An Image Encryption Approach using Pixel and Position Manipulation Technique

Panduranga H T[#1], Naveen Kumar S K[#2]
[#1]Dept of Electronics, University of Mysore, PG-Center, Hemagangothri – Hassan – Karnataka.
[#2]Dept of Electronics, University of Mysore, PG-Center, Hemagangothri – Hassan – Karnataka.

ABSTRACT
Information security is very important task in the field of information and communication technology. Encryption is one way to secure information. In this paper we present combined concept of pixel and position manipulation technique for image encryption. The proposed technique involves three stages. In first stage pixel position manipulation is done by using pixel shuffling block where index value of each row is rearranged in bit-reversed order so that the positions of rows are manipulated. Similarly index value of each column is rearranged in bit-reversed order, which leads to manipulation of columns. This position manipulated image is used as input to the pixel manipulation block in second stage, where each pixel is rearranged in reverse order. In third stage, this scrambled image is again undergone pixel value manipulation by using bit-rotation concept leading to encrypted image. This proposed combined concept is implemented for different images using MATLAB. Decryption involves the reverse process of encryption.

Keywords
Pixel manipulation, Position manipulation, Bit-reversal, Bit-rotate, Encryption.

1. INTRODUCTION
In this fast-growing digital world there is a huge demand for information security. There are several areas which needs information security like, military application, medical information transmission during telemedicine, video confecting, video on demand, and image database management system for satellite images and so on. There are several image encryption techniques with its own advantages and disadvantages. In general image encryption can be classified in two ways, fist one is image encryption by pixel manipulation and second is image encryption using pixel-position manipulation. In case of pixel manipulation technique, weight of a pixel is altered which leads to image encryption. Similarly in case of pixel-position manipulation technique, position of each pixel is changed by re-arranging the pixel is pre-defined patterns.

S.S. Maniccam and N.G. Bourbakis [1] have presented a new methodology which performs both lossless compression and encryption of binary and gray-scale images. The compression and encryption schemes are based on SCAN patterns generated by the SCAN methodology. The SCAN is a formal language-based two-dimensional spatial-accessing methodology which can efficiently specify and generate a wide range of scanning paths or space filling curves. S. R. M. Prasanna et. el [2] have presented an image encryption method with magnitude and phase manipulation using carrier images. Here they used the concept of carrier images and one dimensional Discrete Fourier Transform for encryption purpose and it deals with private key cryptosystem, works in the frequency domain. A Mitra et al [3] have presented a new approach for image encryption using combination of different permutation techniques. The intelligible information present in an image is due to the correlations among the bits, pixels and blocks in a given arrangement. This perceivable information can be reduced by decreasing the correlation among the bits, pixels and blocks using certain permutation techniques. Panduranga H T. et al [4] have proposed a concept of carrier image generated by a pre-define code called 4 out of 8 code with the condition of each nibble having two ones and two zeros. In this concept original image is added with the carrier image to obtain the encrypted image. Panduranga H T. et al [5] have proposed an encryption using the concept of pixel value manipulation technique. Here each pixel of an image is re-arranged in reverse order to manipulate the value of the pixel. Bibhudendra Acharya et al [6] explained the concept of image encryption using hill cypher technique. Here self-invertible matrix is generated and multiplied with the original image to obtain the encrypted image.

Organization of this paper is as follows: section 2 describes the concept of image encryption using pixel value manipulation technique. In section 3 the concept of pixel position manipulation is explained. Proposed image encryption method is explained in section 4. Results are discussed in section 5. This paper is concluded by providing the summary of present work in section 6.

2. IMAGE ENCRYPTION USING PIXEL MANIPULATION TECHNIQUE
In this method encryption process is divided in to three stages. In first stage each pixel value in decimal form is converted in to eight-bit binary number. In second stage eight bit binary number is arranged in reverse order. In third stage this new eight-bit binary number is converted into its equivalent decimal number. Since weight of the pixel is responsible for its color, this change in weight of pixel leads to encryption of an image. Figure 1 shows the block diagram of image encryption using pixel manipulation technique and figure 2 shows the input image and output encrypted image. Let us consider an example; if a pixel value is 123 then its binary value is 01111011. The reversed binary value is 11011110 and its equivalent decimal value is 222. It shows that as change in pixel value changes the intensity of that pixel.

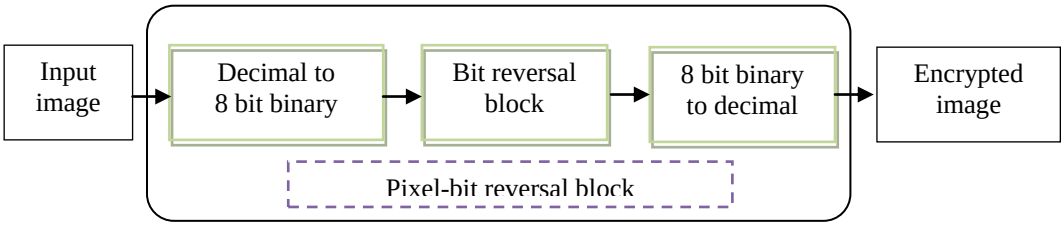


Fig 1. Block diagram of Pixel manipulation technique.

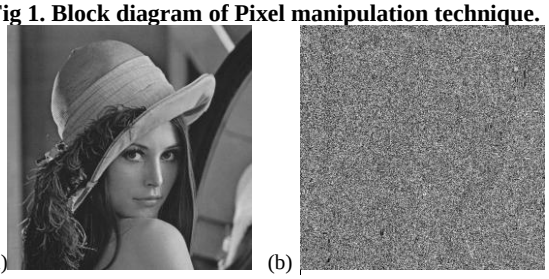


Fig. 2.(a) Input image (b) Encrypted Image for lena image.

3. IMAGE ENCRYPTION USING POSITION MANIPULATION TECHNIQUE

In this method encryption process includes two blocks and each block includes three stages. In first stage each row index value in decimal form is converted in to binary number. In second stage eight bit binary number is arranged in reverse order. In third stage this new binary number is converted into its equivalent decimal number. Weight of the row index vale changes leads to changes in the position of that row. Similarly columns position also scrambled in second index bit-reversal block. Figure 3 shows the block diagram of image encryption using pixel position manipulation technique and figure 4 shows the input image and output encrypted images at two different blocks. Index bit reversal block can be explained with an example. Let us consider an image of size 256x256. Now consider 25th row of an image and its index value is 25 (its equivalent binary representation is 00011001), its bit-reverse binary representation is (10011000) and its decimal value is 152. Now 25th row of input image is placed in 152nd row of shuffled image. Similarly column index of image is changed and shuffled. Decryption follows exactly reverse process to obtain the original image.

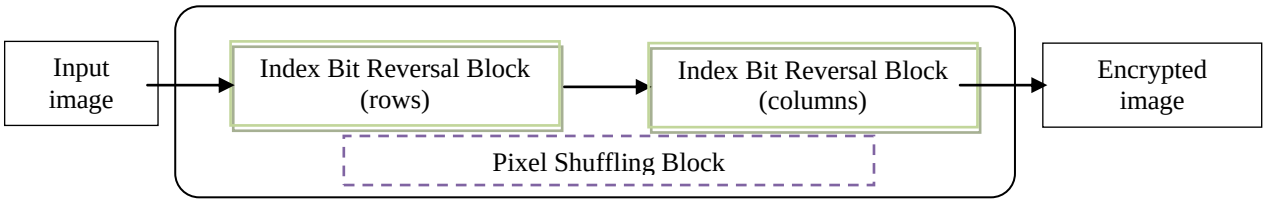


Fig. 3. Block diagram of Position manipulation technique.

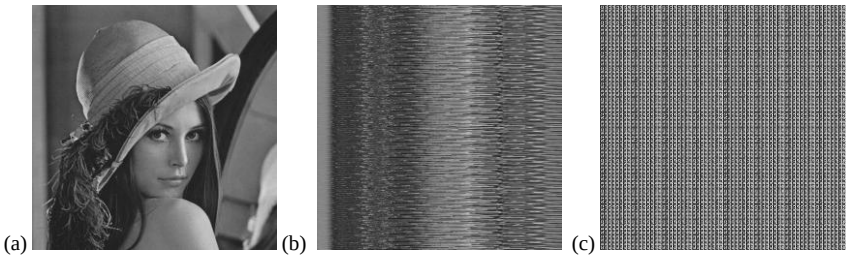


Fig. 4.(a) Input image (b) Encrypted Image after row wise shuffling (c) Encrypted Image after row wise shuffling for lena image.

4. PROPOSED IMAGE ENCRYPTION USING COMBINED TECHNIQUE

Here we are presenting the combined concept of image encryption using pixel value manipulation and pixel position manipulation techniques. Figure 5 shows the block diagram of proposed image encryption technique it consist of pixel position manipulation block (pixel shuffling block) and pixel value manipulation block (pixel-bit reversal block). Here combination of pixel value manipulation and pixel position manipulation technique is used. Figure 6 shows the extended block diagram of figure 5 containing pixel rotation block. In this case addition to pixel value and position manipulation, the value of each pixel is modified according to the given password with the help of bit-rotation technique. Figure 7 and figure 8 shows the results obtained in the proposed method.

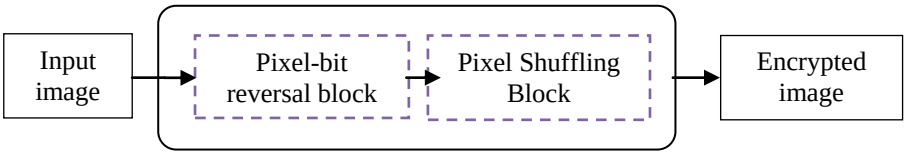


Fig. 5. Block diagram of proposed image encryption technique.

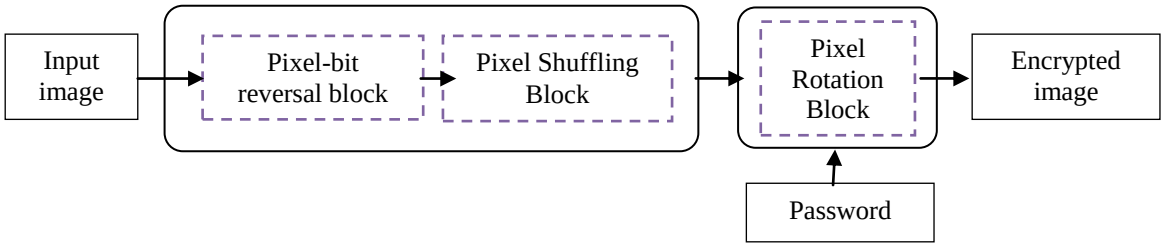


Fig. 6. Block diagram of proposed image encryption technique with pixel rotation block.

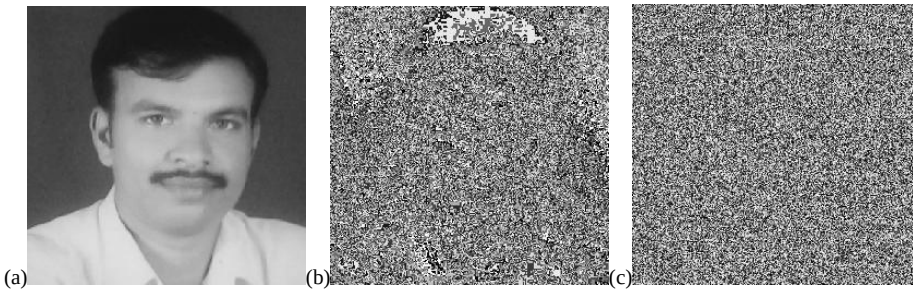


Fig. 7.(a) Input pandu image (b) Encrypted Image at pixel bit-reversal block (c) Encrypted Image at pixel shuffling block

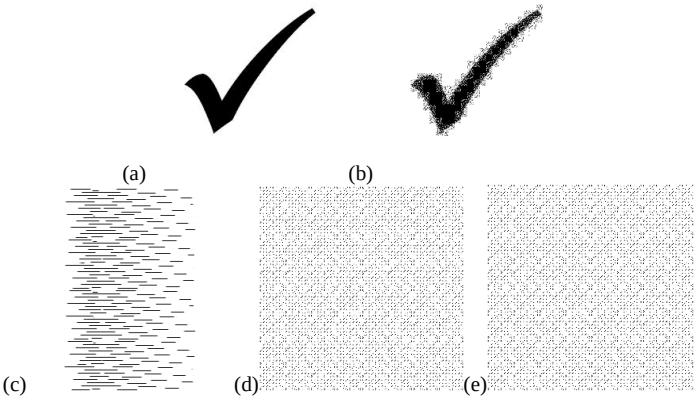


Fig. 8. (a) Input tic image (b) Encrypted Image at pixel bit-reversal block (c) Encrypted Image after row wise (d) Encrypted Image at pixel shuffling block (e)Encrypted image at the output of pixel rotation block.

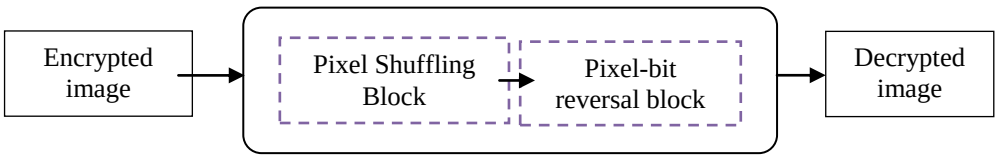


Fig. 9. Block diagram of proposed image decryption technique with-out pixel rotation block.

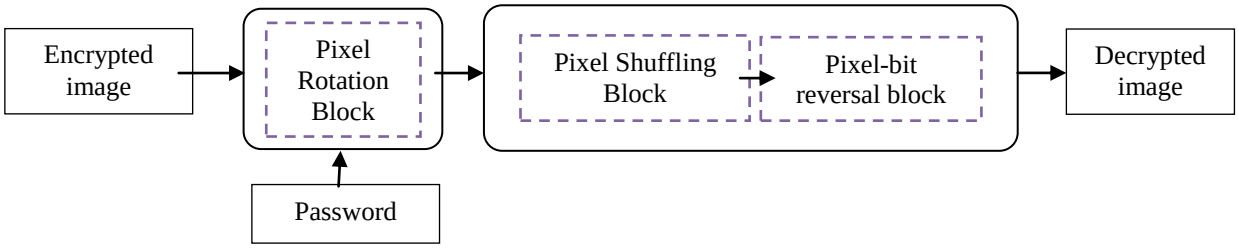


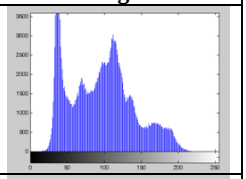
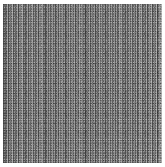
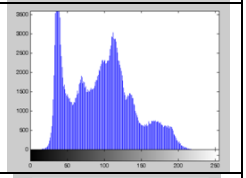
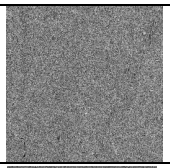
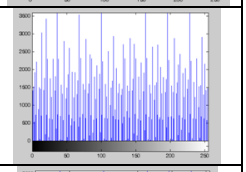
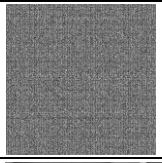
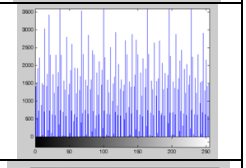
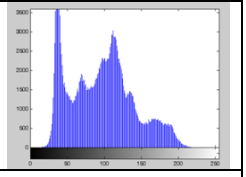
Fig. 10. Block diagram of proposed image decryption technique with pixel rotation block.

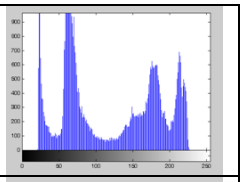
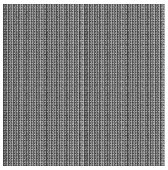
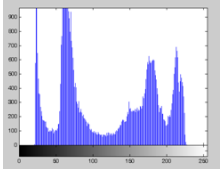
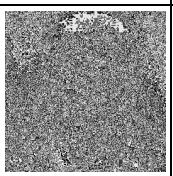
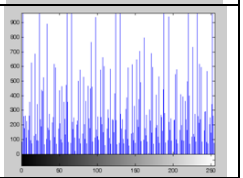
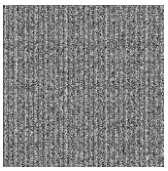
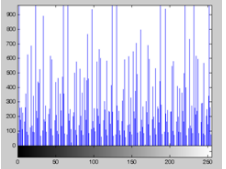
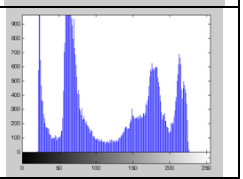
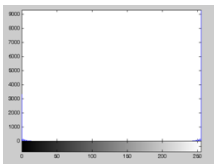
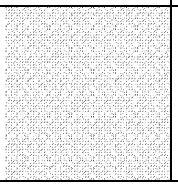
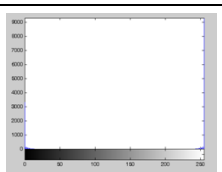
Figure 9 and 10 shows the block diagram of proposed decryption process. It is just a reverse process of encryption. Results of encryption and decryption process are tabulated in table1.

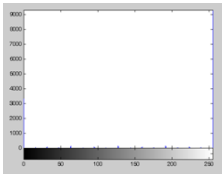
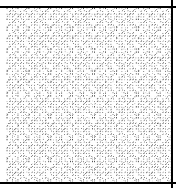
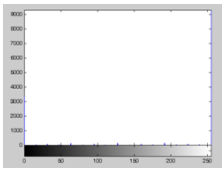
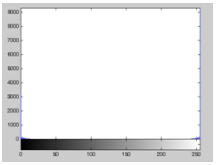
5. RESULTS AND DISCUSSION

In this paper we done the experiment on different images and also taken the histogram at different stages. From the histogram we came to know that histogram of encrypted image by pixel position manipulation technique remains same as the histogram of original image. But histogram of encrypted image due to pixel value manipulation technique is altered as compare to histogram of original image. Even in the histogram of the encrypted image at bit-rotation block is also altered as compare to the histogram of the original image. Results of the encryption process for different images along with its histogram are tabulated in table 1.

TABLE 1

Image Name	Image	Histogram
Lena		
Encrypted image of lena (using Position Manipulation technique – pixel Shuffling)		
Encrypted image of lena (Using Pixel Manipulation technique-bit reversal)		
Encrypted image of lena (Using Pixel Manipulation technique-– pixel Shuffling-bit reversal and rotation)		
Decrypted Lena image		

Pandu		
Encrypted image of pandu (using Position Manipulation technique – pixel Shuffling)		
Encrypted image of pandu (Using Pixel Manipulation technique-bit reversal)		
Encrypted image of pandu (Using Pixel Manipulation technique-– pixel Shuffling-bit reversal and rotation)		
Decrypted Pandu image		
Tic		
Encrypted image of tic (using Position Manipulation technique – pixel Shuffling)		

Encrypted image of tic (Using Pixel Manipulation technique-bit reversal)		
Encrypted image of tic(Using Pixel Manipulation technique-– pixel Shuffling-bit reversal and rotation)		
Decrypted Tic image		

6. CONCLUSIONS

In this paper we presented a combined technic for image encryption using pixel value manipulation and pixel position manipulation technique. From the experimental result we can conclude that that we can predict the original image by observing its histogram if we use only position manipulation technic, but it is difficult if we use pixel-value manipulation technique. We can also guess the original image if there is a uniform background in an image in case of pixel-value manipulation technique. If we use the combined technic of pixel position manipulation and pixel-value manipulation along with the bit-rotation technique it is very difficult to decode the image. We conclude that the encrypted images using combined approach is more scrambled as compare to individual technique.

7. REFERENCES

[1] S S Maniccam and N G Bourbakis, "*Image and video encryption using scan patterns*", Pattern Recognition, 2004, vol.37, pp 725-737.

[2] S. R. M. Prasanna et. el., "An Image Encryption Method with Magnitude and Phase Manipulation using Carrier Images," IJCS, 2006, vol. 1, No 2, pp.132-137.

[3] Mitra et. el., " A New Image Encryption Approach using Combinational Permutation Techniques," IJCS, 2006, vol. 1, No 2, pp.127-131.

[4] Panduranga H T, Naveenkumar S K, "*A novel image encryption method using 4 out of 8 code*", proc. CommV'09, pp460-462, 2009.

[5] Panduranga H T, Naveenkumar S K, "*An Image Encryption Approach using Bit-Reversal Method*", proc. NCIMP, pp181-183, 2010.

[6] Bibhudendra Acharya, Girija Sankar Rath, Sarat KumarPatra, Saroj Kumar Panigrahy. 2007. Novel Methods of Generating Self-Invertible Matrix for Hill Cipher Algorithm, *International Journal of Security*, Vol 1, Issue 1, 2007, pp. 14-21.