DNA Steganography

Advisor: Dr. Dipendra Sengupta
Elizabeth City State University

Thomas Hilton Johnson III
Elizabeth City State University

Douglass Smith
Elizabeth City State University

Abstract

Cryptography and Steganography are the two popular methods available to provide security. The former distorts the message and the latter itself hides the existence of the message . Using cryptography, the data is transformed into some other gibberish form and then the encrypted data is transmitted. In steganography, the data is embedded in an image file and the image file is transmitted. In the present, DNA has been widely used in cryptography and steganography. DNA Cryptography can be defined as a hiding data in terms of DNA Sequence. In this research endeavor we will present a new technique for DNA Cryptography and DNA Steganography.

Introduction

Cryptography, the study of concealing and safely transferring messages form recipient to sender, has been around since the time in which the classical human civilizations took shape. Cryptoanalysis is the study of dissecting and implementing cryptographic elements for the purpose of cracking cryptographic algorithms. DNA cryptography arose through implementing DNA patterns for the purpose of developing encrypted transmissions [2]. The DNA insertion method possesses the most protections against cryptoanalysis, making the DNA complementary and substitution methods less viable for DNA encryption [1].

Materials and Methods

The implementation of this project is based on M. P, M. M, M. R, V. Raghavan and V. R E's suggested implementation DNA insertion for a tenable DNA encryption algorithm [1]. The DNA encryption Algorithm starts with a "[randomized] DNA sequence" [1] that will serve as the target for embedding the message. DNA, or Deoxyribonucleic acid, itself is constituted of six molecular structures: "deoxyribose, a phosphate molecule, and four… nitrogenous bases," [1] or nucleic acids, guanine, cytosine, adenine and thymine. The message must be transformed along with the key to start the initial encryption into the ASCII counterparts of letters, numbers and special characters, then transforming the ASCII counterparts to their binary counterparts [1]. The first character in binary message must be XORed with the binary value of the key, with the result of that operation being XORed with the next character[1]. This operation perpetuates until each character of the message has been encrypted [1]. The initial DNA that will be used to embed the message is transformed into its binary counterpart by the substituting each nucleic acid with its respective binary value [1]. A second key value determines the length of DNA segments to divide the DNA into [1]. Each bit of the original message is appended to the start of each separated segment of DNA [1]. The segments are then appended together as one complete string of DNA [1]. To finish the encryption, transform the binary counterparts of the DNA back to their nucleic acid counterparts [1].

Encryption Algorithm DNA Steganography

Message:BORN B = 66 B = 66 = 01000101
Key_1 = 7 O = 79 O = 79 = 01001111
Key_1 = 00000111 R = 82 R = 82 = 01010010
Key_2 = 3 N = 78 N = 78 = 01001110
Dictionary: A = 00, C = 01, G= 10, T =11

DNA = ATCT GATC AGAT CGTA CGGA CTAT TAGT TGGC CAAT GCTA

DNA Binary = 001 101 111 000 110 100 100 011 011 011 000 110 100 001 101 000 011 010 000 111 001 111 001 011 111 010 010 100 001 110 011 100

B XOR Key = 01000010 = result_1
01000101
00000111
01000010

result_1 XOR O = 00001101 = result_2
01001111
01000010
00001101

result_2 XOR R = 01011111 = result_3
01010010
00001101
01011111

result_3 XOR N = 00010001 = result_4
01011111
01001110
00010001

DNA Binary with most significant Bit = 0001 1101 0111 0000 0110 0100 1100 0011 0011 0011 0000 0110 1100 1001 0101 0000 0011 1010 0000 1111 1001 1111 1001 1011 0111 0010 0010 1100 0001 0110 0011 1100

DNA with most significant Bit = AC TC CT AA CG CA TA AT AT AT AA CG TA GC CC AA AT GG AA TT GC TT GC GT CT AG AG 1100 AC CG AT TA

Decryption Algorithm DNA Steganography

DNA with most significant Bit = AC TC CT AA CG CA TA AT AT AT AA CG TA GC CC AA AT GG AA TT GC TT GC GT CT AG AG 1100 AC CG AT TA

DNA Binary with most significant Bit = 0001 1101 0111 0000 0110 0100 1100 0011 0011 0011 0000 0110 1100 1001 0101 0000 0011 1010 0000 1111 1001 1111 1001 1011 0111 0010 0010 1100 0001 0110 0011 1100

Significant Bit Concatenation:
{01000010, 00001101, 01011111, 00010001}

First XOR Operation: 10110100 / 10110101 / 00000001 — Index 1 XOR with key to get first letter of message.

Second XOR Operation: 10111010 / 10110100 / 00001110 — Index 2 XOR with Index 1 to get second letter of message.

Third XOR Operation: 10101011 / 10111010 / 00010001 — Index 3 XOR with Index 2 to get third letter of message.

Fourth XOR Operation: 10100110 / 10101011 / 00001101 — Index 4 XOR with Index 3 to get fourth letter of message.

00000001 - B
00001110 - O
00010001 - R
00001101 - N

Message: BORN

Results/Discussion

Implementing the DNA Encryption algorithm within code would allow further exploration of its mechanics and attributes. First tests would be on small DNA sequences with limited messages followed by larger sequences with expanded messages. The next stage would be taking that encrypted message and embedding the encrypted message into a picture to add another level of defense against cryptoanalysis methods.

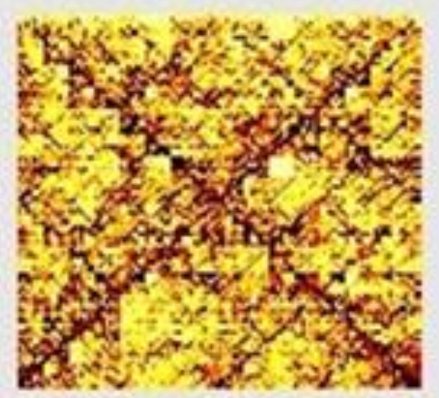
Acknowledgements

Special thanks to Dr. Sengupta for suggesting this project and providing mentorship during this research endeavor.

References

[1] M. P, M. M, M. R, V. Raghavan and V. R E,, "Highly Improved DNA Based Steganography", in 7th *International Conference on Advances in Computing & Communications*, Rajagiri School of Engineering and Technology, 2019, pp. 651-659.

[2] R. Challa, K. Rao and N. Srilatha, "BIT BASED SYMMETRIC ENCRYPTION METHOD USING DNA SEQUENCE AND QUANTUM TECHNIQUE TO GENERATE ENCRYPTED KEY", *http://www.ijarcs.info*, 2019. [Online]. Available: http://www.ijarcs.info/index.php/Ijarcs/article/view/5860/4814. [Accessed: 20- Mar- 2019].



A fulgidus

ELIZABETH CITY STATE UNIVERSITY
FOUNDED 1891