Modify Algorithm Cryptography by Image Detection Using Wiener Filter

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Abstract

The cryptography of image is very important in the communication networks, when you transmit image from sender and receiver does not understand the original image, a feature of secure out of obscurity.

This paper, has been proposed a new algorithm for cryptography of image by using edge detection method. Five steps used to encrypt original image, first enhancement image by Point detection, Laplacian filter, and Convolution mask. Then compress image by two level of Haar Wavelet Transform after that used wiener filter to secure data of original image.

The outcome of system gets efficiency, powerful, and high security image in the five steps, it has cryptography of image to without sensitive attackers, the form of image it cannot be a known or exchange during transmit from sender to receiver.

Keyword: *Point Detection, Laplacian Filter, Convolution, Wiener Filter, Image Processing, cryptography.*

تعديل خوارزمية تشفير لحواف صورة باستخدام الونر فلتر

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الملخص

ان تشفير الصور مهم جدا في الاتصال شبكات الانترنيت ، عندما يتم ارسال الصورة من المرسل الى المستلم تكون الصورة الاصلية غير مفهومة، وشكلها سري وغير واضح.

في هذا البحث تم اقتراح خوارزمية جديدة لتشفير الصور بواسطة اكتشاف طريقة الحدود للصورة.

الخمسة خطوات التي تم استخدامها لتشفير الصورة الاصلية ، الخطوة الاولى حي تحسين الصورة بواسطة Point detection, Laplacian filter, and Convolution mask . وثم ضغط الصورة بواسطة مستويين لطريقة تحويل الموجي Haar Wavelet Transform وبعدها استخدام الفلتر ونير Wiener filter لتشفير بيانات الصورة الاصلية .

النتائج التي تم الحصول عليها في هذا النظام كفوءة، وقوية، وسرية عالية للصورة في هذه الخمسة خطوات، وان تشفير الصورة وارسالها عبر شبكات الانترنيت بدون ان يتحسسها المهاجم ، وشكل الصورة لايمكن ان يتعرف او يغير عليها المهاجم اثناء الارسال من المرسل الى المستلم.

1- Introduction

The picture processing consists handling or changing an existing picture in demand manner. An image involves of 2-dimension matrix of numbers. The colour or gray scale picture show for a given image element "pixel" rely on the number stored in the matrix for that pixel [1].

Picture is split into separate areas that are symmetric with regard to a chosen ownership. Essentially represents which in deblurring pictures using a wiener filter. Basic wiener filter is used to produce an evaluation of coveted or base random operation by linear filtering [2] of an observed noisy operation, assuming renowned fixed signal and noise spectrum, and additional noise. The Wiener filter lower the mean square error between the evaluated random operation and the coveted operation [5].

"Cryptography image is import in internet network, its provide security transmission".

2- Point Detect

The coordinates of an border point may be the integer row and column (i, j) indicator of the pixel wherever the border was detected, or "the coordinates of the edge location at subpixel resolution". The border coordinates may be in the coordinate system of the premier picture, "A point has been detected at the location p(i, j) on which the mask is centered if |R |>T, where T is a nonnegative threshold, and R is obtained with the mask", shown in Figure (1) [1,2].

$$\begin{matrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{matrix}$$

Figure (1): Mask Of Point Detect.

The concept is that the gray scale of an removed point will be quite different from the gray scale of its neighbors [1,2].

3- Laplacian Filter

The three Laplacian masks that follow appear various approximation of the Laplacian operator. "Its mask are rotationally symmetric, which means edge at all orientations contribute to the result". "They are applied by selecting one mask and convoluting it with the image" [3]. Laplacian mask shown in Figure (2).

$$\begin{matrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{matrix} \qquad \begin{matrix} 1 & -2 & 1 \\ -2 & 4 & -2 \\ 1 & -2 & 1 \end{matrix} \qquad \begin{matrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{matrix}$$

Figure (2): Mask OF Laplacian Filter.

4- Convolution

"Convolution mask, which is slid across the extended image, and perform a simple arithmetic operation at each pixel location. Convolution mask for First-Order hold", shown in Figure (3).

$$\begin{matrix} 1/4 & 1/2 & 1/4 \\ 1/2 & 1 & 1/2 \\ 1/4 & 1/2 & 1/4 \end{matrix}$$

Figure (3): Mask Of Convolution.

The convolution operation demand us to too the mask on the picture, multiply the coincident values, and add all these outcome. This is equal to returns the vector inside production of the mask with the implicit subpicture, the vector inside production is found by overlaying the mask subpicture, multiply coincident expression, and add angle of the picture, "it obtain(form right to left, and top to bottom)", the example of convolution mask applied.

$$1/4(0)+1/2(0)+1/4(0)+1/2(0)+1(3)+1/2(0)+1/4(0)+1/2(0)+1/4(0)=3$$

Note that the existent picture values does not change. The next step is to slide the mask through by one pixel and duplicate the operation, the example of convolution mask applied.

$$1/4(0)+1/2(0)+1/4(0)+1/2(3)+1(0)+1/2(5)+1/4(0)+1/2(0)+1/4(0)=4$$

Note this is the middle of the two existent neighbors. This operation go ahead until it obtain the end of the row, "each time placing the result of the operation in the location corresponding to center of the mask" [3,6].

5- Wavelet Transform

The Haar Transform is memory efficiency, properly inverse without the edge effect, it is fast and easy [6,7]. The Haar Wavelet Transform (HWT) is one of the easy and basic transformation from "the space domain to a local frequency domain". "HWT decomposes each signal into two components, one is called average (approximation) or trend and the other is known as difference (detail) or fluctuation" [7,8]. In order to given an idea of its implementation in image compression [7]. The LL is the original image in this level. The A= Approximation, H=Horizontal, V= Vertical, D= Diagonal, as shown in Figure (4).

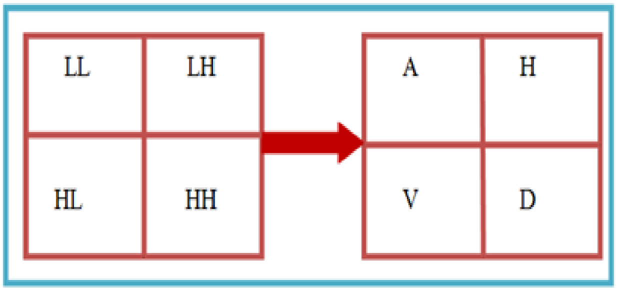


Figure (4): The Haar Wavelet Transform.

6- Wiener Filter

"The space domain for the purpose of restoration of an image degraded by white Noise". Through this paper, "it can assume that $P(i, j)$ and $n(i, j)$ represent the original image and additive noise, respectively". "The observed degraded image $x(i, j)$ is given by":

$x(i, j) = P(i, j) + n(i, j)$ ………... 1

"The goal is to obtain a restored image $y(i, j)$ from $x(i, j)$, in which $y(i, j)$ should be equivalent to the original image $P(i, j)$ ideally"[4,5,9].

- **Wiener Filter in the Space Domain**

The output of the Wiener filter is $y(i, j)$, it is represented by:

$$y(i,j) = \sum_{m=-N}^{N} \sum_{n=-N}^{N} w(m,n)x(i+m, j+n) \quad ....2$$

"The weights of the Wiener filter, $w(m, n)$, can be found by minimizing":

$$J = E[\{P(i,j) - y(i,j)\} \quad ....3$$

"where E denotes expectation. The solution for $w(m, n)$ is obtained in a vector form As":

$$\boldsymbol{w} = \boldsymbol{R}^{-1}\boldsymbol{p} \quad ....4$$

"$R(m, n)$ and $p(m, n)$ correspond to the autocorrelation function of $x(i, j)$ and cross-correlation function of $P(i, j)$ and $x(i, j)$, respectively"[4, 5, 9].

7- Proposed Algorithm

This paper offers new algorithm to cryptography image by cryptography image method, it uses wiener filter. In this paper a new proposed algorithm, is converted each original image in five steps , *the first step*: point detect method is applied, *the second step*: laplacian filter method is applied, *the third step*: convolution method is applied, *The fourth step*: using compression each image in three steps previous uses wavelet transform in L2 and L3, and *The fifth step*: result of these four steps its use cryptography method each image by uses wiener filter in space domain is applied. Obtains the cryptography image without detected sensitive attacks during transmit.

The first step:

Point Detect Algorithm:

Process:
Input : Original Image
Output: Point Detection Image
Initial:
A = Load Original Image
B = Execution Point Detection
C = Point Detect Image
Step1: x = Picture.Hight
Step2: y = Picture.Width
Step3: Min = 0 In A.
Step4: Max = 0 In A.
Step5: For i = 1 To x-1 In A.
Step6: For i = 1 To y-1 In A.
Step7:RX1 = red(i-1, j-1):GX1= green(i-1, j-1):BX1= blue(i-1, j-1) In B.
Step8:RX2 = red(i, j-1):GX2= green(i, j-1): BX2 = blue (i, j-1) In B.
Step9: RX3 = red(i+1, j-1): GX3= green(i+1, j-1): BX3 = blue (i+1, j-1) In B.
Step10: RX4= red(i-1, j):GX4= green(i-1, j):BX4 = blue (i-1, j) In B.
Step11: RX5 = red(i, j):GX5= green(i, j):BX5 = blue (i, j) In B.
Step12: RX6=red(i+1, j-1): GX6= green(i+1, j-1):BX6= blue (i+1, j-1) In B.
Step13:RX7=red(i-1, j+1):GX7=green(i-1, j+1):BX7= blue (i-1, j+1) In B.
Step14: RX7 = red(i, j+1):GX8= green(i, j+1):BX8= blue (i, j+1) In B.
Step15:RX9=red(i+1, j+1):GX9=green(i+1, j+1): BX9 = blue (i+1, j+1) In B.
Step16:m1_redcolor= 8*RX5(RX1+ RX2+ RX3+ RX4+ RX6+ RX7+ RX8+ RX9) In B.
Step17:m1_greencolor=8*GX5(GX1+GX2+GX3+GX4 + GX6+ GX7+ GX8+ GX9) In B.
Step18:m1_bluecolor=8*BX5(BX1+BX2+ BX3+ BX4+ BX6+ BX7+ BX8+ BX9) In B.
Step19:If m1_redcolor < 0 Then m1_redcolor = 0 In B.
Step20: If m1_greencolor <0 Then m1_greencolor = 0 In B.
Step21: If m1_bluecolor<0 Then m1_bluercolor = 0 In B.
Step22:Picture (i, j), RGB(m1_redcolor, m1_greencolor , m1_bluecolor) In B.
Step23: Value = i
Step24: Next i, j
Step25: Put the result Point Detect Image In C.

- For example: implementation of point detect of image horse as shown in Figure (5).

Figure (5): The Point Detect of image Horse.

The second step:

Laplacian Filter Algorithm:

Process:
Process:
Input : Original Image
Output: Laplacian Filter Image
Initial:
A = Load Original Image
B = Execution Laplacian Filter Image
C = Laplacian Filter Image
Step1: x = Picture.Hight In A.
Step2: y = Picture.Width In A.
Step3: Min = 0 In A.
Step4: Max = 0 In A.
Step5: For i = 1 To x In A.
Step6: For j = 1 To y In A.
Step7: q = Picture. Point (i, j) In B.
Step8: red(i, j) = q And &HFF In B.
Step9: q = (q - red(i, j)) / 256 In B.
Step10: green(i, j) = q And &HFF In B.
Step11: q = (q - green(i, j)) / 256 In B.
Step12: blue(i, j) = q And &HFF In B.
Step13: q = (q - blue(i, j)) / 256 In B.
Step14: Value = i In B.
Step15: Put the result Laplacian filter Image In C.

- For example: implementation of Laplacian filter of image fruit , as shown in Figure (6).

Figure (6): The Laplacian Filter of Image Fruit.

The third step:

Convolution Algorithm:

Process:
Input : Original Image
Output: Laplacian Filter Image
Initial:
A = Load Original Image
B = Execution Laplacian Filter Image
C = Convolution Image
Step1: x = Picture.Hight In A
Step2: y = Picture.Width In A
Step3: Min = 0 In A In A
Step4: Max = 0 In A In A
Step5: For i = 1 To x-1 In A
Step6: For j = 1 To y-1 In A
Step7: redcolor = Text1(0)* red(i-1, j-1)+Text (1)* red(i, j-1)+ Text (2)*red(i+1, j-1)+ Text(3) *red(i-1,j) +Text (4)*red(i, j-1)+ Text (5)*red(i+1, j-1)+Text (6)*red(i-1,j+1)+Text(7)*red(i,j+1)+Text(8)*red (i+1, j+1) In B.
Step8: greencolor = Text(0)*green(i-1, j-1)+Text(1) * green(i, j-1)+Text (2)*green(i+1, j-1)+Text(3)* green(i-1, j)+Text(4)*green(i,j-1)+Text(5)*green (i+1, j-1)+Text(6)*green(i-1, j+1)+Text(&)* green(i, j+1)+Text (8)*red(i+1, j+1) In B.
Step9: bluecolor = Text(0)*blue(i-1, j-1)+Text (1)* blue (i, j-1)+Text (2)* blue(i+1, j-1)+Text (3)* blue(i-1, j)+Text (4)*blue(i, j-1)+Text(5)* blue(i+1,j-1)+Text(6)*blue(i-1,j+1)+Text(7)* blue(i, j+1) +Text (8)*blue(i+1, j+1) In B.
Step10: If redcolor < 0 Then redcolor = 0 In B.
Step11: If greencolor < 0 Then greencolor = 0 In B.
Step12: If bluecolor < 0 Then bluecolor = 0 In B.
Step13: Picture (i, j), RGB(redcolor , greencolor , bluecolor) In B.
Step14: Value = i
Step15: Put the result Laplacian Filter Image In C.

- For example: implementation of convolution of image apple as shown in Figure (7).

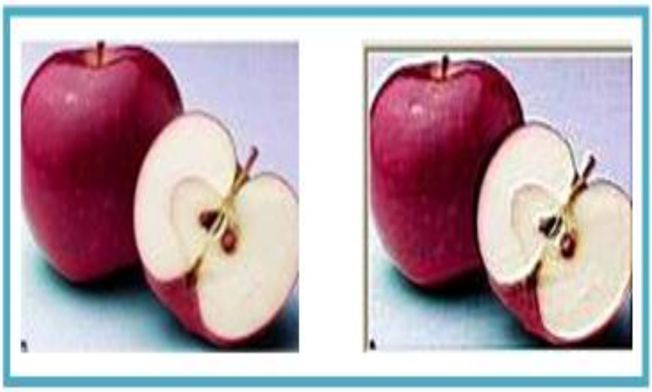


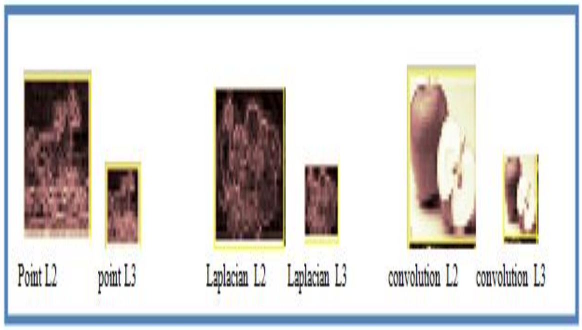
Figure (7): The Convolution of Image Apple.

The fourth step:

Haar Wavelet Transform Algorithm:

Process:
Process:
Input : Point Detect Image, Laplacian Filter Image, Convolution Image.
Output: Wavelet Transform Image in Level Two and Level Three.
Initial:
A = Load Point Detect Image, Laplacian Filter Image, Convolution Image.
B = Execution Point Detect Image, Laplacian Filter Image, Convolution Image.
C = Wavelet Transform Image in Level Two.
D= Wavelet Transform Image in Level Three.
Step1: ii = 0 In A.
Step2: For i = 0 To High - 1 In A
Step3: jj = 0 In A.
Step4: For j = 0 To Width - 1 In A
Step5: X1 = Img (i, j) In B.
Step6: X2 = Img (i, j+1) In B.
Step7: X3 = Img (i+1, j) In B.
Step8: X4 = Img (i+1, j+1) In B.
Step9: LL (ii, jj)= (x1+x2+x3+x4)/4 In B.
Step10: ii = jj+1 In B.
Step11: Next j In B.
Step12: ii =ii+1 In B.
Step13: Next i In B.
Step15: For i = 0 To (High -1)/4 In B. (L2)
Step16: For j = 0 To (High -1)/4 In B.
Step17: Get Pic(i, j), RGB(LL(i, j), LL(i, j), LL(i, j)) In B.
Step18: For i = 0 To (High -1)/8 In B. (L3)
Step19: For j = 0 To (High -1)/8 In B.
Step20: Get Pic(i, j), RGB(LL(i, j), LL(i, j), LL(i, j)) In B.
Step21: Put the result wavelet Level Two Image In C.
Step22: Put the result wavelet Level Three Image In D.

- This step uses Haar Wavelet Transform in each image for three steps above is applied in level two and level three to hide data of image, as shown in Figure (8).



Figure(8): The Implementation Wavelet transform of Image.

The fifth step:

This step uses cryptography image after these three steps above, can be uses wiener filter in space domain to applied in these image by uses XOR Gate in, point detect, laplacian filter, and convolution. And appears cryptography image after add noise in image of wiener filter.

Wiener Filter Algorithm:

Process
Input : Original Image
Output: Wiener Filter Image
Initial:
A = Load Original Image
B = Execution Wiener Filter Image
C = Wiener Image
Step1: read Image In A.
Step2: Add Noise of Image A blurring In B,
Step3: NSR Equal Noise(:) *^2 Divide (in2double (I (:))*^2) In B.
Step4: wiener Deconwnr (blurred Noise, PSF, NSR) In B.
Step5: Put The Result in C.

- For example: implementation of wiener filter of image papper as shown in Figure (9).

Figure (9): The Wiener Filter of Image Papper.

8- Test of Result

The implementation of system in point detect, laplacian filter, convolution, and these methods is applied wavelet Transform in level two and level three, and the wiener filter is applied to cryptography image, is shown in Figure (10). The system is powerful in image security, and without sensitively by attackers.

For example: Point detect

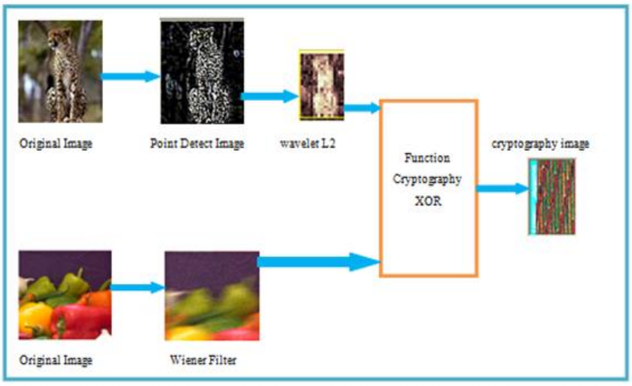


Figure (10): The cryptography Image in Wavelet Transform point detect.

- The implementation of system all steps is represented in Table (1), and Table (2).

Table (1): The Implementation of Point Detect and Laplacian Filter.

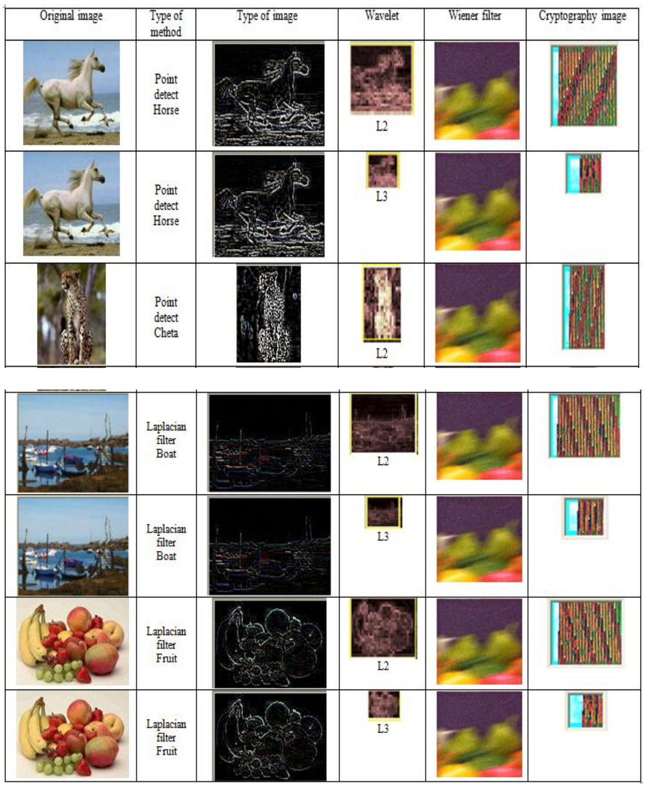
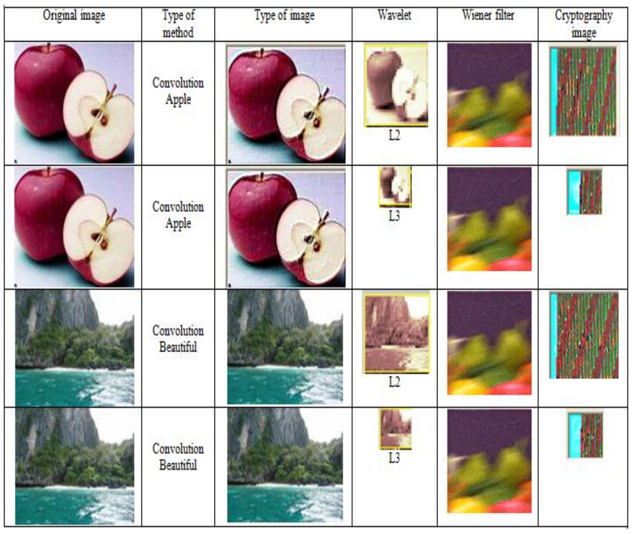


Table (2): The Implementation of convolution.



- Table (3) indicate distortion measures in image processing in PSNR, SNR, RMAE, MSE, correlation. These measures explain in equation 5, 6, 7, 8, 9.

PSNR = $10.\log_{10} MAX_1^2 / MSE$ …….5

MSE = $1/m\ n\ \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} [I(i,j) - K(i,j)]^2$……………………………..…6

SNR = P_{Signal} / P_{Noise} ………………..7

RMAE = $1/n \sum_{i=1}^{n} |ei|$………………..8

$$\text{Correlation} = \frac{\Sigma_i (x_i - x_m)(y_i - y_m)}{\sqrt{\Sigma i(xi - xm)^2}\ \sqrt{\Sigma i(yi - ym)^2}} \quad ….9$$

Where :

X_i is value of image pixel.

X_m is value of relation between X_i and Y_i .

Y_i is value of image pixel.

Y_m is value of relation between X_m and Y_m .

P_{Signal} is power of signal.

P_{Noise} is power of noise.

Table (3): The Implementation of Distortion Measures.

Name of picture	Type of operation	Type of Level	PSNR	SNR	RMAE	MSE	Correlation
Horse	Point detect	L1	1.245038	2.489772	138.0672	19062.5599	4.7453254
Horse	Point detect	L2	1.513055	5.656087	123.1036	15154.4868	26.491247
Cheta	Point detect	L1	1.222022	4.132461	139.4697	19.451.7988	5.9238111
Cheta	Point detect	L2	1.588723	5.929684	119.295	14231.2974	72.0582687
Boat	Laplacian filter	L1	1.283636	2.935023	135.7594	18430.6232	3.1879306
Boat	Laplacian filter	L2	1.483356	5.547564	124.6455	15536.5000	22.047179
Fruit	Laplacian filter	L1	1.203283	2.173896	140.6264	19775.7764	8.030008
Fruit	Laplacian filter	L2	1.958372	7.212410	102.9037	10589.1796	35.977753
Apple	Convolution	L1	1.064835	1.301376	149.6044	22381.4743	10.613658
Apple	Convolution	L2	1.399951	5.240914	129.1246	16673.1697	32.471652
Beautiful	Convolution	L1	1.244409	2.617027	138.1053	19073.0753	2.5524309
Beautiful	Convolution	L2	1.483356	5.547564	124.6455	15536.5000	22.047179

9- Conclusion

This paper compared between the image of point detect and image of Laplacian filter and image of convolution mask to transform by using haar wavelet transform and encryption image by uses wiener filter to prevent attacker detect image through transmit internetwork.

This system to make a new algorithm more security in point detection and Laplacian filter than convolution mask, and it does not where any attacker to observe and analyze data image existence.

The result obtained from this cryptography algorithm, its efficiency, powerful, and high security. From comparing original image with transform image in each status image in all above, is found distortion measure in PSNR, SNR, RMAE, MSE, and correlation between them.

The range of PSNR in point detect of image horse and image of cheta in L1 is 1.245 to 1.222, the range of PSNR in L2 is 1.513 to

1.588, the range of SNR in L1 is 2.489 to 4.132, the range of SNR in L2 is 5.656 to 5.929, the range of RMAE in L1 is 138.067 to 139.469, the range of RMAE in L2 is 123.103 to 119.295, the range of MSE in L1 is 19062.5599 to 19.451, the range of MSE in L2 is 15154.4868 to 1423.2974, and the range of Correlation in L1 is 4.7453 to 4.9238, range of Correlation in L2 is 26.4912 to 72.0582.

The range of PSNR in Laplacian filter of image Boat and image of fruit in L1 is 1.238 t0 1.203, the range of PSNR in L2 is1.483 to 1.958, the range of SNR in L1 is 2.935 to2.173, the range of SNR in L2 is 5.547 to 7.212, the range of RMAE in L1 is 135.759 to 140.626, the range RMAE in L2 is 124.102.903, the range of MSE in L1 in 18430.623 to19775.776, the range of MSE in L2 15536.500 to 10589.179, and the range of correlation in L1 is 3.1879 to 8,030, the range of correlation in L2 is 22.0471 to 35.977. these measures is powerful than the measures of convolution.

The distortion measure of range existent Table (3).

References

[1] D. Phillips, "Image Processing in C", Second Edition, 1994.
Available at:
http://members.aol.com/dwaynephil/cips2edsrc.zip

[2] I. Laptev, and T. Lindeberg, "Interest point detection and scale selection in space-time", 2003.
Available at:
www.irisa.fr/vista/Papers/2003_scsp_laptev.**pdf**

[3] S. E. Umbaugh, "Computer Vision and Image Processing", Prentice Hall PTR, 1998.

[4] H. Furuya, S. Eda, and T. Shimamura, " Image Restoration Via Wiener Filtering in the Frequency Domain", Wseas Transactions on Signal Processing, ISSN: 1790-5052, Issue 2, Volume 5, February 2009.

[5] P. Biswas, A. Sufian Sarkar, and M. Mynuddin," Deblurring Images using a Wiener Filter", International Journal of Computer Applications (0975 – 8887) Volume 109, No. 7, January 2015.

[6] T. Acharya , and A. K. Ray. "Image Processing Principles and Applications", 2005.

[7] A. Bhardwaj, and R. Ali, "Image Compression Using Modified Fast Haar Wavelet Tansform", World Applied Sciences Journal 7 (5): 647-653, 2009.

[8] V. Ashok, T. Balakumaran, and C. Gowrishankar," The Fast Haar Wavelet Transform for Signal & Image Processing", (IJCSIS) International Journal of Computer Science and Information Security, Vol. 7, No. 1, 2010.

[9] W. Burger, and M. J. Burger," Principles of Digital Image Processing Fundamental techniques", 2009.