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LSB TECHNIQUE FOR IMAGE AND TEXT HIDING USING THE RED AND GREEN CHANNELS

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Abstract

Recently, Information hiding has an important role to protect data via the Internet from malicious attack, Steganography - which is the art of hiding data- uses a cover file to hide data by utilizing different schemas to prevent it from being detected. There are many different carrier file formats used to hid data, but digital images are the most popular because of their frequency on the Internet. This paper proposes an algorithm that hides a text file, a gray image, or both within a JPEG colored image by using a Least Significant Bits (LSB) steganography technique. This paper proposes a one tool to shrouds either a content record or a dark picture or both inside a JPEG shaded picture The algorithm makes use of each color channel separately where a gray picture will be concealed in the Red channel, while the content document will be covered up in the Green channel. It also uses the adjacent pixels in each channel for the process of hiding which results in fast process of both concealing and decoding the original content. This proposed algorithm has been implemented in MATLAB R2010a using basic image proceeding techniques. The system is then tested to see the viability of the proposed algorithm. Various sizes of data are stored inside the images. The Peak signal-to-noise ratio (PSNR) and the Mean Square error (MSE) are calculated for each of the tested images. The proposed algorithm was also compared to another similar algorithm and the results showed. The proposed algorithm scored higher PSNR and lower MSE.

Keywords: Least significant bits, Mean squared error, Peak signal-to-noise ratio, Steganography.

1. Introduction

The computerized transformation and transmission of interactive media has huge effect on all parts of human life. Computerized pictures are progressively transmitted over non-secure channels, for example, the Web. Thus, information security and information protection have turned out to be progressively critical as an ever-increasing number of frameworks are associated with the Web. Issues of information protection emphatically require in numerous fields like medicinal services records, money related exchange and establishment, criminal equity examination.

Security alludes to the honesty, secretly and accessibility of information. At the end of the day, it is every one of the procedures and practices expected to ensure that information will not be utilized or gotten to by unapproved people. Protection alludes to "the capacity of an individual (or association) to choose whether, when, and to whom individual (or authoritative) data is discharged. While security is worried about methods that control who may utilize or alter the PC frameworks or the data contained in it.

To guarantee protection and security, diverse procedures can be utilized. One understood method depends on concealing the information in a picture organization. In doing as such, three surely understood methods are used. These are watermarking, steganography and cryptography. Steganography is to conceal the mystery message inside a cover-question, utilized as a part of a lot of computerized information design. This term is a Greek word signifies "Secured Composing". Steganography comprises of three sections: secured picture, mystery message and stego-protest. Because of imperceptibility or concealed factor, it is hard to recoup data without known strategy in steganography. Least-Significant-Bit (LSB) is one basic strategy used to conceal information by straightforwardly supplanting LSBs of the cover picture specifically with message bits.

As to proposed calculation, the mystery information can be dark picture document, content record or both as per the client needs with a worthy estimation of Peak signal-to-noise ratio (PSNR). The cover picture is shaded image- JPEG-where the red channel is utilized to conceal the dim picture and the green channel is utilized to shroud the content information. A condition is utilized to determine the pixels' position used to stow away or remove the mystery information.

The paper is organized out as follows: section 2 will discuss Steganography and its diverse methods: 2.1 Cryptography and 2.2 LSB and Watermarking, related work is clarified in section 3, section 4 will discuss the proposed calculation, section 5 will discuss the examination of the outcomes, lastly section 6 will discuss conclusion and future work

2. Steganography and Cryptography

Steganography is originally extracted from the Greek words Steganós (Covered) and Graptos, (Writing) which actually stands for “cover writing” [1]. Steganography is the process of hiding communication. This means to hide messages existence in another medium such as image, audio or video etc. Nowadays, a steganography system uses multimedia objects to hold some hidden information for secret communication. Those multimedia objects will serve as cover media that are transmitted over email or share them through other internet communication

application. The main idea of steganography is not to protect the actual content of a message, but to hide some information into other information [2].

Steganography is generally of three categories, steganography in video [3], steganography in image, and steganography in audio. Steganography in text has recently been proposed [4]. In image steganography, which is the area of this paper, an image is used to hide the secret message. The image quality should not be noticeably changed. As for the text steganography, a text file is used as a carrier of the secret message without changing the text meaning.

Numerous applications make utilization of Steganography. Cases are: keen personality cards where individuals' subtle elements are embedded in their photos, and copyright control of materials. Different applications are video-sound synchronization, organizations' protected flow of mystery information, television broadcasting, TCP/IP bundles (for example a unique ID can be inserted into a picture to dissect the system movement of specific clients) [5], and furthermore checksum implanting [6]. It was additionally utilized as a part of Medicinal Imaging Frameworks as exhibited by Petitcolas [7]. Steganography would offer an astounding surety of confirmation that no other security device may affirm. Miaou et al. presented a LSB method for installing electronic patient records in view of bi-polar numerous base information concealing [8]. Different looks into likewise talked about patient information additionally examine quiet information implanting in computerized pictures [9, 10].

Hiding data is the process of embedding information into digital content without causing perceptual degradation [11]. In data hiding, three famous techniques can be used. They are watermarking, steganography and cryptography. The following subsections give a brief description of cryptography and watermarking.

Encryption or Cryptography is the train of writing in mystery code and is an old craftsmanship. The soonest utilization of cryptography goes back to 1900 B.C. at the point when an Egyptian recorder utilized non-standard symbolic representations in an engraving [12]. Cryptography secures the substance of messages while steganography shrouds the message into another medium. In Cryptography, middle of the road people can see the message (encoded) yet in Steganography they cannot. The fundamental objective of cryptography is to shield correspondences influencing the information to vary from its unique frame.

LSB and Watermarking

The simplest spatial domain steganography technique is the Least Significant Bit (LSB)-based steganography. It is one of techniques that hide a secret message in the LSBs of pixel values without introducing many noticeable distortions. The changes in the value of the LSB are invisible. There are two ways of inserting the message bits. The first is done sequentially and the second is randomly. Other spatial domain techniques include LSB replacement, LSB matching, Matrix embedding and Pixel value, and differencing. The main advantages of spatial domain LSB technique are: the degradation of the original image is minimal and more information can be stored in an image (more hiding capacity).

Watermarking and fingerprinting contrast from steganography in their application use as they are essentially utilized for licensed innovation insurance. Advanced watermarking is utilized to verify computerized information by installing a perpetual

advanced flag into this computerized date. The implanted computerized flag will be utilized later to affirm the legitimacy of the information. The watermark might be covered up in the host information and is a mark that expresses the responsibility for information with the end goal of copyright security. Be that as it may, in fingerprinting, every client will get unique and particular imprints implanted in his duplicate of the first work. Henceforth, it will be simple for the proprietor of unique work to track and discover such clients who damage their authorizing understanding when they illicitly transmit the property to different gatherings.

Both steganography and watermarking depict methods that are utilized to unnoticeably pass on data by implanting it into the cover-information. The principal productions that concentrated on watermarking of computerized pictures were distributed by [13-15].

3. Related Work

There are numerous strategies utilized for concealing mystery messages, and the most prominent procedure is LSB technique. Himanshu et al. [16] utilized 2/3 LSB to conceal a mystery picture in the cover picture, by utilizing 2/3 LSB, the measure of the mystery information will be lessened to the eighth of its size, about portion of the bits in the cover picture will be adjusted in this system, the measurements that are utilized for assessment are as per the following:

- MSE: Mean Square error that match between cover picture and setgo picture byte by byte.
- PSNR: Peak Signal to-noise ratio that figures the nature of stego picture contrasted with the cover picture and the higher the PSNR the better the quality is.
- BER: Bit E`rror rate that counts the number of bits position in the cover picture changed in the stego picture.

At last, they reason that utilizing 2/3 LSB had created great picture quality and basic memory get to

In this strategy [17], the secret information is scrambled before implanted in the cover picture keeping in mind the end goal to influence the procedure more to secure. RSA and Diffie Helman calculations are utilized for encryption, and by looking at the two calculations the outcomes demonstrate that the RSA calculation builds time multifaceted nature yet is more secured, while Diffie Helman calculation does not influence time many-sided quality.

Chi-Kwong and Cheng [18] utilized LSB system with optimal pixel alteration process (OPAP). They demonstrated that the WMSE most noticeably worst-mean-square-error-rate between the cover picture and the stego-picture happens when OPAP is utilized as a part of not as much as half as opposed to utilizing basic LS, and the nature of the setgo-picture enhanced without high computational multifaceted nature.

Using stegoanalysis tools increases the possibility of detecting secrets embedded in the cover image, so there must be different stegonography methods to prevent secret detection. Jain et al. [19] converted the secret message into binary value, they search for dark places in the grey image (black). Then each 8 pixels of these dark places are considered as a byte and used to hide the binary value of the characters of the secret message in low bit of each byte. The strong point in this

technique is using edge detection technique to find the dark places in the image, and specifically they used zero crossing detectors algorithm, to hide the message in pixels that are least like to their neighbours in order to be unnoticeable, which leads to a higher security level.

The issues of LSB method as outlined by Vyasl and Pal [20] are that the LSB influences the cover picture quality and furthermore can be effortlessly assaulted. With respect to the mystery message, it can be distinguished effortlessly. Therefore, to beat these issues, authors did a few changes in LSB. The results demonstrate that the technique utilized in [20] is more proficient and exact than the basic LSB strategy.

Kumar and Shrivastava [21] accomplished a superior PSNR, the stego-picture quality additionally enhanced with low computational unpredictability by applying new steganographic calculation for 8-bit and 24-bit picture. They conceal the most noteworthy piece of the mystery picture at all huge piece in the cover picture in view of a legitimate activity. Raghava et al. [22] utilized H'enon tumultuous guide as an encryption technique for the mystery picture and shroud it in the cover picture. This encryption method utilizes pseudo arbitrary generator, so the scrambled information cannot be decoded unless knowing definite irregular generator work, which prompts high security level. The last 4-bits in the cover picture are utilized to conceal the mystery picture in the wake of encoding it utilizing H'enon tumultuous guide.

Tavoli, et al. [23] proposed a technique that utilizes a phase of the literary information pressure and afterward coding it before steganography. In other words, it first applies a pre-processing system on the coveted content, and after that puts the content into the image. The proposed technique encodes the packed content and after that with the utilization of a 4*4 mask performs snake scan ordering. After that, it stacks the eventuated packed and coded message on image pixels

ChandraMouli et al. [24] combined stenography and encryption method to conceal the very existence of the embedded data. Their method supports the data hiding requirements of capacity, security and robustness as claimed by them. They used LSB in the stenography part of the data hiding. They developed a system using their methods but no testing or results were provided for the efficiency and effectiveness of their method.

Deepika and Mann [25] proposed a system that is based on cover-based technique that utilizes digital image as cover image and hides the secret message in a text file. Their system's main objective is to encode and decode the cover image using LSB (Least Significant Bit) and Random Improved LSB techniques. The proposed system consists of two components: Embedding module and Extracting module.

4. Proposed Algorithm

As specified before, steganography is the specialty of concealing information in a document inside another record. In this paper, we are discussing computerized steganography where documents might be content records, pictures or media records. In this paper, we propose an efficient method for Steganography that can be used to hide different types of media according to the user choice. The proposed method also makes use of each colour channel for specific media. Steganography has its own particular arrangement of phrasings. The principal term is mystery message, which denotes the concealed information, in the proposed calculation the

shrouded information, might be a content document, a dark picture or both. The second term is a cover record used to shroud the mystery message and in the proposed calculation, it is a shading picture document. The third term is the Stego document, which is the outcome record that contains the cover record, and the mystery message file(s). It merits saying that the shading picture which is the cover document can be part into three channels (Red, Green, and Blue) where everyone is a framework of a similar picture measure and the estimation of every pixel in it is between 0 - 255. The proposed algorithm will conceal a gray picture in the Red channel, while the content document will be covered up in the Green channel.

The procedure utilized as a part of the proposed algorithm is LSB and it has two segments, the initial segment is utilized to conceal picture as well as a content record, while the second part tries to separate the information from the Stego document. The principle ventures of the proposed algorithm are presented in Fig. 1.

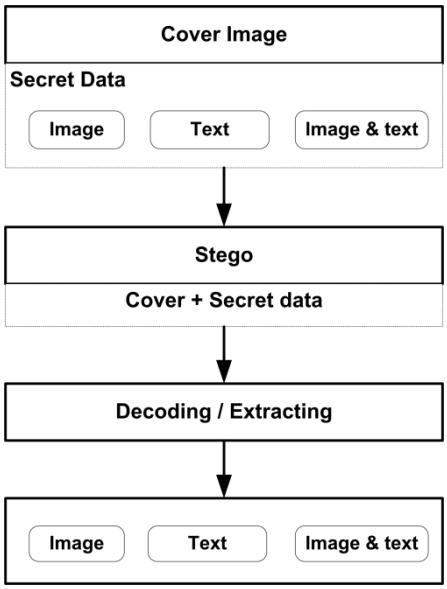

Fig. 1. Proposed algorithm framework.

The accompanying is the pseudo code of the proposed calculation, which is partitioned into six sections as appeared in Figs. 2(a) to (f).

For instance, in the event that we need to utilize the calculation appeared above to shroud a gray picture and a text, i.e., we have the main case - Flag = 1. We need to choose the cover picture, read it and split it into its three channels as appeared in Fig. 3.

Then, we have to read the secret message which is a gray image and a text file as can be seen in Fig. 4.

To begin concealing, a particular pixel ought to be picked in the red channel contingent upon the equation (ColVal = 2*SecCol + SecCol mod 10) then pick the two pixels (i.e. the upper left pixel and the bottom right pixel) as appeared in Fig. 5 to conceal the secret pixel.

```
Begin
        Read  the covered colored image
        Split it into its three channels(Red, Green, Blue)
        Get the Flag value
        If Flag = 1 then
                        Call Hide Image Function
                        Call Hide Text Function
        Elseif Flag = 2  then
                        Call Hide Image Function
        Elseif Flag = 3  then
                        Call Hide Text Function
        Else
                Print nothing to hide
        End if
End //Main function
```

(a)

```
Begin
        While more secret pixels found Do
        {
         Compute the position of a base pixel
         Specify the position of the first pixel to hide the 4-right
                most bits
         Set the 4-right most bits to zeros
         Substitute it with the 4-right most bits of secret pixel
          Specify the position of the second pixel to hide the 4-left
                most bits
         Set the 4-right most bits to zeros
         Substitute it with the 4-left most bits of secret pixel
        }
End   //Hide Image Function
```

(b)

```
Begin
        If PassedFlag = 1 then
                        Call Extract Secret Image
                        Call Extract Secret Text
        Elseif PassedFlag = 2 then
                        Call Extract Secret Image
        Elseif PassedFlag = 3 then
                        Call Extract Secret Text
End  // (Extract Part)
```

(c)

```
Begin
        While more secret character found Do
        {
        Compute the position of a base pixel
        Specify the position of the first pixel to hide the 4-right most bits
        Set the 4-right most bits to zeros
        Substitute it with the 4-right most bits of secret character
        Specify the position of the second pixel to hide the 4-left most bits
        Set the 4-right most bits to zeros
        Substitute it with the 4-left most bits of secret character
        }
End   //Hide Text Function
```

(d)

```
Begin
        While Not All secret pixels Extracted Do
        {
        Compute the position of a base pixel
        Specify the position of the first pixel to Extract the 4-right most bits
        Extract the 4-right most bits to zeros
        Specify the position of the second pixel to Extract the 4-left most bits
        Extract the 4-right most bits to zeros
        Concatenate the 8-bit extracted together
        }
End   //Extract Image Function
```

(e)

```
Begin
        While Not All secret character Extracted Do
        {
        Compute the position of a base pixel
        Specify the position of the first pixel to Extract the 4-right most bits
        Extract the 4-right most bits
        Specify the position of the second pixel to Extract the 4-left most bits
        Extract the 4-right most bits
        Concatenate the 8-bit extracted together
        }
End   //Hide Text Function
```

(f)

Fig. 2. The pseudo code of the proposed framework functions: (a) Main (hide part), (b) Hide image, (c) Main (extract part), (d) Hide text, (e) Extract image, (f) Extract text.

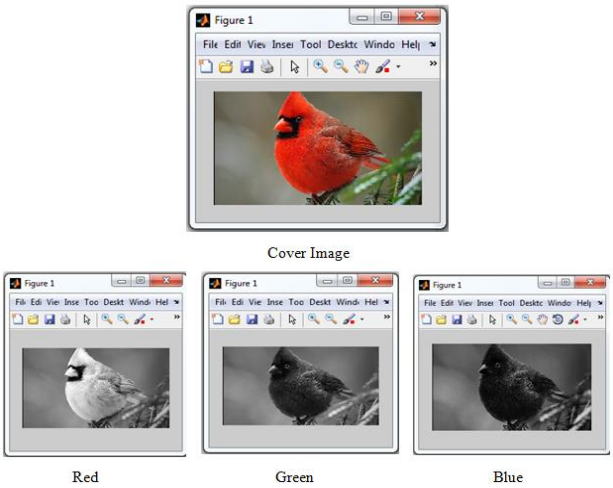

Fig. 3. Colored image 3 channels (Red, Green, Blue).

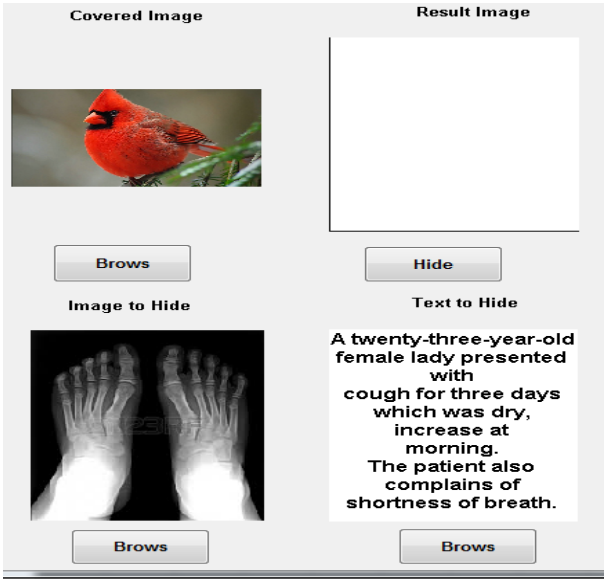

Fig. 4. Project Interface with two secret files (Gray image and Text).

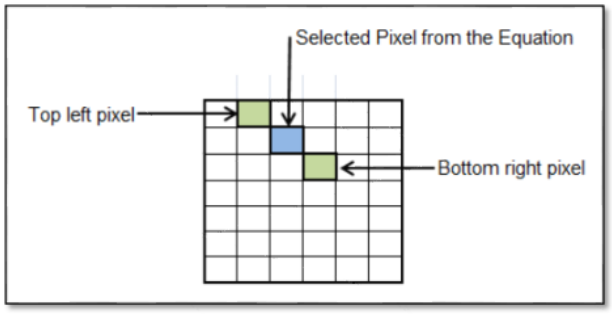

Fig. 5. Two pixels selected to hide the gray image.

Assume the chose pixel value is 20 and the values of the upper left pixel and the bottom right pixel are 5, 4 separately. The new esteems for the two pixels in the wake of concealing information will be as appeared in Fig. 6.

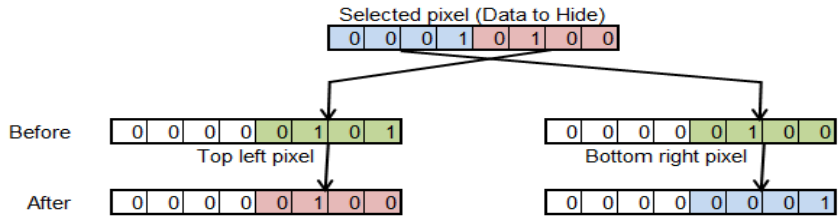

Fig. 6. Two pixels value before and after hiding data.

To conceal the text file, initially a pixel is chosen, and afterward the two pixels (i.e. bottom left pixel and upper right pixel) will be utilized to conceal information as appeared in Fig. 7.

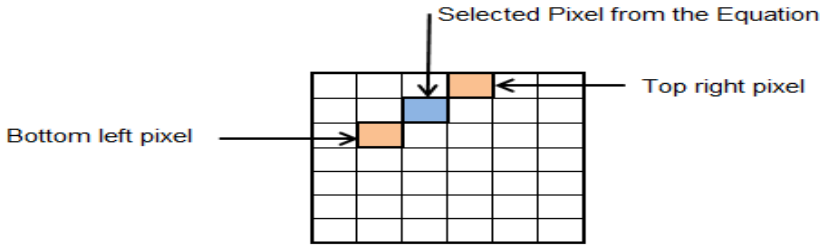

Fig. 7. Two pixels selected to hide text file.

Assume that the first character to cover up is 'A', and the substance of the two pixels in the Green channel is 5 and 6 separately as appeared in Fig. 8.

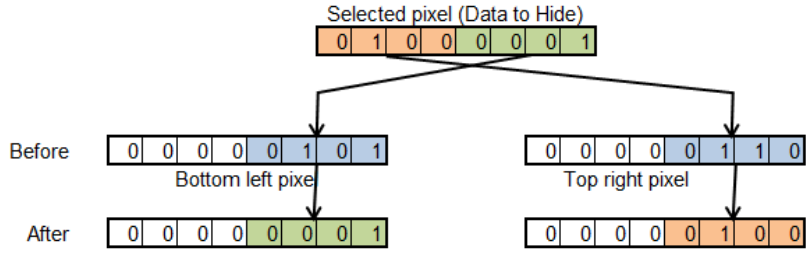

Fig. 8. Two pixels values before and after hiding text.

Subsequent to concealing all picture pixels and text pixels the outcome will be as appeared in Fig. 9.

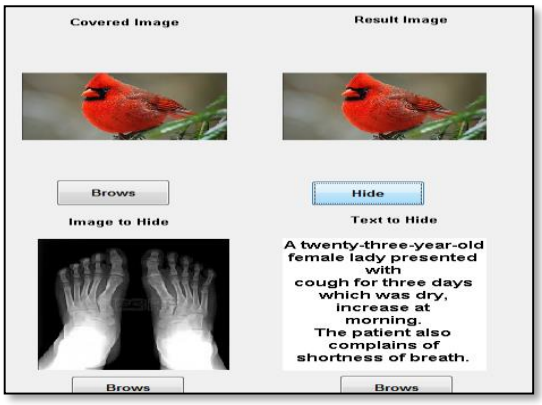

Fig. 9. Project interface after hiding gray image and text.

5. Results and Discussion

In the wake of actualizing the proposed calculation on an accumulation of pictures and messages, the outcome is tried utilizing the PSNR (Peak signal-to-noise ratio) as in Eq. (1). PSNR is a standard estimation utilized as a part of steganograpy strategy so as to test the nature of the stego pictures. The higher the estimation of PSNR, the greater quality the stego picture will have.

$$PSNR = 10.\log 10\left(\max_i 2 \left| MSE\right.\right) \quad (1)$$

The Mean Squared Error (MSE) is computed by performing byte by byte comparisons of the cover image and the stego-image as shown in Eq. (2).

$$\text{MSE}= \frac{1}{mn} \sum_{i=0}^{m-1} \sum_{i=0}^{n-1} [I(i,j) - K(i,j)]^2 \quad (2)$$

Table 1. demonstrates the outcome; we need to specify that we actualize a similar mystery picture and content on various cover pictures.

As shown in Table 1, the estimation of PSNR expanded when the measure of the cover picture diminished; the estimations of PSNR are inside adequate range, which is between 30 db-50 db for picture and video [https://en.wikipedia.org/wiki/Peak_signal-to-noise_ratio]. Even after adding noise (salt & pepper with noise ratio 0.002) to an image hiding both secret text and secret image

A similar simulation is conducted that uses the same data as in Table 1. However, different cover images were used that are divided into two types according to their sizes: small sizes and larger sizes. The results obtained are shown in Table 2. As can be seen from Table 2, the MSE and PSNR results for the small images and the larger ones are considerably close.

Also in this simulation, we tried different hidden data from various sizes and we found that there is no limit for the minimum hidden data. The maximum hidden data the proposed algorithm can handle must be less that the cover image.

The proposed algorithm was also compared with the algorithm developed by Tavoli et al. [23] and the traditional LSB algorithm. The measures used are the MSE and PSNR. The data used in the evaluation process consists of four images used by the previous researches as indicated in [23] and shown in Fig. 10.

Table 1. PSNR and MSE evaluation results.

Cover Image	Secret Image	Secret Text	Both Image & Text	Adding a noise to a cover image hiding the secret text and secret image
	 Size 5.09 KB 207 x 243	A twenty-three-year-old female lady presented with cough for three days which was dry, increase at morning. The patient also complains of shortness of breath. Size 1 kB		

	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR
 Size 260 KB 1920×1080	5.5055	40.7568	4.6711	41.4706	5.5092	40.7563	3.9046	42.2151
 Size 267Kb 1600×1200	3.3460	42.9196	2.8809	43.5695	3.3465	42.9189	3.9609	42.1529
 Size 221KB 1950×1270	1.7823	45.6549	1.0337	48.0210	1.7832	45.6528	5.0230	41.1212
 Size 185 1920×1200	2.2888	44.5687	1.5332	46.3089	2.2894	44.5675	4.2361	41.8611

Table 2. PSNR and MSE evaluation results for different cover images' sizes.

	Secret Image	**Secret Text**	**Both Image & Text**
Cover Image	 Size 5.09 KB 207 x 243	A twenty-three-year-old female lady presented with cough for three days which was dry, increase at morning. The patient also complains of shortness of breath.	

	Size 1 KB					
	MSE	**PSNR**	**MSE**	**PSNR**	**MSE**	**PSNR**
Small images	1.8543 to 5.6821	37.6219 to 41.8923	2.7686 to 4.4595	41.563 to 43.796	1.9342 to 3.4995	40.551 to 42.268
Larger images	3.4862 to 4.7895	40.3498 to 44.2315	2.1782 to 5.41765	39.734 to 42.173	2.4486 to 5.5327	41.133 to 45.895

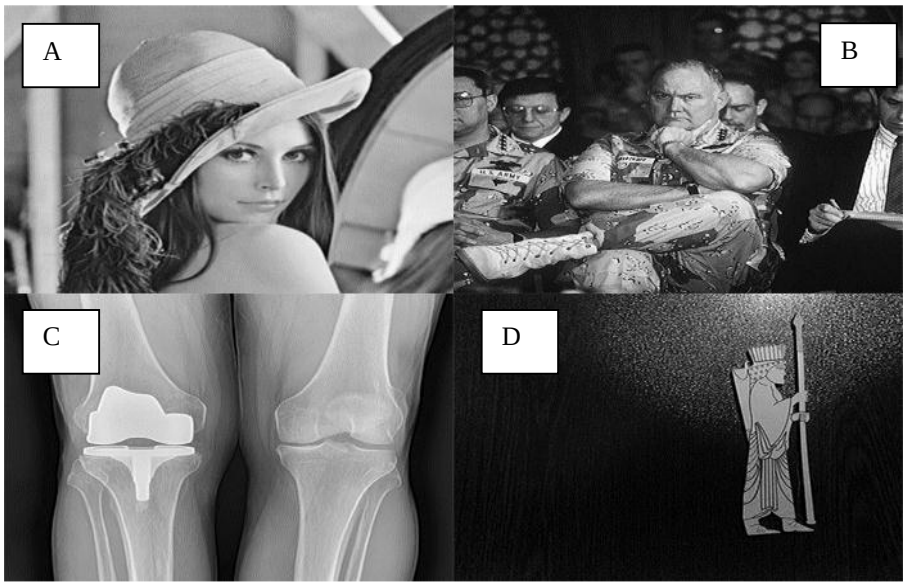

Fig. 10. The Four used pictures in evaluation.

Table 3 summarizes the results obtained for the comparison where the proposed algorithm scored better. The proposed algorithm scored the higher PSNR followed

by Tavoli et al. algorithm and the last score for the traditional LSB. As for the MSE, the proposed measure scored the lowest followed by Tavoli et al. algorithm followed by the traditional LSB algorithm.

Table 3. Summary of comparison results between the Proposed, Tavoli et al. and the Traditional LSB algorithms.

Image	Traditional LSB		Tavoli et al.		Proposed Algorithm	
	MSE	**PSNR**	**MSE**	**PSNR**	**MSE**	**PSNR**
A	37.63	32.27	0.273	54.41	0.251	55.28
B	113.03	27.59	0.271	57.76	0.224	58.33
C	52.59	30.92	0.275	54.65	0.255	57.67
D	50.54	31.09	0.274	54.40	0.258	57.19

6. Conclusions

A proposed Steganography algorithm was exhibited, executed and dissected in this paper. The proposed strategy has the ability to hiding the mystery message in pixels as indicated by an equation which pick a position at that point concurring on this position another two pixels are characterized, which make it hard to distinguish the pixels used to shroud the information. It also enables the client to choose the kind of mystery information either a picture, text or both. When the proposed algorithm is utilized to stow away both picture and text then extraordinary pixels in various channels - red and green - are utilized to conceal the information to have pixels just influenced by one sort of shrouded information. The algorithm can also hide the text content alone or a picture alone or both. It utilizes the adjacent pixels in each channel, which result in fast process of both hiding and extracting the original content.

The proposed algorithm can be used to hide different types of media according to the user choice. The proposed method also makes use of each color channel for specific media. The algorithm utilizes only the red and green channels to shroud information, so in the future we will examine the ability to utilize the blue channels if the extent of the mystery information ended up noticeably greater.

The proposed algorithm was evaluated in different cases and in all cases, it proved superiorly to other previous techniques and performed well for different images sizes.

As future work, the algorithm needs to be evaluated with more data and the results to be compared with more algorithms that are similar.

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Abbreviations

BER	Bit Error rate
LSB	Least Significant Bits
MSE	Mean Squared Error
OPAP	Optimal Pixel Adjustment Process
PSNR	Peak signal-to-noise ratio
WMSE	Worst-Mean-Square-Error

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