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Long Messages Segmentation for Efficient Message Cryptography

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Abstract: Protecting LSB method of data steganography is a vital issue. In this paper research a secure LSB method will be introduced. The method will use a private key to divide a covering image into block and a secret block will be selected to apply message hiding and message extracting. The extracted message will be very sensitive the selected block size and the selected block number. The proposed method will simplify the hiding and extraction functions by using patch method, this simplification will increase the method efficiency. The proposed method will be tested for sensitivity, several images and several messages will be selected and the quality of the stego images will be examined.

Keywords: Steganography, covering image, stego image, PK, block, quality, sensitivity.

Introduction

Due to the increasing use of the global information network, the Internet, it has become difficult to protect this information, especially since it is in a form that arouses suspicion in the intruder [1-10]. As a result of imposing many restrictions to prevent the use of encryption across the network, this led to the emergence of another method in the field of data security development, which is the science of hiding information. Not only to prevent intruders from knowing the hidden information, but also to remove doubt about the existence of this information. The distinctive thing about the concealment technology is that it keeps pace with modern technologies and can be used in all computer media such as images, texts, audio, video and network packets [31-35].

The masking technique is one of the data security techniques, as it works to include information in a specific medium in a way that does not raise suspicion of the existence of a correspondence between two parties. In this research, an algorithm is proposed to secure the process of message steganography using a complicated private key (PK) [36-40].

The system of message steganography as shown in figure 1 contains: Secret message, covering color image, stego image, PK, hiding function and extracting function [55-59].

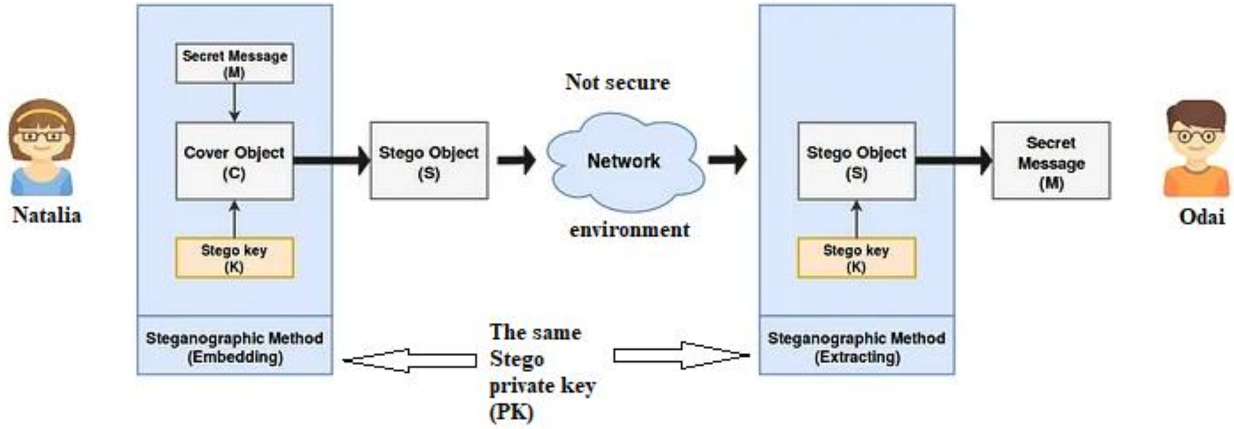


Figure 1: Steganography system

Many methods were introduced for message steganography, and many of these methods were based on least significant bit (LSB) method [12-20].

LSB method of data steganography is a simple method and it reserve the LSBs (see figure 2) of the covering bytes to hold a message, the stego byte will be very closed to the covering byte and the changes are within the range -1 to +1, these changes cannot be noticed by human eyes (see figure 3) [21-28].

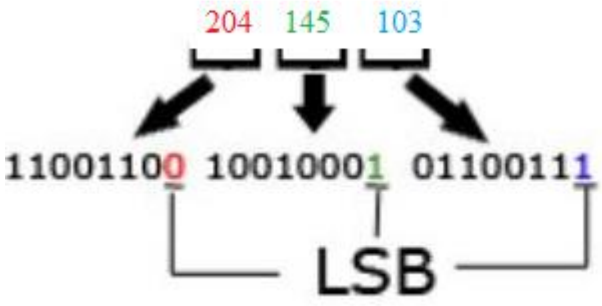
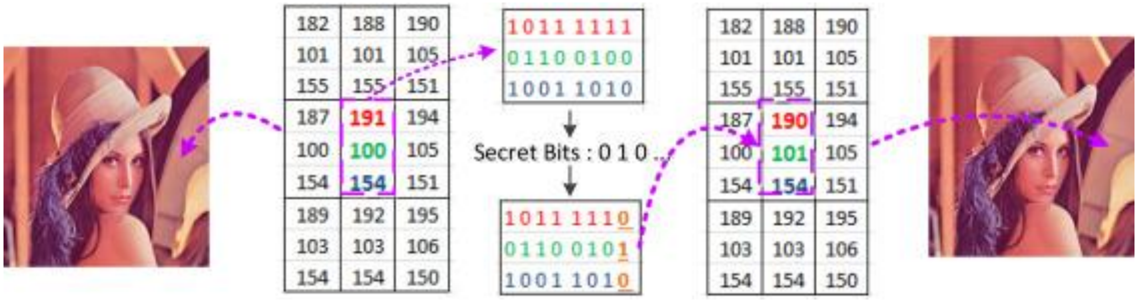


Figure 2: LSBs of the covering/stego bytes



182	188	190
101	101	105
155	155	151
187	191	194
100	100	105
154	154	151
189	192	195
103	103	106
154	154	150

182	188	190
101	101	105
155	155	151
187	190	194
100	101	105
154	154	151
189	192	195
103	103	106
154	154	150

Figure 3: Changes in the stego bytes

LSB method of data steganography has the following features (some of these features can be considered as disadvantages) [1-11]:

- Each message byte requires 8 bytes from the covering image, so the hiding capacity will equal the image size divided by 8 (max byte which can be hidden in the image), increasing the image size, and using a high resolution image will increase the hiding capacity.
- Message hiding/extracting stars from the first byte in the image, the hiding message can be easily hacked applying LSB extracting [40-48].
- The covering-stego bytes must be consecutive, first 8 bytes for the first character, second 8 bytes for the second character and so on (see figure 4), doing this will add extra operations which will increase the complicity of method programming [50-55].
- LSB method of data steganography is not secure, it is easy to hack the hidden message.
- The quality of the stego image is high, mean square error (MSE) between the covering and stego images is always low, while the PSNR (peak signal to noise ratio) between them is always high, so by eyes it is difficult to notice that the stego image is holding a secret message [49-59].

Digital color image (DCI) [21-30] is usually used as a covering image because of the following reasons:

- DCI is available and we can get it without any cost, and it is easy to store and retrieve it.
- DCI has a huge size, which allow us to hide long messages.
- Easy to process, DCI is represented by a 3D matrix as shown in figure 5, this matrix can be divided easily into blocks, and one or more blocks can be used to hide the secret message [11-20].

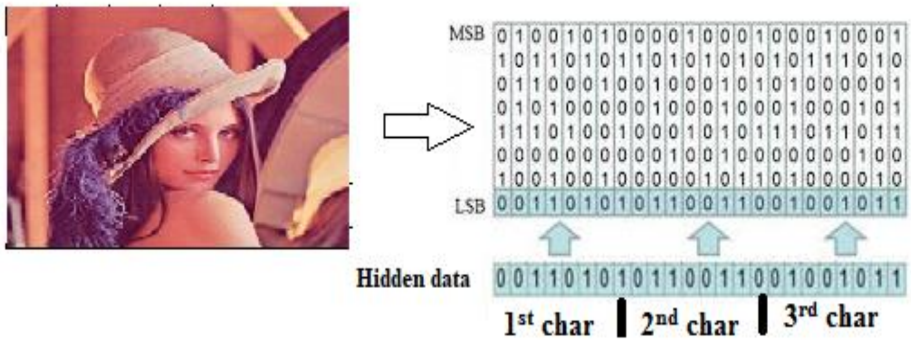


Figure 4: Consecutive bytes to hide a message

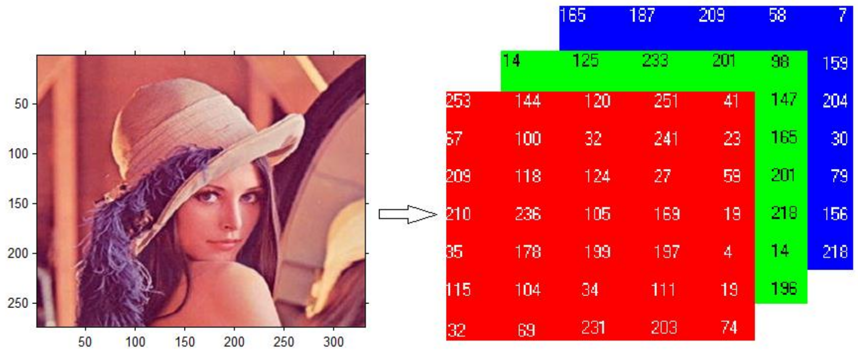


Figure 5: DCI 3D matrix

Proposed Method

The proposed method is based on LSB method of data steganography with an added feature. These features add a security to the LSB method and simplify the process of message hiding and extracting.

The proposed method uses a private key (PK), which contains two parameters p1 and p2, these parameters point to the fractions from the image rows and columns. Figures 6 and 7 show the source image and obtained blocks when p1=0.25 and p2=0.25.

The same private key must be used in the hiding and extracting phases, any changes in the PK in the extraction phase will lead to extract a damaged message.

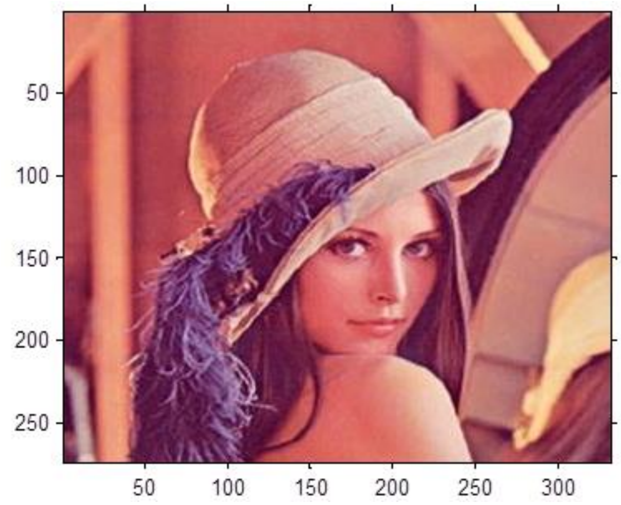


Figure 6: Source DCI

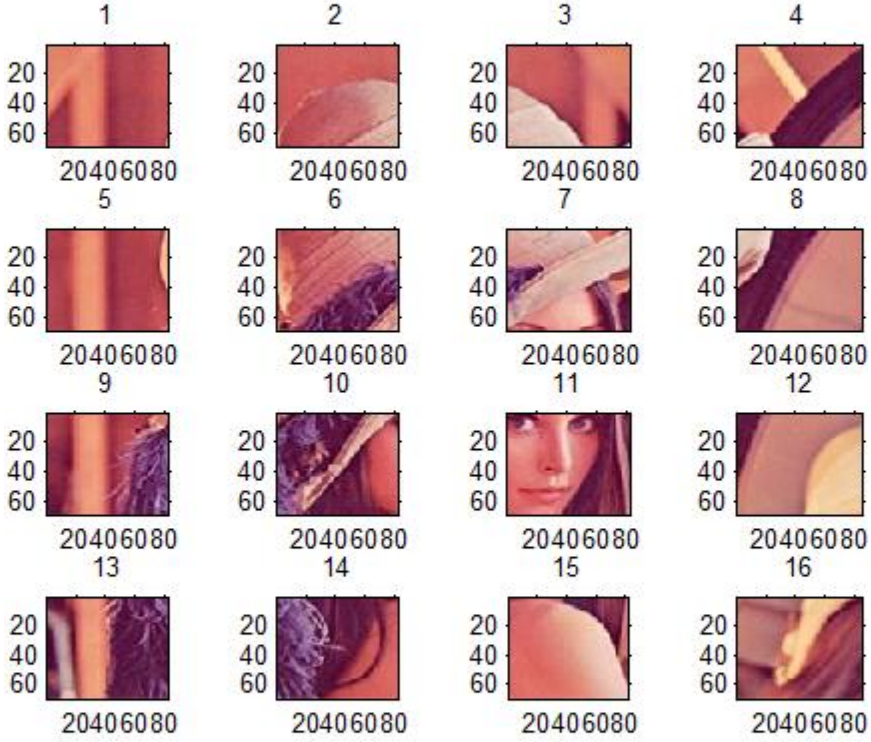


Figure 7: DCI blocks

The proposed method uses a patch method of data hiding/extracting. Instead of using consecutive bytes to hold a message byte the message is to be converted to decimal, the decimal version is to be converted to binary. The message binary matrix is to be reshaped to one column matrix and inserted into the LSBs of the covering bytes as shown in figure 8.

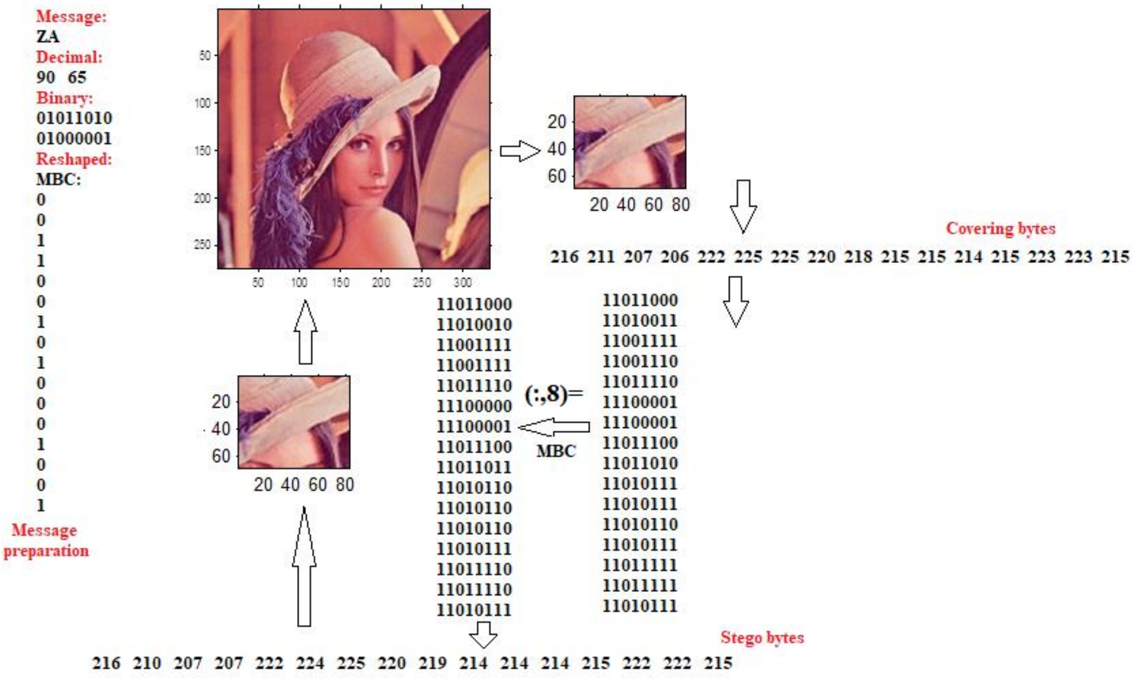


Figure 8: Proposed method data hiding example

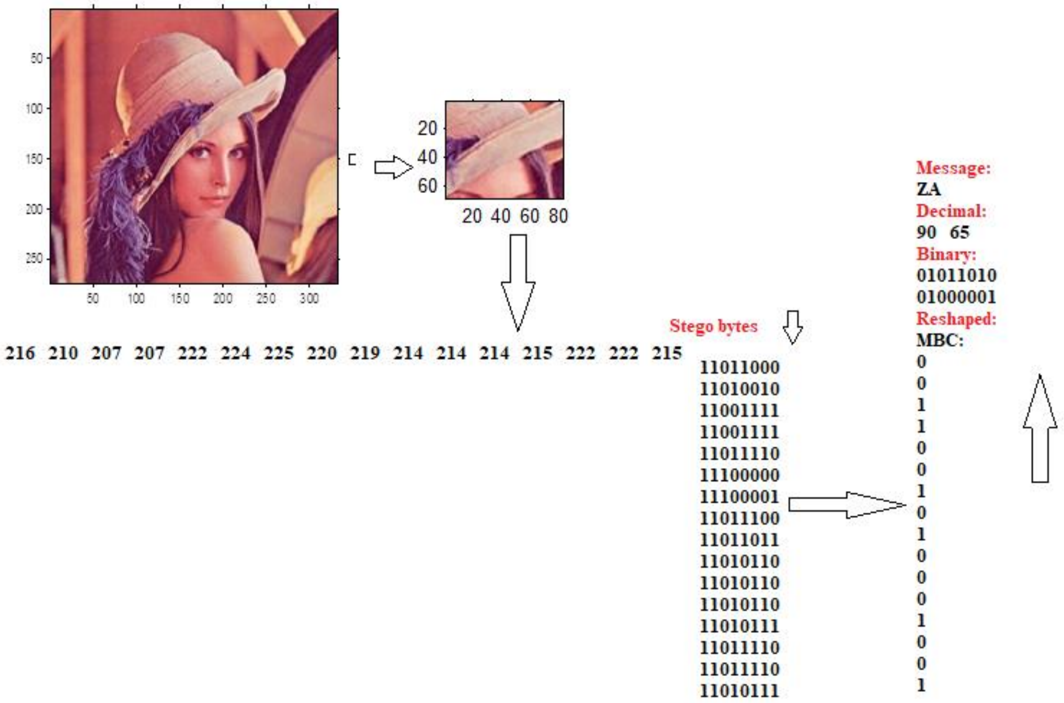
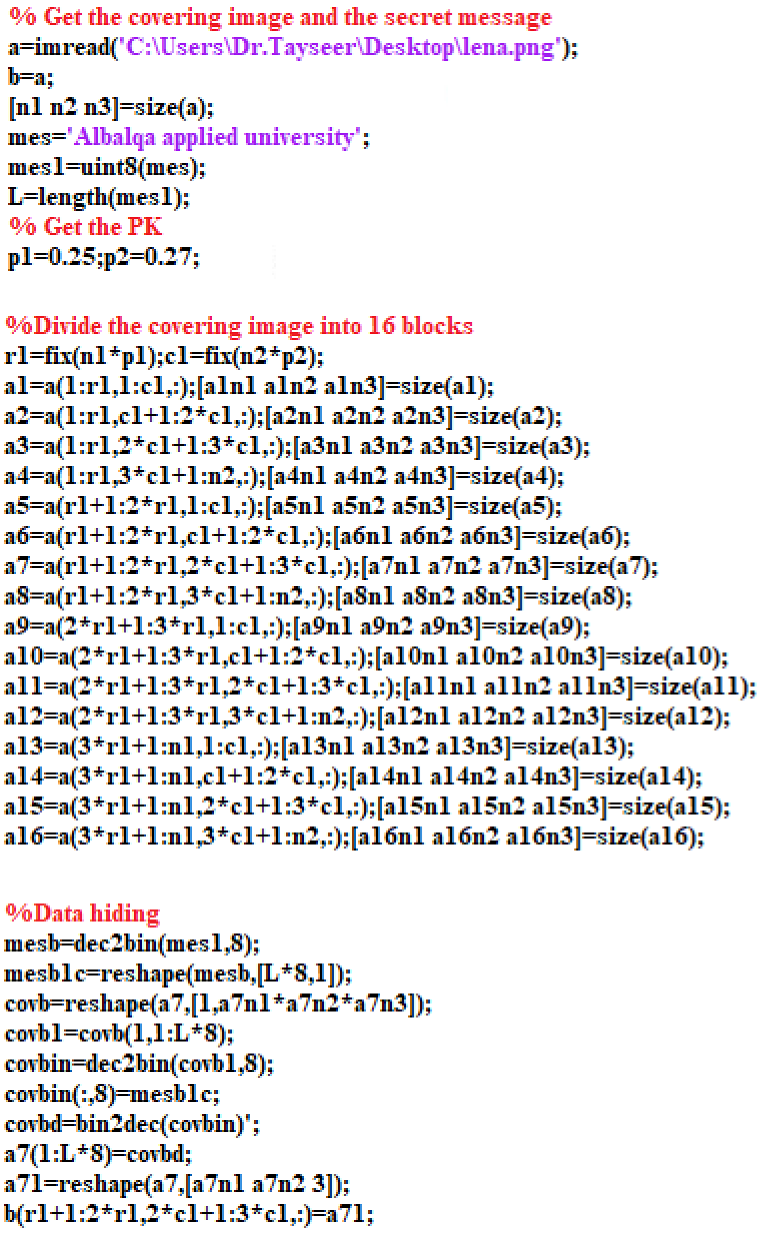


Figure 9: Proposed method data extracting example

The extracting process is to be implemented using patch method, this method can be implemented applying the following:

The covering bytes must be converted to binary, the LSBs must be extracted and the obtained one column matrix must be reshaped to 8 columns matrix to get the message binary matrix, this matrix must be converted to decimal then to characters to get the secret message. Figure 9 shows an example of data extracting.

Below is the mat lab code which can be used to hide/extract a secret message:



```
% Get the covering image and the secret message
a=imread('C:\Users\Dr.Tayseer\Desktop\lena.png');
b=a;
[n1 n2 n3]=size(a);
mes='Albalqa applied university';
mes1=uint8(mes);
L=length(mes1);
% Get the PK
p1=0.25;p2=0.27;

%Divide the covering image into 16 blocks
r1=fix(n1*p1);c1=fix(n2*p2);
a1=a(1:r1,1:c1,:);[a1n1 a1n2 a1n3]=size(a1);
a2=a(1:r1,c1+1:2*c1,:);[a2n1 a2n2 a2n3]=size(a2);
a3=a(1:r1,2*c1+1:3*c1,:);[a3n1 a3n2 a3n3]=size(a3);
a4=a(1:r1,3*c1+1:n2,:);[a4n1 a4n2 a4n3]=size(a4);
a5=a(r1+1:2*r1,1:c1,:);[a5n1 a5n2 a5n3]=size(a5);
a6=a(r1+1:2*r1,c1+1:2*c1,:);[a6n1 a6n2 a6n3]=size(a6);
a7=a(r1+1:2*r1,2*c1+1:3*c1,:);[a7n1 a7n2 a7n3]=size(a7);
a8=a(r1+1:2*r1,3*c1+1:n2,:);[a8n1 a8n2 a8n3]=size(a8);
a9=a(2*r1+1:3*r1,1:c1,:);[a9n1 a9n2 a9n3]=size(a9);
a10=a(2*r1+1:3*r1,c1+1:2*c1,:);[a10n1 a10n2 a10n3]=size(a10);
a11=a(2*r1+1:3*r1,2*c1+1:3*c1,:);[a11n1 a11n2 a11n3]=size(a11);
a12=a(2*r1+1:3*r1,3*c1+1:n2,:);[a12n1 a12n2 a12n3]=size(a12);
a13=a(3*r1+1:n1,1:c1,:);[a13n1 a13n2 a13n3]=size(a13);
a14=a(3*r1+1:n1,c1+1:2*c1,:);[a14n1 a14n2 a14n3]=size(a14);
a15=a(3*r1+1:n1,2*c1+1:3*c1,:);[a15n1 a15n2 a15n3]=size(a15);
a16=a(3*r1+1:n1,3*c1+1:n2,:);[a16n1 a16n2 a16n3]=size(a16);

%Data hiding
mesb=dec2bin(mes1,8);
mesb1c=reshape(mesb,[L*8,1]);
covb=reshape(a7,[1,a7n1*a7n2*a7n3]);
covb1=covb(1,1:L*8);
covbin=dec2bin(covb1,8);
covbin(:,8)=mesb1c;
covbd=bin2dec(covbin)';
a7(1:L*8)=covbd;
a71=reshape(a7,[a7n1 a7n2 3]);
b(r1+1:2*r1,2*c1+1:3*c1,:)=a71;
```

```
%Data extracting
a7r=reshape(a7,[1,a7n1*a7n2*a7n3]);
a7rs=a7r(1,1:L*8);
a7rsb=dec2bin(a7rs,8);
a72=a7rsb(:,8);
a74=reshape(a72,[L,8]);
a75=bin2dec(a74);
em=char(a75')
```

Implementation and Results Discussion

The proposed method was implemented using various images and various messages, figure 10 shows the selected images:

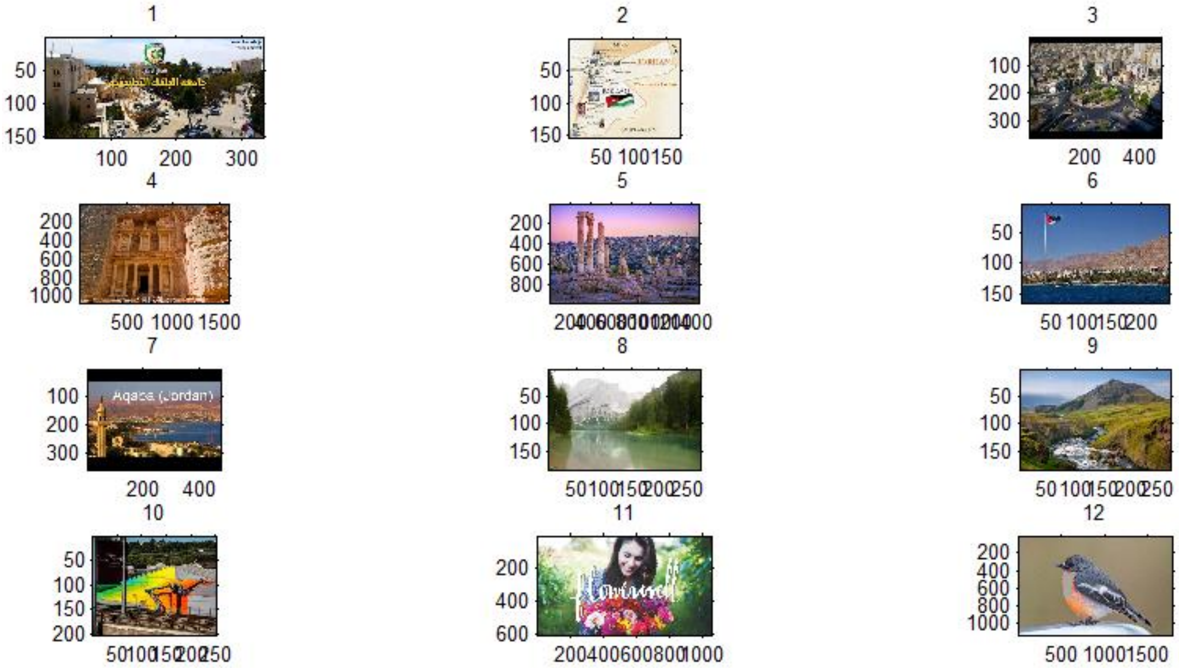
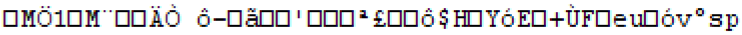


Figure 10: Selected covering DCI

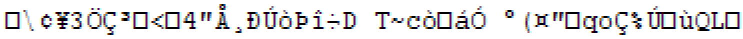
The proposed method is sensitive the selected PK, any changes in the PK during the extraction phase will lead to extract a damaged secret message, the message “Secure data steganography using image blocking’ was hidden using the PK: p1=0.25, p2=0.27 and extracted using p1=.03, p2=0.19.

The following rubbish was extracted:



```
□MÖ1□M¨□□ÄÒ ô-□ã□□'□□□ª£□□ô$H□YóE□+ÙF□eu□óv°sp
```

The extracting phase was implemented using the same PK but the block was changed to block 9, here also we obtained a damaged message:



```
□\¢¥3ÖÇ³□<□4"Å¸ĐŰòÞî÷D T~cò□áÓ °(¤"□qoÇ‰Ű□ùQL□
```

The quality of the stego image was tested, table 1 shows the obtained values of MSE and PSNR calculated between the covering and stego images after hiding a message of 46 characters:

Table 1: Quality parameters

Covering image	Size (byte)	MSE	PSNR
1	150849	0.0012	177.9163
2	77976	0.0024	171.0494
3	518400	0.00036073	190.0992
4	5140800	0.000036376	213.0414
5	4326210	0.000043225	211.3162
6	122265	0.0015	175.7612
7	518400	0.00034336	190.5925
8	150975	0.0012	177.7629
9	150975	0.0012	177.8704
10	151353	0.0012	177.8415
11	1890000	0.000095767	203.3612
12	6119256	0.000028598	215.4469

From table 1 it is shown that the quality for all stego images is acceptable, MSE decreased when increasing the image size and PSNR increased when increasing the image size.

Conclusion

A simple method of data steganography was introduced, the method simplified the process of message hiding and message extracting by using patch method, the binary message was hidden using one operation, and also the binary data extracting was also implemented using one operation. The proposed method protect the hidden message based on using a private key, the message was hidden in a selected secret block, which increased the security level of message protection. The hiding and extracting phases must use the same private key, any changes in the private key during the extraction phase was considered as a hacking attempt by producing a damaged message. The quality of the stego images was tested and it was shown that the proposed method provided a good quality image.

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