Encrypt Images Using Mutation Methods

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Abstract— *As a result of the tremendous development of information and communications technology, especially after the wide spread of the internet, the process of preserving images has become a major and important subject. The most important method to preserve images is the use of encryption, which aims to ensure the preservation of the privacy of images and not allowing anyone to tamper with or view them because they are either confidential or very special. Also, no one can understand the content of those images unless they have a means of encryption.*
In this research, a new methods has been applied in images encryption using mutation methods. Different analysis like correlation coefficient, and histogram analysis is applied for the verification of the performance of the suggested algorithm. Matlab language has been used to implement the suggested algorithm, because of its efficiency, accuracy and flexibility in giving results.

Keywords— Methods of Mutation, Images Encryption, Correlation Coefficient, Histogram analysis.

I. INTRODUCTION

Encryption is one of the most important methods used to preserve information and images[1, 2]. Image encryption algorithms are an integral part of image delivery [3], aiming to achieve efficiency while achieving the highest levels of security[4, 5]. It is the process of converting the original image into an encrypted image that is difficult to understand[6, 7].

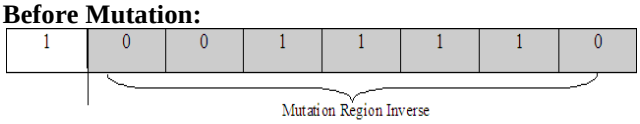
In this research, image encryption algorithm were proposed by using many mutation methods and finding the best method to encrypt images.

II. NEW METHODS OF MUTATION

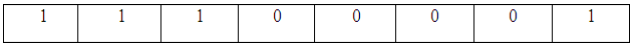
Several studies have been performed on different types of mutation techniques to improve the performance of the genetic algorithm over the years[8-10]. The purpose of mutation operators is to change the gens in the offspring and increase the diversity of the population[11, 12]. In this research the following mutation methods were proposed:

1-Method One: This mutation is done by reversing bit values within the confined region between bit 2 to bit 8.

Before Mutation:

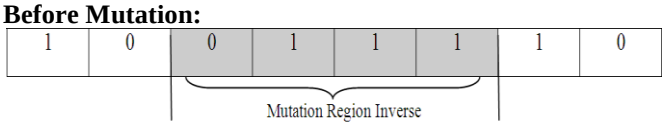


After Mutation:

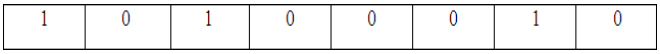


2-Method Two: This mutation is done by reversing bit values within the confined region between bit 3 to bit 6.

Before Mutation:

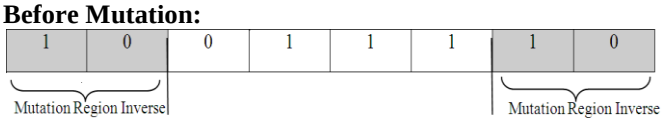


After Mutation:

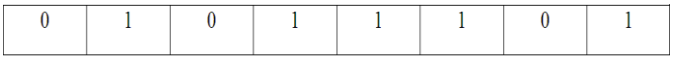


3- Method Three: This mutation is done by reversing bit values within the confined regions between bit 1 to bit 2 and bit 7 to bit 8.

Before Mutation:

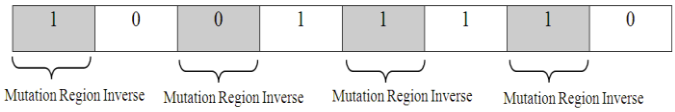


After Mutation:



4- Method Four: This mutation is done by reversing the values bit 1, bit 3, bit 5 and bit 7.

Before Mutation:

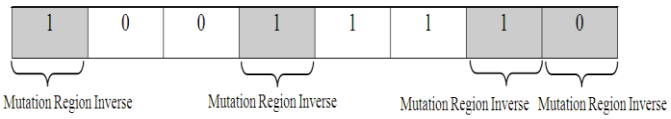


After Mutation:

0	0	1	1	0	1	0	0

5- Method Five: This mutation is done by selecting four random positions and inverse them.

Before Mutation:

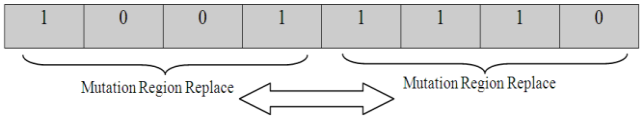


After Mutation:

0	0	0	0	1	1	0	1

6- Method Six: This mutation is performed by replacing the bit values between the two specified regions, (bit 1-bit 4) with (bit 5-bit 8).

Before Mutation:

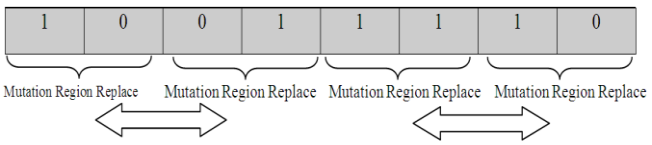


After Mutation:

1	1	1	0	1	0	0	1

7- Method Seven: This mutation is performed by replacing the bit values between the four specified regions, (bit 1-bit 2) with (bit 3-bit 4) and (bit 5-bit 6) with (bit 7-bit 8).

Before Mutation:

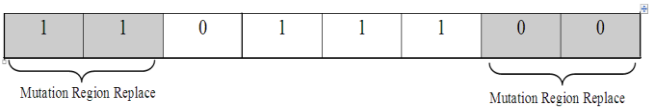


After Mutation:

0	1	1	0	1	0	1	1

8- Method Eight: This mutation is performed by replacing the bit values between the two specified regions, (bit 1-bit 2) with (bit 7-bit 8).

Before Mutation:

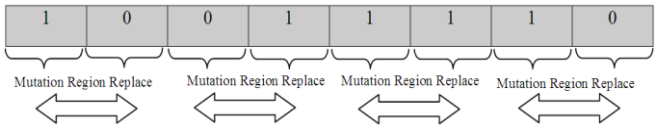


After Mutation:

0	0	0	1	1	1	1	1

9- Method Nine: This mutation is performed by replacing the bit values between (bit 1 with bit 2), (bit 3 with bit 4), (bit 5 with bit 6) and (bit 7 with bit 8).

Before Mutation:

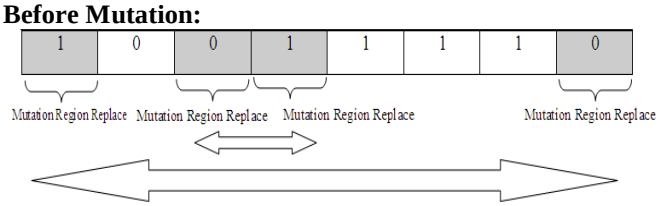


After Mutation:

0	1	1	0	1	1	0	1

10- Method Ten: This mutation is done by selecting four random positions and replacing them.

Before Mutation:



After Mutation:

0	0	1	0	1	1	1	1

III. PERFORMANCE EVOLUTION FACTORS

Two factors were used to evaluate the methods of images encrypted, these factors are:

1-Correlation Coefficient (r):

This is one of the common statistical measures used to measure the relationship between two variables. It is widely used in the sciences. [13-15]. as in (1):

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}} \qquad (1)$$

The value of r is between -1 and +1[16].

2-Histogram Analyses

An image histogram is a graphical representation which returns the relative frequency of the pixel values in a given image. It can effectively be used for image analysis. The gray level histogram contains two axes: x-axis represents the gray level values and the y-axis represents the relative frequencies. We can see the histogram of the encrypted image is different from that of the original image[17, 18].

IV. SUGGESTED ALGORITHM

In this section, an algorithm was proposed to perform encrypted images, we will list the steps for it in the following:

1- Read original image.

2- Make size of image (row=100, column=100).

3- Show original image.

4- Convert original gray level image to binary image.

5- Execute one method of previously mentioned ten methods of mutation.

6- Go to step 5 until all pixels in image are check.

7- Convert binary image to gray level image.

8- Show encryption image.

9- Calculate correlation coefficient (r) between original image and the encrypt image.

10- Draw the histogram of the original image and the encrypted image.

11- End.

RESULT AND DISCUSSION

After applying the mutation methods on three images different results were obtained in image encryption. As observed in (Fig.1 - 6). Mutation region replace methods gave better results in image encryption than mutation region inverse methods, as noted from table I of correlation coefficient values calculated for the original image and encrypted images. It was also noticed that method 8 and method 6 gave the best results in image encryption.

The result of any image crypto system is very good If the original image and encrypted image are very different. This means that the value of correlation coefficient is zero or close to zero. If the correlation coefficient value is equal to one or close to one, means that the original image and encrypted image are identical and this result of image crypto system is very bad. If the correlation coefficient value is equal -1, means that the encrypted image is negative of original image.

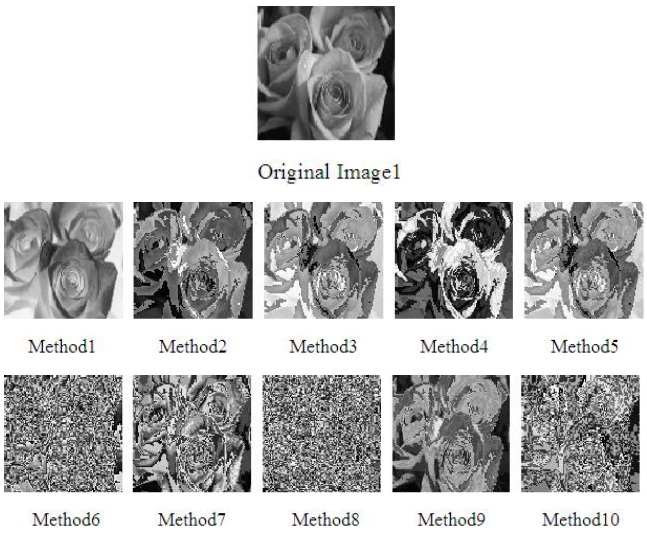
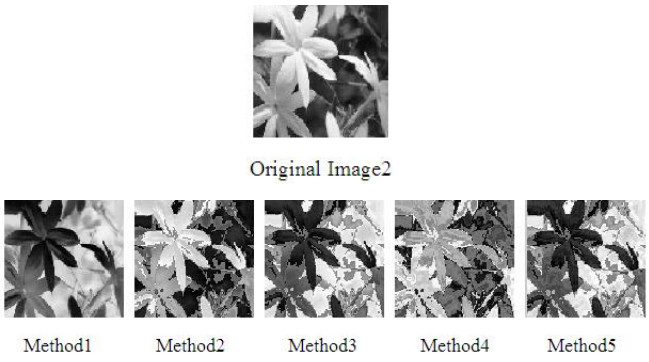


Fig. 1. Original Image 1 before and after executing the encrypt methods



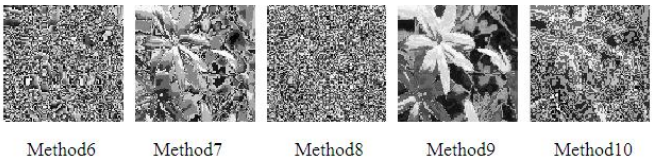


Fig. 2. Original Image 2 before and after executing the encrypt methods

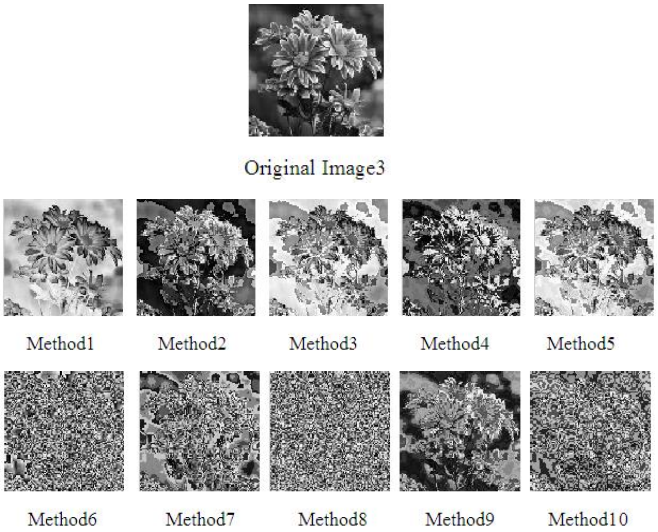


Fig. 3. Original Image 3 before and after executing the encrypt methods

TABEL I. represent values of correlation coefficient for Image 1, Image 2 and Image 3

Methods	Image 1	Image 2	Image 3
M1	-0.99	-0.99	-0.99
M2	0.77	0.90	0.84
M3	-0.77	-0.90	-0.84
M4	0.60	0.59	0.49
M5	-0.78	-0.90	-0.84
M6	0.05	0.05	0.05
M7	0.30	0.29	0.21
M8	0.02	0.01	0.08
M9	0.44	0.82	0.69
M10	0.07	0.27	0.20

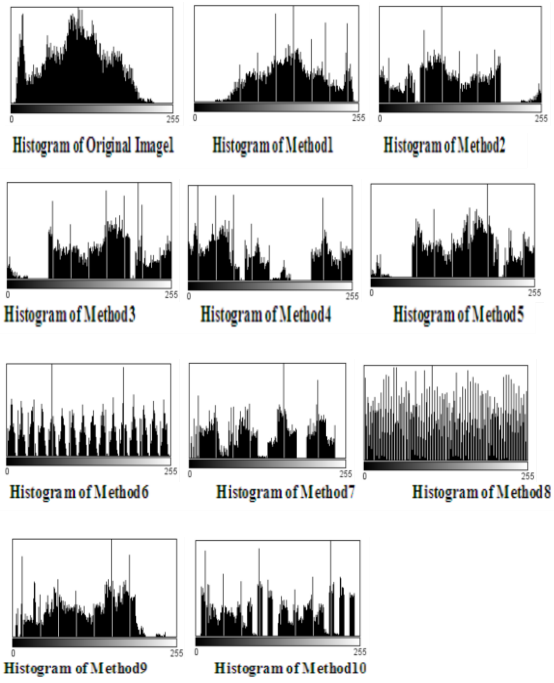


Fig. 4 Histogram of the original Image 1 and histogram of the encrypted image 1 methods

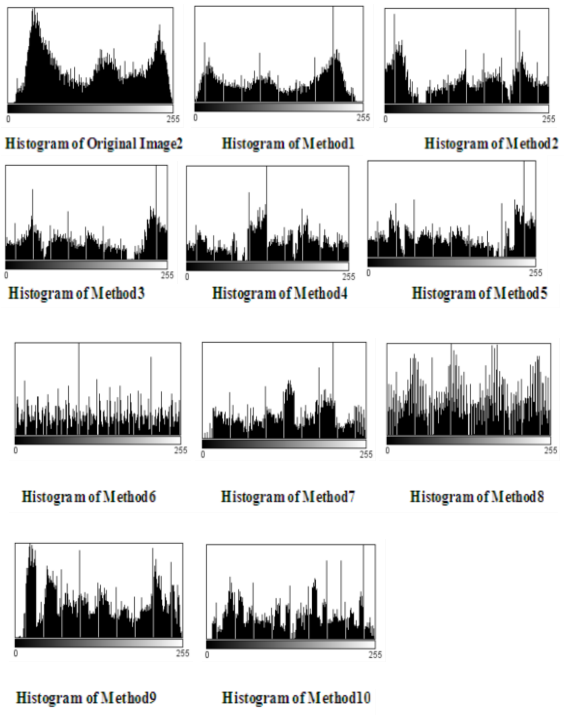


Fig. 5 Histogram of the original Image 2 and histogram of the encrypted image 2 methods

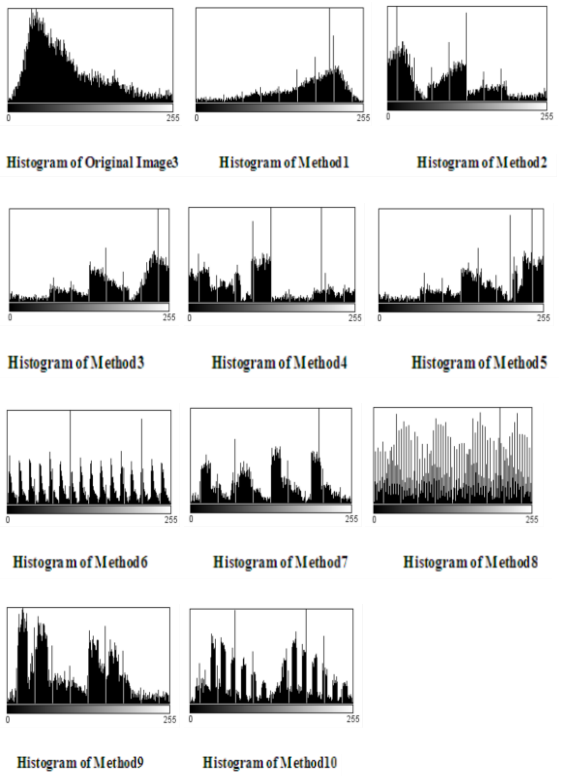


Fig. 6 Histogram of the original Image 3 and histogram of the encrypted image 3 methods

CONCLUSION

Image encryption is a method to achieve security. It is a method to convert the original image to another image that is difficult to understand. In this research, a new image encrypted algorithm is applied using new methods of mutation. Different analysis like correlation coefficient, and histogram analysis is done to compare the results of different mutation methods and verification of the performance of the algorithm. After execution the suggested algorithm it was noticed that method 6 and method 8 gave the best results in image encryption compare to other methods. In the future works, the proposed algorithm can be applied to texts and multi media data.

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