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Encryption and Decryption of Digital Colored Images Using Six Different Keys

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***Abstract* - A new proposed system of image encryption is submitted in this work. Each colored image is manipulated to extract the three color layers red, green and blue. Each color layer is encrypted individually using two different keys, one for encrypting the rows and the other for encrypting the columns. Then, the three deformed color layers of the image are mixed with each other to form a new encrypted colored image with no visual meaning. Six keys are needed to extract the original image. This gives a very solid encrypted image that can overcome any sort of attacking by any unauthorized party. The system proposed in this work can encrypt any type of images with any size.**

Keywords: Encryption, Decryption, Digital Colored Images, Six, Keys.

I. INTRODUCTION

Converting certain type of information to another type usually overcomes the problem of attacking on from third party through transmitting within networks. Digital images are very important now days since it contain important information. So, protecting images is a very important issue. Thousands of researchers around the world work on digital images and the protection of it. They scored important successes for protecting images and other types of data. The submitted system is an additional effort on this area.

Encryption is the process of transforming the original data which called plaintext in to encrypted data called cipher text [1]. Digital images used in many communication applications. So, the protection of these images becomes very important. Image encryption is a technique which encrypts the original image (plain image) to another un-understood image (cipher image) [2]. The visual information in the decryption side must be decoded in such a way that the visual information does not loosen [3].

Many hundreds of proposed techniques were published in literature for encryption and decryption of images. Some of these were robust and others are weak. Some of these techniques depend on the nature of the images; others are not [4-6]. Any digital colored image is represented by mixing three color layers. These color layers represent the three main colors Red (R), Green (G) and Blue (B). The RGB color format manipulates digital colored images by this representation. Each color layer is represented by its matrix of intensity values [7].

Any digital color image can be represented with this color format that is simulated to the human visual system. Every color in the image is a combination of the three main colors in different proportions [8]. In RGB color format, each pixel in each color layer is represented by 8 bits. This will give 256 different probabilities for the value of each pixel which represents the intensity value [9] and [10].

Every pixel in the colored image that contains the three colors has 16777216 different possibilities. This result from the fact that each color layer has 256 different possibilities. So, we have $(256 \times 256 \times 256) = 2^8 \times 2^8 \times 2^8 = 2^{24} = 16777216$ possibilities. Therefore, each pixel can take any color from these millions of colors. Because of this we have a very wide area to work with the values of these pixels and the huge number of pixels that contained in any digital colored image [9].

II. ENCRYPTION AND DECRYPTION

The problem that we try to solve is converting the original view of the image to another type which contains un-understood visual information. Then, it cannot be understood by any third party in the path of image transmitting. The proposed system is a new system to encrypt digital colored images to safely transmit it's via different networks. This encryption depends on extract the three color layers from the colored image. Then, encrypt the three color layers by manipulating the positions of the pixels of the three color layers using six different keys. Every color has two different keys to encrypt the rows and the columns of each layer. After using six different keys, two for each color layer, the resulted version of the colored image will be very secure and no one can extract the original image from the encrypted version unless he know the six different keys.

The main idea of this system is to modify the image by spoiling the scene of the image. The digital colored image, as we have mentioned previously, has three colored layers. These

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three color layers represent the RGB colors. Every color layer is extracted for the image. The matrix that represents each color layer is manipulated to get a deformed version. The three deformed color layers are mixed to form one deformed colored image. At the receiving end, the authorized receiver can use the system operations in reverse order to extract the original image. The following block diagram Fig. 1 explains the different operations used.

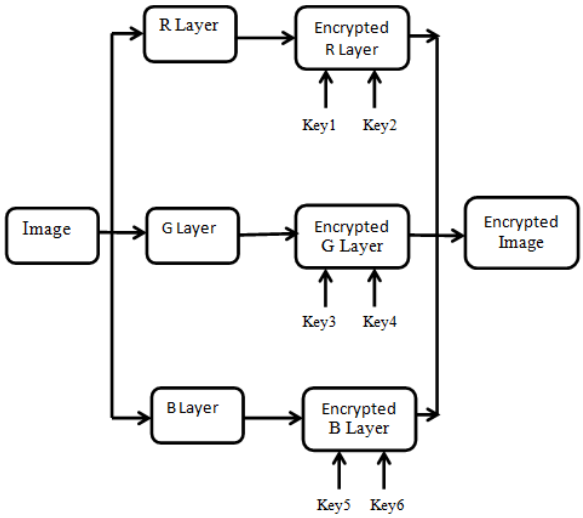


Figure 1: The block diagram for the submitted system of image encryption

III. IMPLEMENTATION AND RESULTS

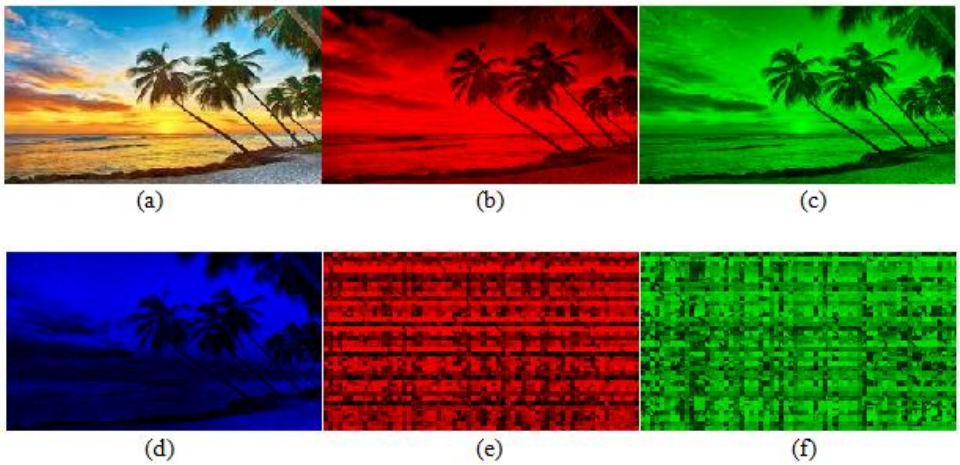
We used the most powerful tool for dealing with images, namely MATLAB. We write a code in MATLAB to read images. Reading images means reading the intensity values that is representing the image and save it in MATLAB to deal with. The intensity values of the images were represented by a matrix of numbers with a size depending on the image height and width. Each number within the matrix has the value between 0 and 255. The gray image composed of one gray layer and represented by one matrix. On the other hand, the colored image composed of three color layers RGB and represented by three matrices.

We write a code to extract the three color layers from the original images. The color layers matrices will be saved on MATLAB. Each matrix represents one of the main three colors RGB. The three matrices are of the same size but with different values. The values of the matrices elements depend on the nature and colors of each image that the color layers extracted from.

At this stage, we have encrypted the image by scrambling the rows and columns that formed the color layers that formed the complete image. Different keys are used to encrypt rows and columns of each color layers. After that, the deformed color layers are mixed to form the final deformed image. This deformed image represents the encrypted version of the original image. This will results in a deformed image that could not be understood visually. This means that the resulted image does not have a meaningful scene. So, resulted image could be transmitted through any network and no one can understand this image. Furthermore, no one can transform the image to a meaningful image with a meaningful scene visually.

The final stage in this system is the process of extracting the original image from the encrypted image at the receiving side. This operation could be done by using the same previous processes on the reverse order. Strictly speaking, the first step is the process of extracting the deformed layers of the image. Then, using the same six keys of conversion to extract the original color layers. Then, the three extracted image layers are mixed to form the final extracted colored image.

One hundred images were tested and the system was succeeded with all. In spite of the ability of the system to deal with any image with any size, we focused finally on the jpg images with sizes of 16:9 aspect ratio. The chosen aspect ratio compatible with the sizes of the modern screens.



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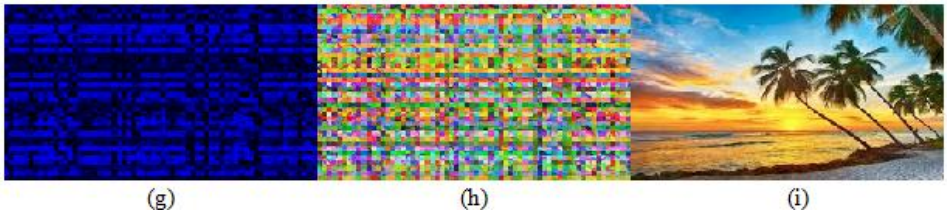

Figure 2: The resulted visual results for the image 1, (a) represents the original image before encryption, (b) represents the red color layer, (c) represents the green color layer, (d) represents the blue color layer, (e) represents the red deformed color layer, (f) represents the green deformed color layer, (g) represents the blue deformed color layer, (h) represents the resulted encrypted image, and (i) represents the decrypted image

Figure 2 represents the visual results for encrypting image 2. Fig. 1 (a) represents the original image. Fig. 2 (b) represents the extracted red color layer of the image. Fig. 2 (c) represents the extracted green color layer of the image. Fig. 2 (d) represents the extracted blue color layer of the image. Fig. 2 (e) represents the encrypted red color layer of the image. Fig. 2 (f) represents the encrypted green color layer of the image. Fig. 2 (g) represents the encrypted blue color layer of the image. Fig. 2 (h) represents the final encrypted colored image. Finally, Fig. 2 (i) represents the decrypted colored image on the receiving side. Moreover, figure 3 has the same visual results as figure 2 but for another image, image 2, which represent another test image for the proposed system.

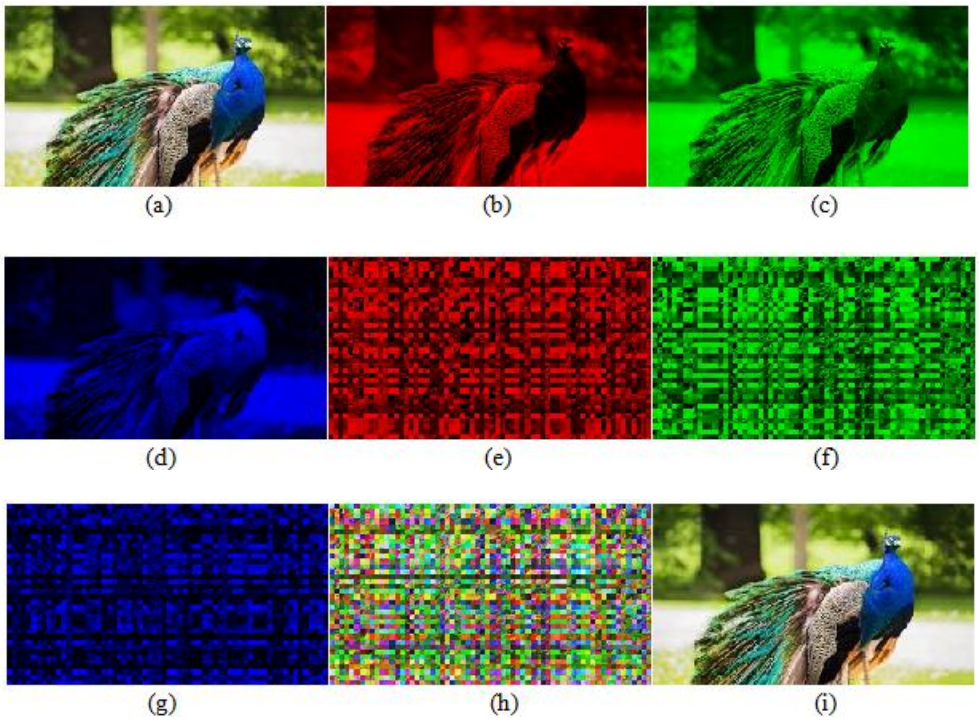

Figure 3: The resulted visual results for the image 2, (a) represents the original image before encryption, (b) represents the red color layer, (c) represents the green color layer, (d) represents the blue color layer, (e) represents the red deformed color layer, (f) represents the green deformed color layer, (g) represents the blue deformed color layer, (h) represents the resulted encrypted image, and (i) represents the decrypted image

IV. CONCLUSIONS

The proposed system is very robust and the encrypted images are very solid and can overcome any trial of any unauthorized party to extract the original image from the encrypted image. Any authorized person must have the six keys that were used to encrypt the original image to own the ability to extract that image. This system was succeeded with all types of images with any size. The proposed system could be used for protecting images while transmitting it's through any type of channels.

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