Hiding of Image using N-Queen Solution Matrix and DNA Sticker

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Abstract
This paper presents a technique of staganography where hiding of secret image done by LSB substitution and N-Queen matrix act as key. Key used to indicate pixel position of Cover image where substitution will take place.Memomy complex (Memory strand and DNA stickers) used to represent N-Queen matrix so that key isn't understandable to unauthorized user. Size of N-Queen matrix relate with no. of bits in Secret Image. To make N-Queen matrix reasonable size, Secret image embed after compression.

Key words
DNA, Secret Image, Cover Image, N-Queen, Sticker, and Memory strand

INTRODUCTION

Steganography or Stego, as it is often referred to in the IT community, literally means, "Covered Writing" which is derived from the Greek language. Steganography is defined by Markus Kahn [1] as follows, "Steganography is the art and science of communicating in a way which hides the existence of the communication.

The eight queens is a well known NP-complete problem proposed by C. F. Gaus in 1850 [Wirth (1976)]. The Problem was investigated by several 19-th century mathematicians.

The characteristic property of this problem is that it requires large amount of computations. The general N-Queen problem was explored in 1950's by Yaglom and Yaglom [Yaglom and Yaglom (1964)]. A general N-Queen problem is defined by the following constraints on an *N*N* grid and it is shown in Figure 1.

			Q				
						Q	
		Q					
							Q
	Q						
				Q			
Q							
					Q		

Figure 1 8×8 NQ matrix

The constraints are as follows:

No two Queens attack each other. In other words it means that:

1. Only one queen can be placed in any row.
2. Only one queen can be placed in any column.
3. Only one queen can be placed on any diagonal.
4. Exactly *N* queens must be placed on the grid.
5. No two Queens shall be placed in the adjacent position.

There have been several approaches taken in the study of this problem (as diverse as algorithmic design, program development, parallel and distributed computing, and artificial intelligence). This widespread interest in the N-Queen problem is in part due to the property that characterizes difficult problems, viz., satisfying a set of global constraints [2].

The sticker model has a random access memory. The memory of the sticker model consists of memory complexes. A memory complex is a DNA strand that is partially double, and can be viewed as an encoding of a binary number (e.g. Figure 2, double strands represent 1, and single strands represent 0). Each memory complex is formed with two basic types of single stranded DNA molecules referred to as memory strands and sticker strands. A memory strand is a single stranded DNA molecule of *l* bases; a memory strand is a single stranded DNA molecule consisting of *l* bases in length.

A memory strand contains *n* no overlapping substrands, each of which is *m* bases long. Let $l = mn$. For example, here is a memory strand for $m = 5$ and $n = 6$:

5' AAAAA TTTCC GGGGG TAGAT TTTTT CCCCC 3'

Each sticker strand is *m* bases long, here are three sticker strands for $m = 5$:

3'TTTTT5', 3'AAAGG5', 3'CCCCC5'

We require that each sticker strand is complementary to exactly one of the *n* substrands in a memory strand. Each substrand of a memory strand will be identified with one bit position. If a sticker strand is annealed to its matched substrand on a memory strand, the particular substrand is on; otherwise, it is off. In summary, memory complexes represent binary numbers, where a substrand being on represents bit 1 and a substrand being off represents bit 0. Here is an example of four memory complexes:

Figure 2 Denoted four-memory complex of binary digits

Their coding has five bits, the encoded five bit words are 00000, 10100, 11011, and 11111, respectively. A (*K*, *L*) library is a set, it contains strings of length *K* generated by taking the set of all possible bit strings of length *L* followed by *K*-*L* zeros. There are thus 2*L* length *K* strings in the set. For example, the (5, 3) library set is the set {00000, 00100, 01000, 01100, 10000, 10100, 11000, and 11100}. [3]

The objective of this paper is to develop a method of staganography in which key is used to select embed position .We used very common embedding procedure LSB but key generation using NQ-matrix .Uniqueness of this procedure is the key generation and hiding .Hiding is done by DNA sequence in the form of memory complex.

The remainder of the paper is organized as follows. In Section 2 described related works, In Section 3, the description of the proposed steganography in flow diagram is presented. In Section 4, the description of the proposed steganography algorithms is presented. In Section 5, presents the experimental results .In Section 6,conclution.

2. RELATED WORKS

Least Significant Bit Insertion

One of the most common techniques used in steganography today is called least significant bit (LSB) insertion. This method is exactly what it sounds like; the least significant bits of the cover-image are altered so that they form the embedded information. The following example shows how the letter A can be hidden in the first eight bytes of three pixels in a 24-bit image.

Pixels: (00100111 11101001 11001000)
(00100111 11001000 11101001)
(11001000 00100111 11101001)
A: 01000001
Result: (00100110 11101001 11001000)
(00100110 11001000 11101000)
(11001000 00100111 11101001)

The three underlined bits are the only three bits that were actually altered. LSB insertion requires on average that only half the bits in an image be changed. Since the 8-bit letter A only requires eight bytes to hide it in, the ninth byte of the three pixels can be used to begin hiding the next character of the hidden message. A slight variation of this technique allows for embedding the message in two or more of the least significant bits per byte. This increases the hidden information capacity of the cover-object, but the cover-object is degraded more, and therefore it is more detectable. Other variations on this technique include ensuring that statistical changes in the image do not occur. Some intelligent software also checks for areas that are made up of one solid color. Changes in these pixels are then avoided because slight changes would cause noticeable variations in the area [4, 5]

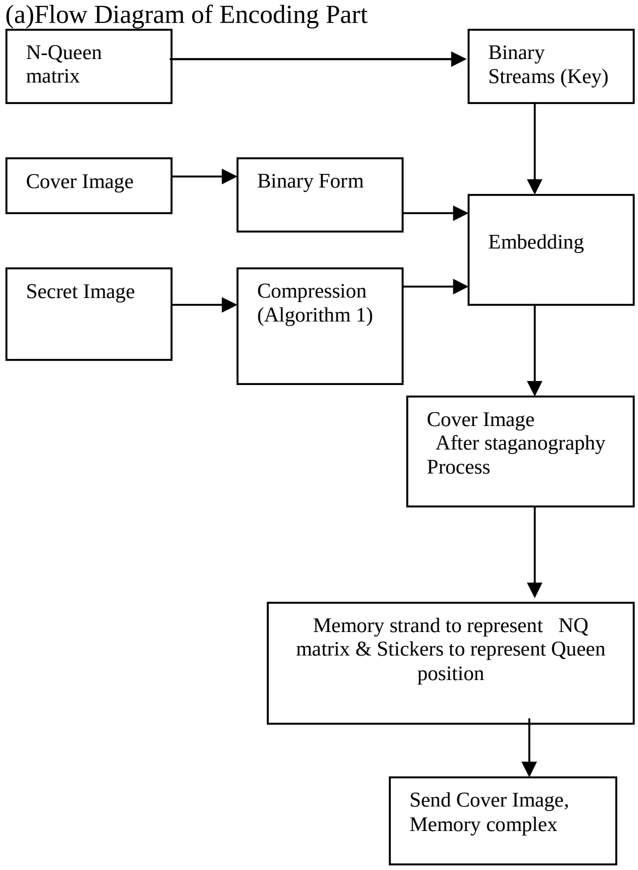
While LSB insertion is easy to implement, it is also easily attacked. Slight modifications in the color palette and simple image manipulations will destroy the entire hidden message. Some examples of these simple image manipulations include image resizing and cropping [6, 7].

Image Compression Algorithm (Algorithm-1)

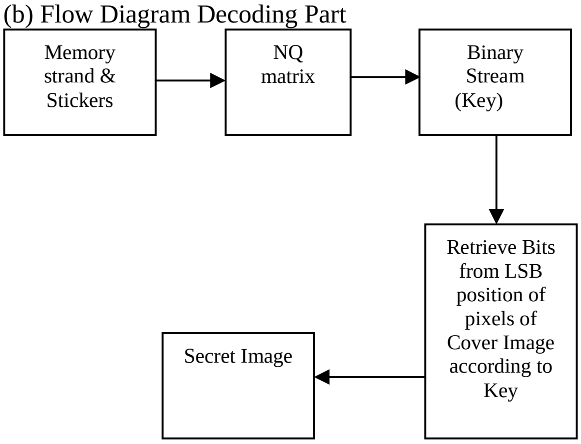
Step 1. Choose an arbitrary mRNA sequence for binary sequence of an image.
Step 2. Convert mRNA sequence into amino acid sequence.
Step 3. Use Arithmetic encoding. Arithmetic encoding will convert amino acid sequence into an interval of real numbers between 0 and 1.
Step 4. Get the corresponding binary form [8].

3. FLOW DIAGRAM OF PROPOSE METHOD

(a)Flow Diagram of Encoding Part



(b) Flow Diagram Decoding Part



4. Algorithms

Encoding Algorithm

Step 1: Compress the Secret image.

Step 2: Take a solve NQ matrix, size equal to no. of bits in Secret Image after compression.

Step 3: Represent NQ matrix row wise in binary form, 1 for Queen Position and 0 for blank room. For example binary stream for figure-1 matrix 1st row is 00010000.So, 1st row value is 16.

Step 4: LSB substitution (Pixel positions will indicate by NQ matrix row values).

Step 5: Convert the NQ matrix in memory strand and Queen positions by stickers.

One sub-strand used for each room.

Step 6: Send memory complex and Cover Image.

Step 7: End.

Decoding Algorithm

Step 1: From memory complex construct the NQ matrix.

Step 2: Calculate row values of NQ matrix to find out bits of Secret Image.

Step 3: Secret Image.

Step 4: End.

5. Experimental Results

Decoding Side

Figure-3 Secret Image

Figure-4.Cover Image (46×35)

Step-1:

Using Algo-1, mRNA sequence of secret image (Fig-3) is "CUU CCG UGC GAU GUA GCC GGU AUC UUU GGA CAU UGG UAU AUU UCA UGC" which is chosen arbitrarily .Arithmetic encoding convert this mRNA sequence in decimal form is 0.272850788. Equivalent binary form is 0.01000111.

Step-2:

No. of bits in secret image after compression is 8.Then NQ matrix size 8×8

	Q						
				Q			
		Q					
							Q
			Q				
						Q	
Q							
					Q		

Figure-5. 8×8 NQ matrix

Step-3:

Corresponding bit streams row wise are, 01000000, 00001000, 00100000, 00000001, and 00010000,00000010,10000000,00000100.

Equivalent decimal values are 64, 8, 32, 1, 16, 2, 128, and 4. These are the pixel positions of Cover image where Secret image bits (01000111) will embed by LSB substitutions.

Step-4:

Figure- 6 shows Pixel value of Cover Image before LSB substitution.

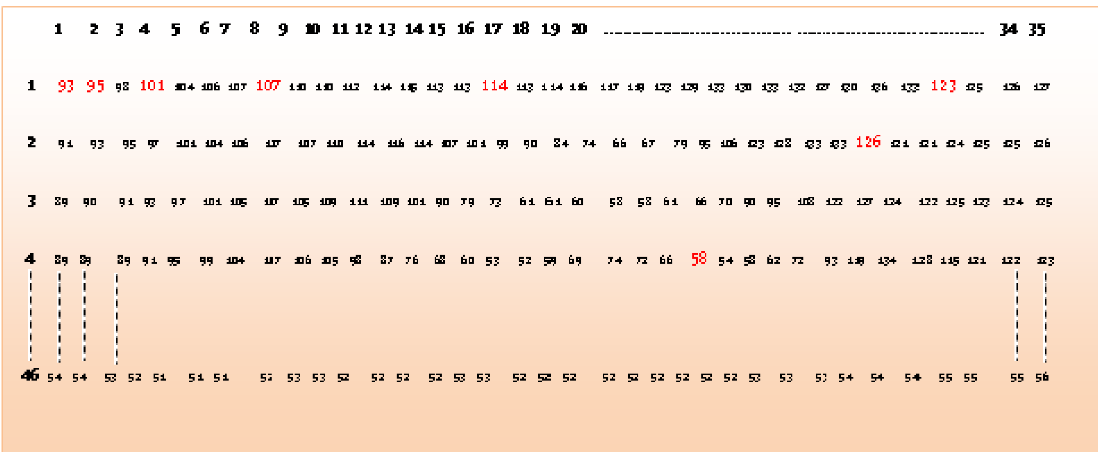


Figure- 6.Pixel value of Cover Image before LSB substitution

Figure- 7.Pixel value of Cover Image after LSB substitution

According to key Secret Image bits(01000111) from left will embed at positions (2,29), (1,8), (1,32), (1,1),(1,16), (1,2), (4,23),(1,4) respectively.

Step-5:

DNA Memory strand of the above matrix is –
AAAAA,AAAAG,AAAAT,AAAAC,AAAGA,AAATA,AAACA,AAAGG,AAATT,AAACC,AAGGG,AAGTT,AAGCC,AAGTC,AAGCT,AATTT,AATGC,AATCG,AATGG,AATCC,AACCC,AACGG,AACTT,AACTG,AGCTG,AGTCG,AGGTC,AGTGC,AGGGG,ATTTT,ACCCC,ATGGG,ATCCC,ATGTG,ATGGC,ACGGG,ACTTT,ACAAA,ACGTG,ACTGT,ACATG,ACAGT,ACAGG,AACATT,ACACC,GGGGA,GGGGT,GGGGC,GGGAA,GGGTT,GGGCC,GGGAC,GGGAT,GGGAG,GGGTA,GGGTC,GGGTG,GGAAA,GGCCC,GGTTT,GGATA,GGCTC,GGCTA,TTGGA.

Stickers are for Queen Positions –
TTTTC, TTCGG, TTACC, TACCC, TGCCC, CCCCT, CCCTT, CCAAA.

Step-6:

So, Memory complex is
0100000000000100000100000000000001000100000000000101000000000000010000.

6. Conclusion

The paper is to develop a method of staganography in which key is used to select embed position .Our method uses common embedding procedure LSB but key generation utilizes NQ-matrix .Uniqueness of this procedure is the key generation and hiding .Hiding is done by DNA sequence in the form of memory complex.

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