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Implementation Of Image Encryption Using DNA Encryption Algorithm

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Abstract: *We created an image encryption technique using DNA sequences and a tangled map. This algorithm has two functions: (1) it rearranges the pixels by transforming the nucleotides into equivalent base pairs and random number of times (2) it confuses the pixels with accordance to a chaotic index based on a tangled map. For any size of the image, the rows and columns are fist rearranged by the arrays generated by a logistic tangled map. Then, using DNA sequencing, each confused pixel is encoded into four nucleotides. At last, each nucleotide is transformed into the corresponding base pair a random number of time(s) by a series of repeating computations based on tangled map. The encryption process information entropy of the encrypted image is 7.9854. The algorithm implement not only has great cryptographic effects, but it also protects against multidimensional threats, as per security studies.*

Keywords: DNA, cryptography, security, privacy, confusion, diffusion, encryption, implementation, algorithm, chaotic maps, maps, image, decrypt.

I. Introduction

As science, technology, and society have progressed, the computer industry is dominating the world, with a small branch of digital image applications growing in popularity. Digital images have become one of the most widely used media forms, with applications in disciplines as diverse as politics, economics, defense, and education. Image transmission security, on the other hand, is vulnerable due to the open nature of networks. In many fields, such as military affairs, trade, and medical care, digital photos must also meet the greatest standards of secrecy. In conclusion, picture encryption has shown to be a secure technique of transmitting photos techniques Text encryption, SCAN language-based encryption, quadtree image encryption, VQ encryption technology (VQ), encryption technology that enables pseudorandom sequences, and "key images" are all examples of popular picture encryption types. Chaotic encryption has gotten a lot of interest recently. Chaos is a nonlinear system performance inner-class random process that is particularly sensitive to initial values, resulting in unpredictable results The chaotic encryption algorithm has many advantages, including ease of processing, durability, efficiency, and privacy. While this encryption offers many advantages, it also has certain disadvantages. Most chaotic encryption algorithms, for instance, currently confuse the single picture pixel value or location. Using either one of the two ways, however, does not guarantee picture security because attackers can decrypt an encrypted image using the pixel technique of differtiate. Adleman was the first to introduce DNA computing into the encryption industry in 1994, paving the way for a new stage of data processing. DNA encryption could be a new frontier, and international cryptography research is currently focused on it. In Conclusion, image encryption technique has demonstrated to be a beneficial tool for protecting photos while they are being conveyed. A high storage density and low energy consumption due to their enormous parallelism. As a conclusion, image encryption is essential.

II. Methodology

The technique of mapping the nucleotide sequence forming a strand of DNA is known as DNA sequencing. Adenine, thymine, guanine, and cytosine are the four bases that forms the foundation of ordering. "A" connect to "T," while "G" is connected to "C". As we all know, each digital image pixel is generally expressed by 8-bit binary numbers. Because the binary numerals "0" and "1" are complementary, so are "00" and "11" and "01" and "10." String of nucleotides is formed by addition of each pixel if the four deoxynucleotides "A," "T," "G," and "C" are used to denote the binary values "00," "11," "01," and "10," respectively. The grey value of a digital image pixel, for example, is 228, while the binary equivalent

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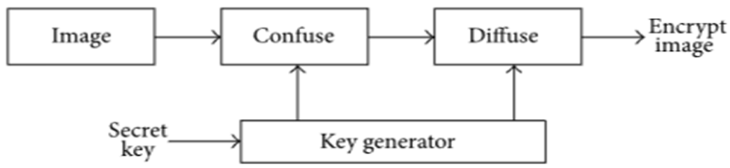
is "11100100." According to the preceding principles, the nucleotide sequence that corresponds to the existing binary is "TCGA." There are 24 different ways to join the four nucleotides together. However, the complementarity principle is only compatible with eight coding combinations.

The overall encryption process is shown in Figure: -



2.1 Image Encryption Algorithm

Step 1: Convert the first grayscale image I into a two-dimensional matrix called I. Now let's name the arrays R and C. These are, respectively, won't to record the rows and columns of image I.

Step 2: Create the two one-dimensional descending index sequences using of the logistic mapping, which is used to exchange the rows and columns of matrix I, respectively. As a result, image I will be muddled.

Step 3: Image I' should be converted into a binary 2-D matrix 1". the dimensions of I" is MxN rows and eight columns. Create a random integer r from one to eight to determine which DNA encoding rule should be used. Make a DNA encoding matrix with M x N rows and 4 columns from I." Finally, make a one-dimensional DNA coding sequence X of the size MxNx4 from this matrix.

Step 4: Using Chebyshev mapping, create a storage unit P. Obtain a C with P sequence of iterations. Then, from one to six, produce a random integer r2. As a result, we'll choose one of the six complimentary base pair rules to apply. Finally, each value of G is consistent. We will decide the tactic to exchange the nucleotides x, within the DNA sequence X. the tactic of iterative substitution is as follows:

switch: case 0, don't change x;

Case 1, x, = L(x_1);

Case 2, x, L(L(x_1));

Case 3, x, = L(L(L(x,))).

The complementarily substituted DNA sequence is X'.

Step 5: Generate a random integer r, from one to eight, which is employed to make a decision which DNA encoding rule should be utilized. Transform the X' sequence to a 1-D binary sequence II'.

Step 6: From the sequence II', construct a decimal dimensional matrix III with M rows and N columns. Finally, produce the encryption picture by converting the dimensional matrix III into the encryption image III'.

2.2 Image Decryption Algorithm

Step 1: Create a 1-D binary sequence II' from the encryption picture III'.

Step 2: Applying DNA encoding rule 13, change the sequence II' into a 1-D DNA coding sequence X'.

Step 3: Generate a storing unit P using of the Chebyshev mapping. Obtain a sequence of iterations C with P. Compute the complementary pair of every nucleotide be X' for (4-c) mod 4 time(s) to get the DNA coding sequence X using the complementary base pairs rule 1_2.

Step 4: "Apply encoding DNA rule r1 to transform sequence X to a 2-D matrix 1".. Then, alter the sequence l" into a decimal matrix of two dimensions l'.

Step 5: Recover the rows and columns of l' consistent with the descending index generated by of the logistic mapping to urge the decrypted image I.

2.3 Software Requirements

- Windows 7, 8, 10
- Python 3.10 x64
- IDE – VS Code + Required Extensions

2.4 Hardware Components

- Processor – Ryzen 5 2500u x64
- Hard Disk – 500 GB
- Memory – 8 GB RAM

III. Conclusion

In our project, we applied DNA encryption algorithm confusion/diffusion algorithm for image encryption. First, we swapped the pixel coordinates of the digital image's rows and columns consistent with a chaotic index based on the logistic chaotic map to confuse the image pixels. Then we decoded each of the pixels into four nucleotides that had been muddled and obtained a 1-D nucleotide sequence after a series of iterative computations supported Chebyshev's chaotic map. Next, we transformed each nucleotide into its corresponding nucleotide a random number of time(s) consistent with the complementary rule. Atlast, we got encrypted image as we transformed the 2-D matrix. Our experimental results and security analyses show that the scheme is able to do not only good encryption results, but also a sufficiently large key space to be ready to repel common attacks. As a result, the system is secure enough to use in picture encryption.

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