < k = n \times m$ وذلك حتى لا نفقد جزءاً من الصوت المضمر. وإذا كان $N \gg k$ فأن الصوت المضمر سيكون واضحاً في أعلى الصورة لذلك اقترحنا بأن نقوم بتوزيع الصوت على كل نطاق الصورة بشكل متساوي أي أن.

$$\Delta h = \frac{k}{N}$$

1.1 introduction

The discrete cosine transform (DCT) is a technique for converting a signal into elementary frequency components. It is widely used in image compression and sometime used in information hiding.DCT functions illustrate the power of *Mathematica l*in the prototyping of image processing algorithms[1]. the DCT is a close relative of the discrete Fourier transform (DFT) [2] .

The transform domain methods operate in the Discrete Cosine Transform, Fourier or wavelet transform domains of the host signal. The *Patchwork algorithm* (developed at the MIT) selects random pairs of pixels, and increases the brightness of the brighter pixel and decreases the brightness of the other. This algorithm shows a high resistance to most nongeometric image modifications. If it is important to provide a protection against filtering attacks, then the information hiding capacity is limited .[3]

The destination extraction algorithms can be divided into two groups: spatial/time domain and transform domain techniques. In the former case information is embedded in the spatial domain in the case of images, and in time domain in the case of audio materials.[4]

The rapid growth of digital imaging applications, including desktop publishing, multimedia, teleconferencing, and high-definition television has increased the need for effective and standardized image compression techniques and image information hiding .[1]

Digital images is pictures that have converted into a computer readable binary format consisting of logical or's and 1's Usually , by an image we mean , a still picture that does not change with time , whereas a video evolves with time and generally contains moving and / or changing objects . Digital images are usually obtained by converting continuous signals into digital format although "direct digital" systems are becoming more prevalent. Likewise, digital visual signals are viewed by using diverse display media (display devices). The frequency with which information transmitted, stored, processed and displayed in a digital visual format is increasing rapidly.

An audio file format is a file format for storing audio data on a computer system. It can be a raw bit stream, but it is usually a container format or an audio data format with defined storage layer.[6]

 Wave Files – filename.wav, WAV is short for *Waveform Audio Format*, Standard Microsoft audio format used for storing raw sound files, uncompressed Wave files are quite large, but retain all the sound quality of the original track, and easily manipulated with appropriate software

When information is hidden inside video the program or person hiding the information will usually use the DCT (Discrete Cosine Transform) method .

DCT works by slightly changing the each of the image in the video , only so much though so it isn't noticeable by the human eye . To be more precise about how DCT works . DCT alters values of certain parts of the images , it usually round them up .For example if part of an image has a value of 6.667 it will round it up to 7 .Steganography in videos is similar to that of steganography in image , a part from information is hidden in each frame of video . When only a small amount of information is hidden inside of video it generally is'nt noticeable at all , however the more information that is hidden the more noticeable it will become .

1.2 Discrete Cosine Transform [5]

The cosine transform is similar to Fouriertransform , using basis function only the real part , not the complex . and they are cosine function not sine function .The two-dimensional DCT can be computed using the one-dimensionalDCT horizontally and then vertically across the signal because DCT is aseparable function.

The *two-dimensional discrete Cosine transform*(**2D DCT**) of a block of N x N samples of a two-dimensional signal $I(r,c)$is formulated as

$$C(u,v) = \frac{2}{N} \propto (u) \propto (v) \sum_{r=0}^{N-1} \sum_{c=0}^{N-1} I(r,c) \cos\left[\frac{(2r+1)u\pi}{2N}\right] \cos\left[\frac{(2c+1)v\pi}{2N}\right] \quad \ldots\ldots\ldots (1)$$

for $u,v = 0 , 1 , \ldots , N - 1$, Where

$$\propto(u), \propto(v) = \begin{cases} \frac{1}{\sqrt{2}} & for \ u,v = 0 \\ 1 & for u, v = 1,2,\ldots,N-1 \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots(2)$$

The function I(r,c) represents the value of the r t h sample in the c t h row of a two-dimensional signal. C$(u,$ v) is a two-dimensional transformed coefficient for $u,v= 0,1,\ldots , N-1$.

The *two-dimensional inverse discrete Cosine transform* (**2D IDCT**) is com puted in a similar fashion. The 2D IDCT of $C(u,v)$ is formulated as

$$C^{-1}[C(u,v)] = I(r,c) =$$
$$\sum_{u=0}^{N-1} \sum_{v=0}^{N-1} \propto (u) \propto (v) C(u,v) \cos\left[\frac{(2r+1)u\pi}{2N}\right] \cos\left[\frac{(2c+1)v\pi}{2N}\right] \quad \ldots(3)$$

1.3Transform Domain Based information hiding[3]

Definition of information hiding: method of transmitting secret messages through innocuous carriers in such a way that the very existence of the embeddedmessage is undetectable Examples of cover carriers: images, audio, video, text data .The destination extraction algorithms can be divided into two groups: spatial/time domain and transform domain techniques. In the former case information is embedded in the spatial domain in the case of images, and in time domain in the case of audio materials. The transform domain methods operate in the Discrete Cosine Transform, Fourier or wavelet transform domains of the host signal. The *Patchwork algorithm* (developed at the MIT) selects random pairs of pixels, and increases the brightness of the brighter pixel and decreases the brightness of the other. This algorithm shows a high resistance to most nongeometric image modifications. If it is important to provide a protection against filtering attacks, then the information hiding capacity is limited .

A popular method in a frequency domain is to modify the relative size oftwo or more DCT coefficients in an image block, embedding one bit information in each block. The two coefficients should correspond to cosine functions with middle frequencies which means that the information is stored in a significant part of the signal. The algorithm should be robust against Jpeg compression, so the DCT coefficients with equal quantization values should be chosen, according to the quantization table of Jpeg. In the frequency domain the embedding process can usually hide less information into pictures, there is not such an exact limit in the size of the embedded object as in the case of LSB insertion, where the number of pixels, and the color depth determine the maximum size of the embedded data (and it was sure, that the changes occurred during embedding will be invisible).

In the case of a transform domain operation the embedding process can cause visible changes if the embedded data size is too big, and the limit where a given embedded data size does not change the visual properties of the image is imagedependent. The following figures show the result of the embedding process in transform domain.In the case of a watch test picture 50 kb embedded data (and above) modifies the visible properties of the image, so when the cover-image is compared with the image original one it is possible to recognize a modification.

2.Practical issues

This section concerns with the description of the simple design and implementation of the project. The project's layout will be presented. Next, the implementation of the main parts of the system will be discussed.

2.1 The Proposed System

The Proposed System as shown in fig 2.1
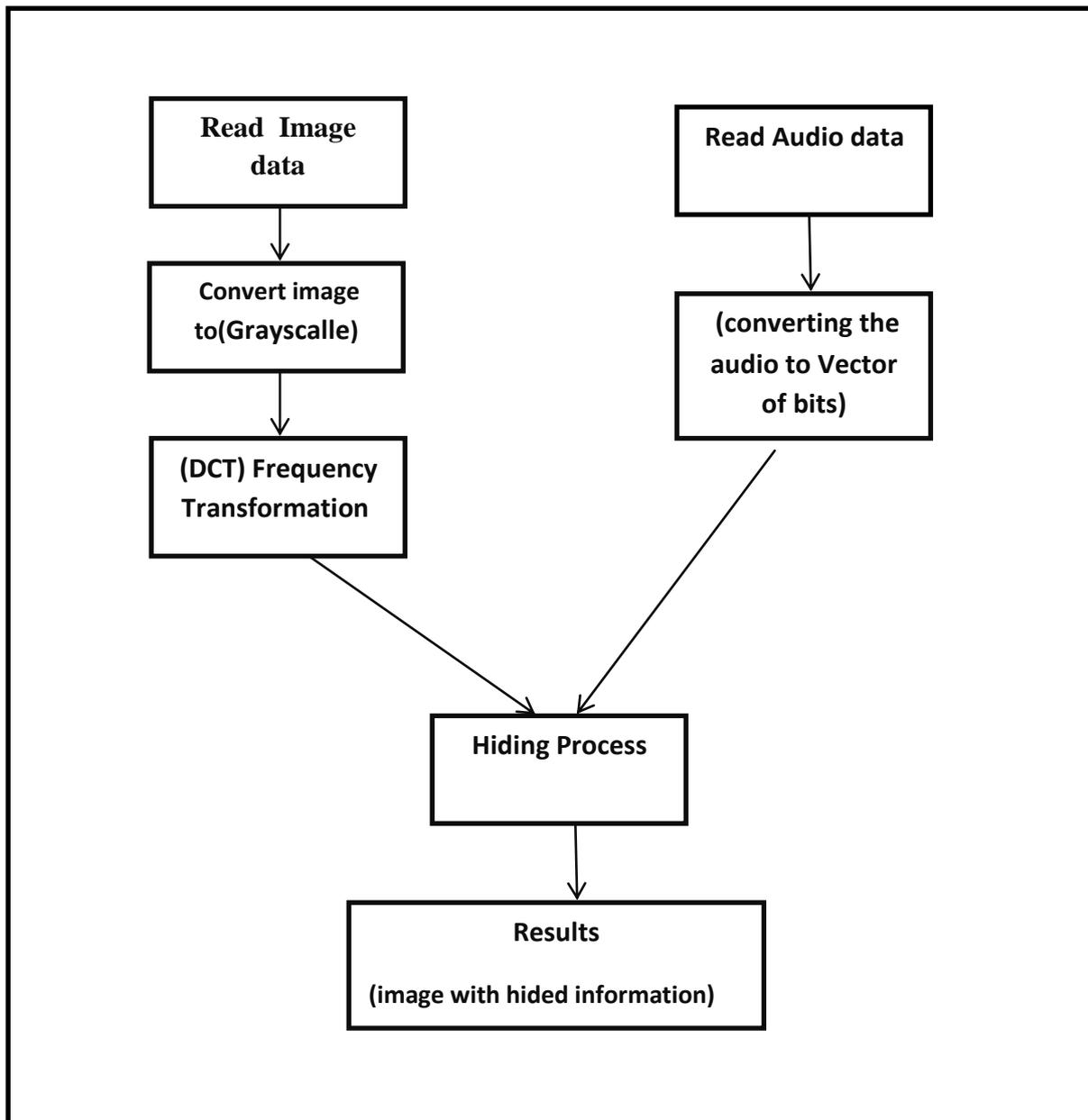
Fig (2.1) The overall System Model

2.2 Read Image

The images are saved as BMP format that start out with header followed by sequence of byte . The size of BMP header is 54 bytes and the data of the image is beginning from 55 to the end of the image pixel . The implemented image is describe as 24 bit per pixel, each pixel have three band (Red, Green, Blue) .this can be to get by use matlab programming to read image file byimread('filename') ;see appendix A

(a)   The girl image   (b) the grayscale of girl image

The histogram of colored imaged (a)   the Histogram of grayscale image(b)

We read the Audio file using the matlab programming by
auread('aufile');
where aufile is audio file ,Then we convert the audio file into Bytes and then the Bytes into array of bits (convert to the binary state B[ ]) to prepare it for information hiding as in the following algorithm:

Algorithm (1) Read Audio file

step (1): input the binary array A[ ] , A[ ] array of the data of read the
         audio file
step (2):for I=1:n , where n is the numbers of elements in A[ ]
step (3): if A[ ] > 0 then
         B[ ] = A[ ] mod 2
Step (4) : A[ ] = A[ ] div 2
Step (5): end if and for loops

2.4 information hiding using DCT

In **LSB** modification,is one of the techniques that used to embedded object is i.e. in two dimensional space of an image .At the beginning the color-plane (R, G, B, or all of them) is chosen, then using the DCT to convert these plane to frequencies using equation(1) will carry the embedded object, by substitution the original bit with embedded bit using Algorithm 2 .
The embedding process requires the original image (I), the embedded object(S) and the three parameters (color plane, pixels position, bit position) as input, the output of embedding process are cover image (I),
The program of is as following:

input ('D_{before}[ ] ') ;
input ('B[ ] ') ;
for I=1:n , n is the number of element of B[ ]
D_{after}[ ] = D_{before}[ ] * 252
D_{after}[ ] = D_{after}[ ] + B[ ]
end
disp (D_{after})

2.5information Hiding at Frequency Domain

The *frequency domain* is a space in which each image value at image position F represents the amount that the intensity values in image I vary over a specific distance related to F.
The DCT is applied to construct the feature vector that will be used to hide information.

$$D(i , j)= \frac{1}{\sqrt{2N}} C(i)C(j) \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} P(x,y)cos\left[\frac{(2x+1)i\pi}{2N}\right] cos\left[\frac{(2y+1)j\pi}{2N}\right] \qquad \dots\dots(7)$$

We apply the information hiding algorithm on the coefficient that result from algorithm of DCT. An additional area that we explored was the information from higher order joint statistics of DCT coefficients. We consider the collection of 64-dimensional vectors obtained by applying the DCT on 8×8 blocks of an image, and taking the absolute value of the resulting transform coefficients. We look at the absolute values of the coefficients in each 8×8 DCT block as a vector in R64.Each image of size $N \times M$ brings N=8 M =8 sample vectors. We study whether the joint distribution of DCT coefficients is affected by a hiding algorithm by means of statistics of the form $w \cdot v0$ where v 2 R64 is a vector of absolute values of DCT coefficients, v0 is its transpose, and w 2 R64 is a projection vector that results from a training process.

2.6 . Check the resultand Conclusions

For all experiments we used different color(24-bits) then converting to grayscale images .This is particularly appropriate for our work ,FirstThe audio file contains set of bytes. For e.g. take an audio file which play for 10 secs. It has more than 60,000 bytes. Each byte is received and checked ,converting it to stream of bits and save it in a matrix of 1-D(vector).
secondly read image data as matrix of three bands converting to it sequivalence matrix of frequencies using DCT transform .then the resultant will be used in embed process as cover that carry the hided information using the suggested technique of hiding LSB and used the vector of bits as the embedded data inside the cover image.
We can check the result by subtract the result image from the original image. If the result image of the subtract is pure black then the embed is failed, otherwise the embed is succeed.
We can notice from the histogram of both images the difference.

before the hiding   after the hiding

In this research we embed a sound file oftype wave inside aBMP image after converting both of wave and bmp into a binary format (0's and 1's) using mathlab environment thatenable us to convert the sound file to a matrix of(0's and 1's) of 1-D(vector) of 8 bits binary cells and converting the image to 3 N X N matrices of binary (0's and 1's) each matrix represent a specific frequencies that represents colors .the first matrix represent the red colors' frequencies. the second matrix represent the green colors' frequencies, .the third matrix represent the blue colors' frequencies, Although the blue frequencies tend to be the less of frequencies so, any simple changes will not be noticed by human eyes. Using this property inhiding the audio data into the blue matrix by substitution with a bit from the cover image bits. there are a variety of algorithms for hiding information we use the LSB substitution algorithm .but we faced many difficulties the

most impotent one is,if the audio file is larger than the image cover file, we solve it by checking the dimensions according to the size of the over image we decide it can be embed or not .

$(N_X M) < k$ Where n, m the image dimensions, k vector length(of audio)

Example : if there is the image (hevrs.bmp) with size 2.85 MB and audio (true.wav) with 138 KB . the shape(1) notethat image before hiding .

Now, in the shape (2) we are going to substitute the audio stream bits(vector) in the image but it will appear in the above part of the image that because it effect the colors of the image so we try to distribute them randomly to achieve the invisibility.

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