Journal of Al-Qadisiyah for computer science and mathematics
Vol.5 No.2 year 2013

Page64-77

Hide Compression Image within the Image

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Recived： 12 /3 /2013 Revised: 2 /6 / 2013 Accepted: 6 /11 / 2013

Abstract

This research includes building a system to hide an image file within the image file (cover) to produce material hidden file, which does not contain misrepresentation or distortion ,can human vision system palpation or note any difference between the cover and the article hidden file output. Where the system consists of two main phases:-

In the first stage was compression secret color image is using a technique of compression so as to reduce the size of the image data to wanted hiding and which features large , compression technology consists of three basic components: -

1. The application of the discrete wavelet transform.
2. The scalar quantization, means to reduce the number of bits in the one-pixel.
3. Use at this stage to Run-Length Encoding (RLE).

Where the use of hybridization in the compression process the hybrid technology merged between discrete wavelet transform and scalar quantization, entropy encoding to obtain the proportion of high compression of the image and this is proven by experiments. In the second phase of the system method was used to hide compression image, which we get from the first phase, where method of information hide in the spatial domain. Main idea the use of threshold mechanism to determine important information in the secret image of and that is hidden within the color image used as a cover so that the change is performed on the image used cover can not be to the human eye detect any choose the threshold so that the appropriate system with the human eye, where they are converted first a ll information compression and is used as a cover to bits, then do the process of replacing the information that was determined using the threshold and which are the sites most important (Most significant bits (MSBs)) of the secret image to be concealed in the less important Least significant bits(LSBs) of stego image the proposed system provides high security so that it is difficult to detect the presence of the hidden image.

Keywords: Steganography, cover-image, LSBs, PSNR.

1.Introduction

the science of the hiding is simply hiding task information in different media, such as text, image, sound or video clips so that they can not be third-party knowledge of the existence of such information, when see great beauty image, has no doubts that there is hidden text in [1]. Then informed embedding is a science which is interested in concealing digital information within an electronic medium without causing any distortion or modified significantly in this medium [2,3]. And elements of the process of the hiding is the cover or pregnant (which is hidden message in it, and is often a image or a sound clip or video), and the other elements is the message and hiding key (used in the

hiding the same) and do not teach only the sender and the future [3]. Let's start with this definition and explain a little bit to give further clarification in order to facilitate understanding of the general idea. For the transfer of your information or digital files (text, image, and sound) you want to be sent across the network to reach safely to the other party, and let's call that information and files of the message of secret. The secret message will be sent directly but must be integrated and be hidden inside the message cover (also this message may be text, image, and voice) a professional manner without leaving any trace of doubt that there is a secret inside the message cover. Thus be the result of the merger is the message of inclusion and which is a copy of the message cover of form but it contains the secret message without creating any doubt or doubt its existence, and the figure(1) shows the process of embedding[1, 4].

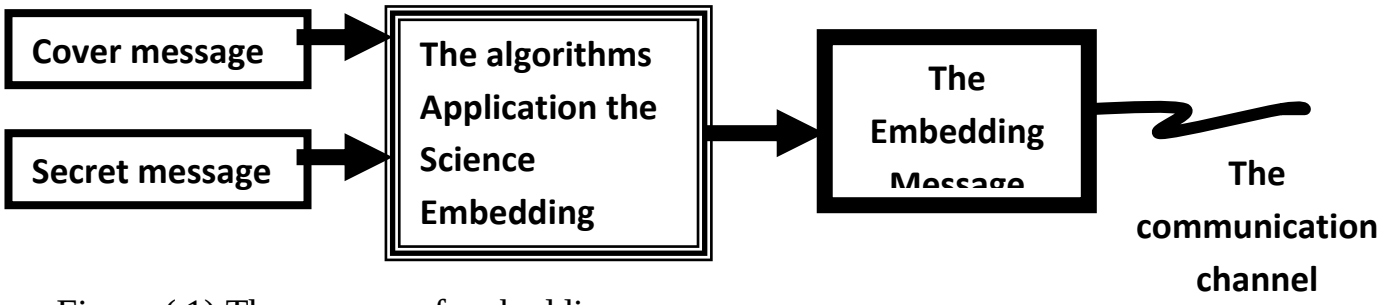


Figure (1) The process of embedding

Made many works in the field of information hiding techniques in 1992 made Kurak and Mchugh system is concealing a picture into another picture, by replacing the number n of the smallest binaries(LSB) in the form of cover, the number n of the biggest binaries (MSB) of the image you want to hide [5]. Chen et al. (1997) embed the VQ (vector quantization) code of the secret image into the cover image by 3 LSBs (least significant bits) replacement method[6]. Liaw and Chen (1997) proposed a gray value replacement method to embed a secret image into a cover image. The authors find each pixel p' in the cover image for the pixel p in the secret image whose pixel values are closed. The stego-image is produced by replacing the pixel value of p' with that of p. Wu and Tsai also proposed a method to embed a gray-level secret image into a gray-level cover image. Their method is based on the feature of gray-level similarity among the adjacent pixels of a natural image. The main advantage of Wu and Tsai's method is the extracted secret image is the same as the original one. It is useful when the secret image is lossy not allowable. However, most natural images are distortion allowable. Consequently, the lossless secret image is not a requirement in most of image hiding techniques. In 2000 provided for a system based Lala- Krikor hide small picture in a large image using a technique LSB [7]. In 2002 submitted Alaa Abdul-Hussein system hides the text within the image, where the system by comparing the ASCII values of text characters with the values of the color palette of the image in search of matching [8]. In 2003 Muhammad Ali is submitted File in Image Steganography System (FISS) which is towards the circular, where can such a system that hides any type of files (audio, image, text, ...) within the image to produce the file of article hidden, Where the FISS system proposed division of the message file into blocks of random sizes between 3 to 5 bits.

And then generate a matrix of random values determine the distances between binaries one block and are values between 1 and Block_Dst. These distances represent the number of binaries that separates between the location of bit and bit site followed in the same block. And then compare binaries block the message and binaries containing the corresponding starting from the specified location to hide the block and calculate the proportion of matching rate[9].Provides current research technology to hide an image in spatial area, and the first phase the use of technology to compression so as to reduce the size of the image data to be concealed, the proposed technical take into account the characteristics of vision system rights and the include the information is secret compression inside the cover image, use technology replacement to include a image of secret that have been identified using threshold. In this paper is organized as follows. Section 2 describes the details of the proposed system. The experimental results of the proposed image hiding scheme are demonstrated in Section 3 . Finally, Section 4 presents the conclusions for this work.

2. The Proposed System

The proposed system includes two stages: -

A- Images Compression Technique by Using Hybrid Wavelet Transform with Scalar Quantization

System consists of compression, as in Figure (2) of the compression part, which consists of three basic components [11]:

1.Transform.
2. Quantization.
3. Entropy encoding .

As part of decompression the archive consists of the inverse of these components, namely:

1. **Decoder entropy.**
2. **Dequantization .**
3. **Inverse transform**.

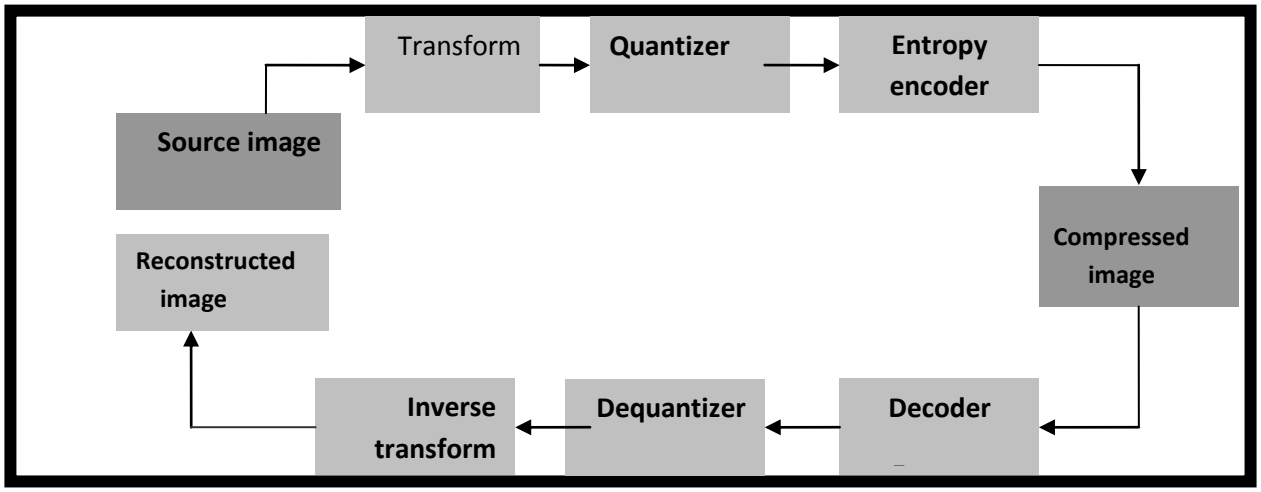


Figure (2) Shows the main stages of the system compression

Will review the stages of compression:-

2.1.1 Discrete Wavelet Transform (DWT) works by using algorithm filters bank, which brings together wavelet transform and digital filters [12] algorithm using two types of filters bank , filters are Low Pass Filters which serves as the scaling function and High Pass Filters which serves as wavelet functions, and implemented an algorithm to two key bank filters [12,13, 14]:

1. Filtering and Down sampling (Fragmentation)

The process of filtering to signal using the process convolution of the signal with another series of transactions, called the filter coefficients by equation (1) the following: -

$$y(n) = \sum_{b=0}^{N-1} h(n) \quad f(n-b) \qquad \ldots(1)$$

Where:

f (n-b): is a signal within.

N: length of signal.

The process of fragmentation, as in Figure (3) identified the symbol $\downarrow 2$ It is a process that defines the retention values of the candidate sites or marital values of individual sites according to Equation (2) the following: -

$$\left.\begin{array}{ll} y1(n) = y(2n) & \text{Even Location} \\ \text{or} & \\ y1(n) = y(2n+1) & \text{Odd Location} \end{array}\right\} \qquad \ldots(2)$$

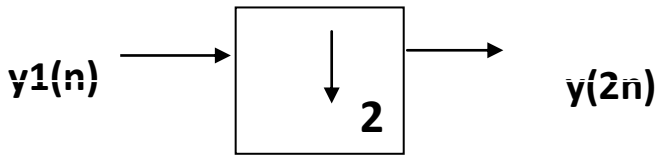
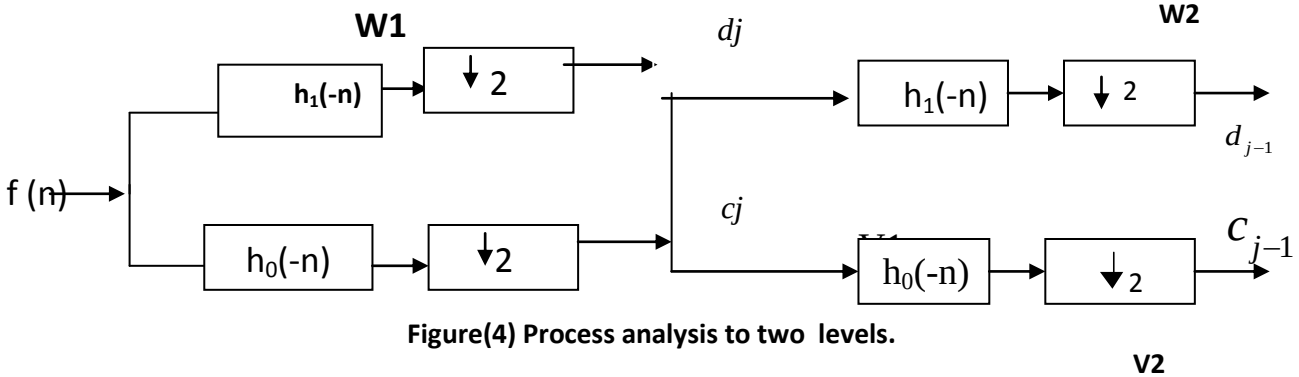


Figure (3) The process of fragmentation

As for the wavelet transform the process filters occur between th signal and of two types of filters. Represents the maximum number of levels that could be divided and he signal is $N=2^n$,N is represent length of the signal and (n +1) represents the number of levels, if the length is equal to the signal (128), the maximum number of levels is 8 such as $2^7 = 128$. Figure (4) the process analysis of two levels of analysis.



Figure(4) Process analysis to two levels.

Represent the dj, cj wavelet coefficients and scaling respectively. Related wavelet coefficients and scaling at the different levels of analysis, for example, related wavelet coefficients and scaling at the level (j) with the scaling coefficients at the level (j-1) by Equation (3) and Equation (4) the following: -

$$c_{j-1} = h0(2n-b)c_j \quad \text{...(3)}$$

$$d_{j-1} = h1(2n-b)c_j \quad \text{...(4)}$$

2. Filtering and Up-sampling

The application of the up-sampling process on the coefficients to purpose of recovery of the resulting function wavelet coefficients that have been obtained in the analysis phase by adding zeros between the samples according to Equation (7) the following: -

y (2n) = y1 (n) and y (2n +1) = 0 … (5)

The symbol for this process ↑ 2 . Figure (5) the process of recovery for the two phases.

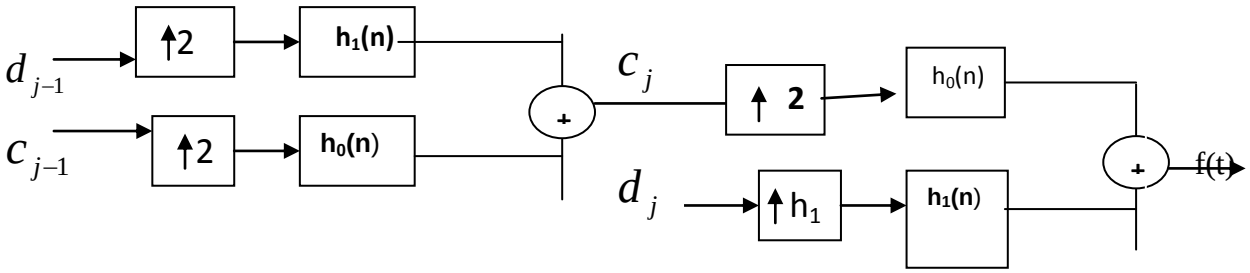


Figure (5) The process of recovery for the two phases.

The output of the process of wavelet fragmentation is as follows; Pack Low-Low (LL) which is to bring the image of the original, and the package of High-Low (HL) details Horizontal(H), but a package of Low-High (LH) represent the details of Vertical(V) , and the package of High - High (HH) is a country details Diagonal(D)[15,14]. Figure (6(a,b)) analysis of the image analysis using discrete wavelet transform to packages the four-level, one can also repeat the analysis of the image to more than one level, as shown in Figure(7).

	LOW	HIGH
LOW	Approximation	Detail Horizontal
HIGH	Detail Vertical	Detail Diagonal

Figure (6 (a)) signal analysis of the image using Discrete Wavelet Transform (DWT)

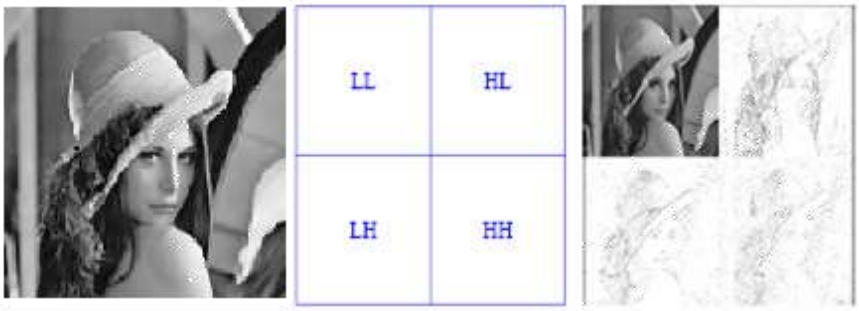


Figure (6 (b)) Shows the analysis of the image to the four packages.

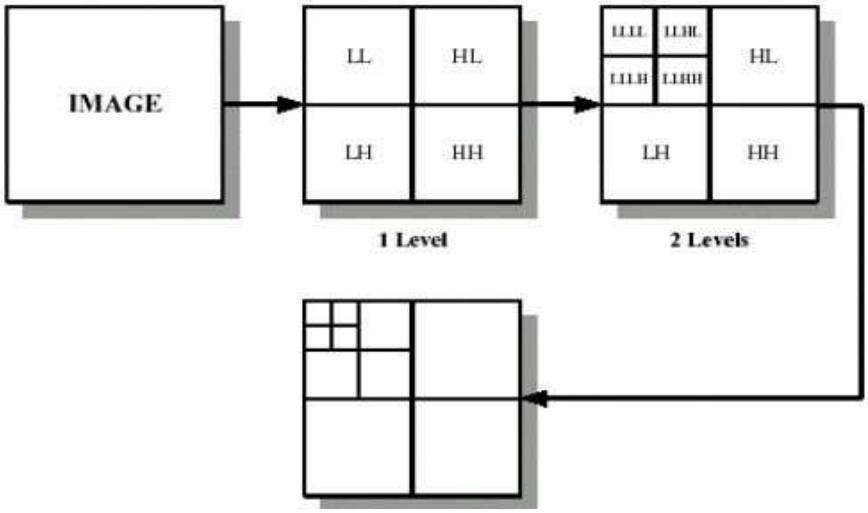


Figure (7) Shows the levels of analysis.

Image analysis are a number of partial packages , using the Haar Wavelet working to produce low frequency coefficients, which represent the approximation of the original image, this high frequency coefficients which represents the details, may be most of these coefficients are neglected values, so it can take advantage of the this feature to reduce the data rate (bit rate reduction) for representation of the signal image [16]. The high frequency packages the horizontal and vertical, diagonal in the first level of analysis to be of little significance for the human visual system (HVS), so the impact of the deletion of these packages would be marked for the eye. Diagonal the package of less importance than the horizontal and vertical packages so all could be deleted without a

significant impact on the quality of the retrieved images, as well as to give the highest compression ratio. Step is the compression at this stage is that it neglects coefficients the package the horizontal and vertical, diagonal removed because it does not affect the image, and this leads to increase the proportion of compression.

2.1.2 Scalar Quantization Stage

At this stage, using the scalar quantization, the quantization means to reduce the number of bits in the one-point using processes truncation or rounding. The process of quantization of the rates of energy no equal in the resulting coefficients from the discrete wavelet transform and the fact that the information contained in each factor in proportion to their capacity, so it must be given the highest levels of quantization with very high capacities (i.e. low-frequency (L)), and lower levels of quantization with high frequency, and this increase the number of zero- quantization , as quantization are reset less energy and is H, V, D. Part of this process is the waste of information which gives the ratio of compression. Equation (6) scalar quantization equation that
.is output is a limited set of integer values [16] .

$$(6)\ldots W^{Q}(u,v) = INT\left\{\frac{W(u,v)-Min}{Max-Min} * (2^{NB}-1)\right\}$$

Where as:
WQ (u, v): quantization output values,
W (u, v): the discrete wavelet transform coefficients.
Min: the smallest value in the input coefficients.
Max: the largest value in the input coefficients
NB: the number of bits the proposed quantization values.

The size of a gray image is the 8 bits, so the value of NB from 1 to 8, as the number of levels quantization that can be reference of these values is 2^{NB}, note that after the experience of all the values, it was observed diminution of the value of the NB with the increasing proportion of any increase compression distortion in the image at the expense of image quality, as in Figure (8).




original image	NB=8 bpp=0.9	NB=6 bpp=0.7	NB=2 bpp=0.1

Figure (8)Shows the effect of quantization at the level of image quality

2.1.3 Entropy Encoding Stage

Entropy encoding stage is used to represent the values of coefficients. The coding is a process to measure the statistical probability of each symbol in element image and then generate symbolic threads of this probability, since different algorithms are able to deal with these symbolic threads. Use at this stage to Run-Length Encoding (RLE), as follows [16]: -

2.1.3.1 Run Length Encoding (RLE)

This is the way the roads lossless of information, and is working through the expense of neighboring elements that have the same color value, called the chain length of the meter, or run-length. The neighboring elements in the image and with the same gray-level value, will be in the form of pairs (P, L), L represents the length of the continuation of P element in the row itself, where a number of less from bits, so because the length of coding sequence of coding elements of the same image repeated [17,18].

This method can clarify the following example: if we have a matrix of dimensions 8 × 8 and the number of levels equal to 16 colors with a (4 bit) to know as follows: -

$$\begin{bmatrix} 10 & 10 & 10 & 10 & 10 & 10 & 10 & 10 \\ 10 & 10 & 10 & 10 & 10 & 12 & 12 & 12 \\ 10 & 10 & 10 & 10 & 10 & 12 & 12 & 12 \\ 0 & 0 & 0 & 10 & 10 & 10 & 0 & 0 \\ 5 & 5 & 5 & 0 & 0 & 0 & 0 & 0 \\ 5 & 5 & 5 & 10 & 10 & 9 & 9 & 10 \\ 5 & 5 & 5 & 4 & 4 & 4 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Therefore, the compressed file will contain on the following values 10,13,12,3,10,5,12,3,0,3,10,3,0,2,5,3,0,5,5,3,10,2,9,2,10,1,5,3,4,3,0,10 the advantage of RLE being easy to apply and faster than the rest of species and efficient in the photographs, which contains large areas with the same gray level[15] .

2.2. Decompression

Entropy encoding stage after, which represents another stage in the process of the image and the compression to complete the process compression the full image. We will now decompress the archive stages of the image, reversing the sequence of action steps to be negative as follows: -

2.2.1 Decoder entropy stage

Which depend on the value of the counter and the value that preceded this, where we repeat this value the number of times the counter, and which from through her will get on the image before the coding, image after quantization.

2.2.2 Dequantization

Stage in the application of dequantization will get the image after the wavelet transform process get the image data transferred, not digital.

2.2.3 Inverse wavelet transform

At this stage is the application of the retrieval function transformation wavelet and therefore decompression the previous stage which this quantization stage to get to the

stage prior to the quantization phase and which the transform stage. After the completion of the previous step will get the original image, i.e. we have to decompress of the compressed image. Note that the phases of the decompress with the compression unlike the previous phases of any act towards the opposite direction to the original image file from any of the entropy encoding stage and then quantization and then transfer.

B- The Stage of the Hiding (The Hiding Method)

The main idea of this method is the compensation binaries the most important in the secret image (which we get after-compression phase) in the least where the amount of information the cover image, the importance of binaries in that is used in both images to be controlled through a threshold certain that determine the amount of binaries that can be her compensation in the cover
image, where the system can not human vision note any difference between the cover and the article hidden output. Will describe the process to include the threshold first, and how the system vision of human help in the process of inclusion to determine the threshold appropriate. Suppose that C represents the image of the cover of which the size of(Hc * Wc) assume that S is the secret image after compressed which the size (Hs * Ws) so that(Hs * Ws $\leq$ Hc * Wc). Each pixel Si$\in$ S (where the i = 1,2, ..., Hs * Ws) will be included within the pixel Ci $\in$ C (as i = 1,2,3, ..., Hc * Wc) ,
Since L represents the number of binaries LSBs least importance in the cover image and be her values position 3,4,5.

Where the threshold T is used to determine the number of binaries the most important (MSBs) in the secret image S, which could include inside the cover image C.

Embedding Algorithm

Step1 : Input: S_i , C_i

S_i is Secret image the application after compression algorithm. And then convert the resulting data from compression process to the binaries,
$S_i=\{s_1,s_2,\ldots\ldots\ldots s_n\}$

Let $S_1 = 169$ ➔ $(10101001)_2$.

C_i, is the cover image then convert the values of cover image to the binaries, image the C_i $=\{ c_1,c_2,\ldots..,c_n\}$, Let $C_1 = 198$➔$(11000110)_2$,

Step2 : determent value to L and T, such as ($L \in \{3, 4, 5\}$) LSBs of C_i are replaced by the L MSBs of S_i, Let L=3 and T is the threshold, Let T=8.

Step3 : Output: C'_i, $P_i \in \{0, 1, 2, 3\}$

Let $P_i = 3$;

while($|C_i - C'_i| \leq$T or $P_i = 0$)

{

Replace C_i's $L + P_i$ LSBs with $L + P_i$ MSBs of S

C'_i is pixel represent as follows: -

$$C'_i = \underbrace{c_{i_7} c_{i_6} \cdots \overbrace{s_{i_7} s_{i_6} \cdots s_{i_j}}^{L+P_i}}_{8};$$

$P_i = P_i - 1$;

}

Example:

Let $L = 3$, $T = 8$, $S_i = 169(10101001)_2$, $C_i = 198(11000110)_2$ The Algorithm EMB
can be illustrated as follows.
Round 1: ($P_i = 3$) $C'_i = 11\underline{101010}=234$,
$|234 - 198| = 36 > T$.
Round 2: ($P_i = 2$) $C'_i = 110\underline{10101}=213$,
$|213 – 198| = 15 > T$.
Round 3: ($P_i = 1$) $C'_i = 1100\underline{1010}=202$,

$|202 – 198| = 4 < T$. Output $C'_i = 202$ and $P_i = 1$.Stop Algorithm for byte i .

3. Test Results

Hiding the image in the technology of the secret image and the cover image are images that must be sure of re-retrieval, where the scale used often PSNR (peaks of the signal to noise) to calculate the difference between the original image and the reconstructed image ratio after the treatment process. Where it is known measure PSNR as follows:

$$\mathbf{PSNR} = \mathbf{10log}_{\mathbf{10}} \frac{255^2}{MSE} \quad \ldots(7)$$

Here 255 stands for the maximum value of each pixel and *MSE* (mean-square error) is defined as:

$$MSE = \left(\frac{1}{H \times W} \right) \sum_{i}^{H} \sum_{j}^{W} (x_{ij} - x'_{ij})^2 . \quad \ldots\ldots \quad \ldots(8)$$

Here *H* and *W* represent the image's height and width, respectively. Xij, Xij ' represents the value of the pixel in each of the original image and the reconstructed image recovered in rays i, j as the great value in PSNR means the difference be little between the original image and the reconstructed image ,، generally when the value of PSNR is greater than 30dB.this means that the reconstructed image is recovered acceptable. Technology to hide an image in spatial area is the proposed method where you use the compression technique of the image secret stage to reduce the amount data the secret image, as a method is used compensation LSBs of data in the lower level of the hide is secret image. Has been testing the system on a set of images, as shown in Figure (9).

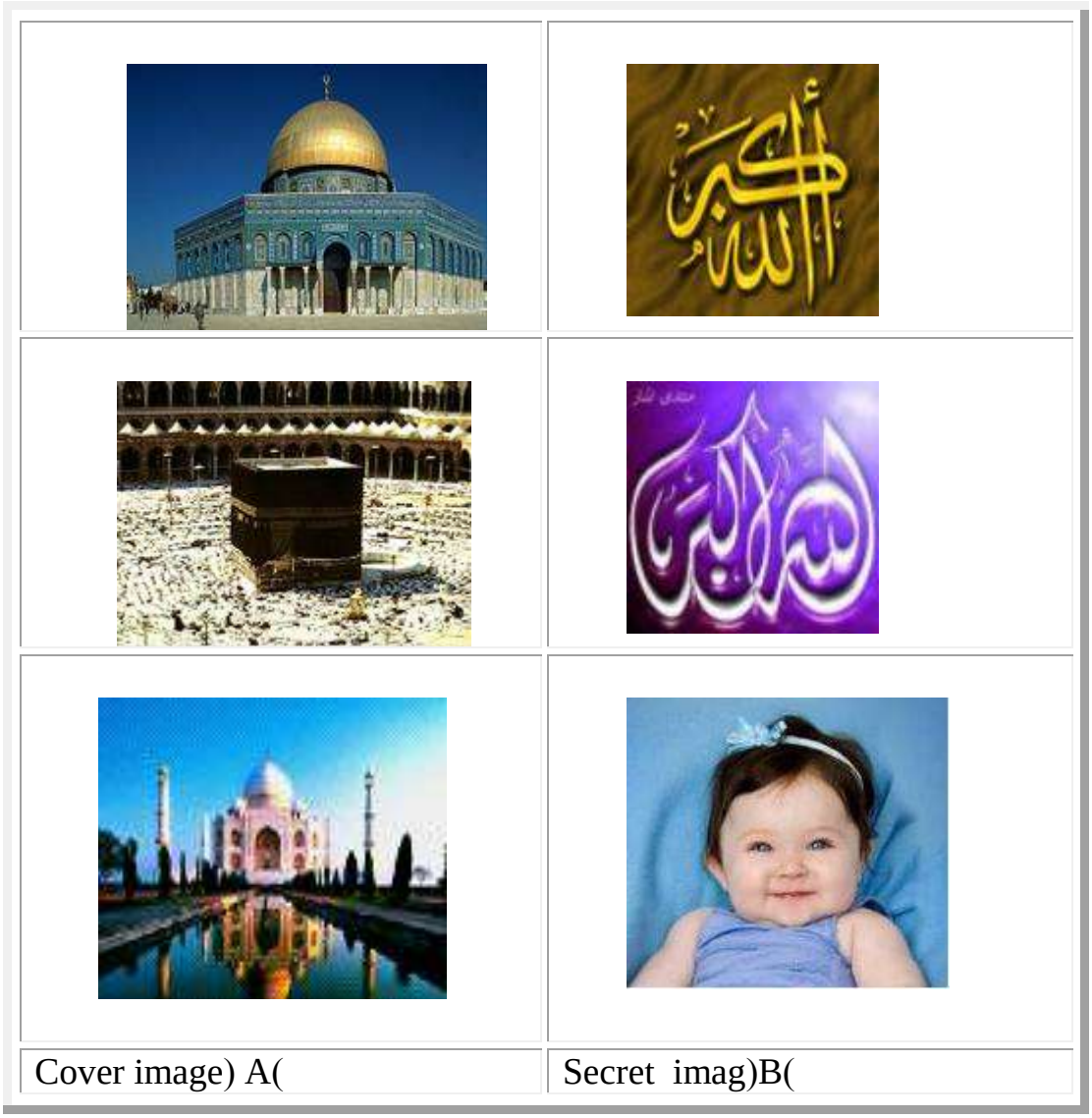
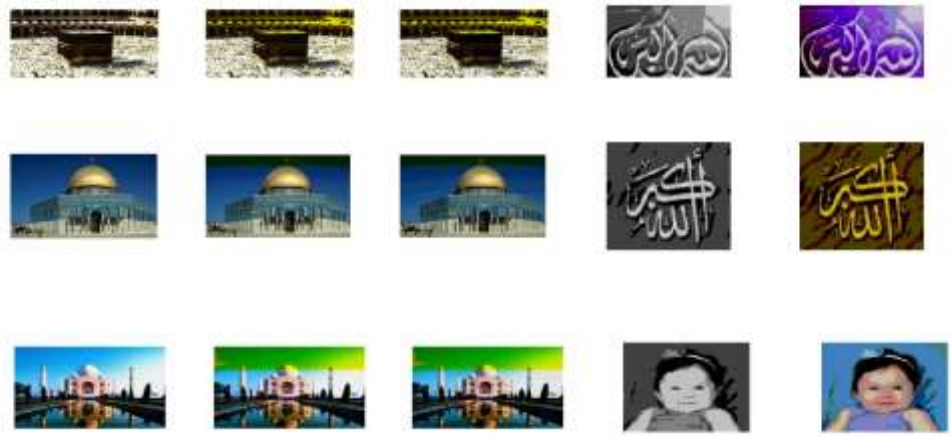


Figure (9)Test Images.

The first experiment was on the image "aqsaa" used the cover image of the size (83025)bytes and the image of "allahh" used the image of secrecy of (65536)bytes and then hold compression on it became the size (18516)bytes, explain Table (1)explain the results of experiments that were made to group the images. Figure (10) illustrates some of the stages of the system that are made on each of the image of the cover and is secret image.



(a) (b) (c) (d) (f)

Figure (10). (a) Cover image. (b) stego images. (c) Reconstructed cover image. (d) Reconstructed secret image. compression (f) Reconstructed secret image

Note of the Figure (10) that the difference between the original cover image and secret image is a little, as we have seen from the results that the reconstructed secret image is well.

Table (1) Shows the results of experiments that were made set from images.

Cover image	*Cover image size (Byte)*	*Secret image*	*Secret image size (Byte)*	*Secret image size after compression) (Byte)*	*PSNR Value of reconstructed stego image(dB)*	*PSNR value of reconstructed secret image (dB)*
Aqsaa	*83025*	*Allahh*	*49152*	*18516*	*35.76*	*33.79*
Maka	*72900*	*Alah*	*49152*	*23894*	*36.42*	*34.81*
Tajmahal	*37248*	*Baby*	*99450*	*10340*	*34.30*	*32.12*
Girll	*287868*	*Bird*	*294912*	*14250*	*36.04*	*37.91*

4. Conclusions

A spatial-domain image hiding technique is proposed in this paper. In the proposed scheme, the human visual system has helped the embedding process to determine a suitable number of LSBs to hide the secret image, and use compression techniques in their work to include specific targets to reduce the working area, including to get good image the objective of the use of hybridization techniques to improve the operation of the secret image in the area of the use of hybridization in order to obtain technical combines the advantages of high efficiency of useful integrated technologies. The difference between the original cover image and the stego-image is perceptually invisible. Moreover, the quality of the secret image is good enough as in the experimental results shown. In addition, this method has capability to embed two times the size of the secret image of previous work. Meanwhile, the extra table size is less, too. As for security, a partial encryption strategy has been introduced in this work.

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