Improving Message Embedding by using some Attributes of Color Image

Ahmed Saadi Abdullah
albashaahmed1985@gmail.com
Department of Computer Science
College of Computer Science and Mathematics
University of Tikrit, Tikrit, Iraq

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ABSTRACT

In this paper, we are using enhancing feedback control on a new continuous 4D autonomous hyper chaotic system proposed by Sadiq A. Mehdi and A. Hayder, Qasim [Analysis of a New Hyperchaotic System with six cross-product nonlinearities terms, 2017], this system has three critical points employs ten terms include six quadratic cross-product nonlinearity terms, We notice that when we apply any linear control method that relies on a single unit control added to the system, the system behavior in this case cannot control it, so we applied enhancing linear feedback control at origin and we noticed that a necessary condition for suppression is getting positive feedback coefficient. Theoretical analysis and numerical simulation check the validity of the results obtained.

Keywords: Embedded text, color space, image processing method.

تحسين تضمين الرسائل باستخدام بعض سمات الصورة الملونة

أحمد سعدي عبد الله
قسم علوم الحاسوب
كلية علوم الحاسوب والرياضيات
جامعة تكريت، تكريت، العراق

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الملخص

تعتبر الصور واحدة من أكثر الوسائط المتعددة استخدامًا في المراسلات بين الأشخاص ، لذلك يمكن استخدام بعض خصائص هذه الصور لإخفاء الرسائل المهمة .نظرًا لكون لكل صورة خصائص مختلفة ، فإن طريقة الإخفاء تتغير تبعًا لخصائص الصورة المستخدمة. في هذا البحث تم اقتراح خوارزمية لزيادة كفاءة خوارزمية تضمين البيانات من خلال الاعتماد على بعض خصائص الصورة الرقمية الملونة , حيث نقوم أولا بتفكيك الصورة الملونة إلى الطبقات أللونيه الاساسيه (الأحمر , الأخضر , الأزرق) . ثم نقوم بقياس مقدار التباين في كل طبقة من خلال استخدام تقنيات معالجة الصور , بعدها يتم تحديد الطبقة ذات التباين العالي واستخدامها كغطاء لتضمين الرسالة المراد تضمينها , إما الطبقتين الأخرى فيتم استخدام قيمها كمفتاح لخوارزمية التشفير التي يتم تطبيقها على النص قبل عملية التضمين لزيادة أمنيه البيانات إما طريقة الإخفاء فتعتمد على قيم البت الأول والثاني في الطبقة التي تم اختيارها كغطاء لعملية التضمين تم استخدام ثلاث معاير لقياس كفاءة الخوارزمية المقترحة (مقدار التقارب , مربع متوسط الخطأ و ذروة نسبة الإشارة إلى الضوضاء).

الكلمات المفتاحية: النص المضمن، نظام لوني، معالجة الصور.

1. Introduction

The process of encrypting or hiding data is to protect this data from unauthorized persons in obtaining, manipulating or altering this information [1]. Encryption is a change in the content of the data by changing the values in a way that is based on a particular method so that the receiving party can rearrange the data in a way that reflects the data encryption process[2]. The process of hiding information is trying to conceal the existence of confidential information, information hiding divided into two sections are watermark and steganography [3][4]. Steganography is the way of invisible communication or hidden communication, this method is used to hide confidential data, which is highly important in other data, these confidential data, which are highly important, may be text messages, pictures, audio or video clips, innocent data that is used as a cover for confidential data may be a text, a picture, a video clip, or a sound, The use of the quality of the cover depends on the size of the data to be hidden. The larger the size of the data to be hidden, the larger the cover should be. The greater the size of the cover data, the more hidden it will be [5][6]. Also the main objectives of the process of hiding data is to hide the existence of a connection between the sender and recipient[7].

The research is divided into a number of sections where the first section provides a general introduction to security data, the second section presented a set of previous studies in the light of information and rely on digital images as a cover, the digital image and its types were presented in a third section, the suggested algorithm and its steps are presented in the fourth sections. Sections fifth and sixth present the results, and the conclusion.

2. Related Work

In this paragraph, we present a number of researches that have been adopted in the process of hiding data on different characteristics of digital images such as color, nature of the picture or used coefficients transform .

In 2016, a group of researchers presented the effect of digital color systems on the data embedding process. Nine color systems were used, data was included in the least significant bit, used (mean square error and peak signal noise ratio) to measure the effect layers of color on information hiding [8]. Other researchers presented a comparative study on the effect of chromatic systems on the process of data concealment. Five color systems were used, and the least important bit method was used in the process of embedded, used (mean square error, signal noise ratio and peak signal noise ratio) to measure the effect layers of color on information hiding[9]. Other researchers presented a study on the application of techniques to hide information by using some places in the picture and include a watermark, as well as use the least important in the inclusion of information data embedded [10]. Use other contour let transform coefficients to hide hidden images in other images used as cover where two images are secreted and used as a cover sampling using contour let transform then calculate the energy of the transform coefficients and use the low energy coefficients [11]. Add it to a range of other research which used the image as a cover[12-17].

3 .Digital Image

The picture in the computer is a two-dimensional matrix form containing a set of matrix elements each element called a pixel. There are many types of images,figure (1) shows the types of digital images[18][19].

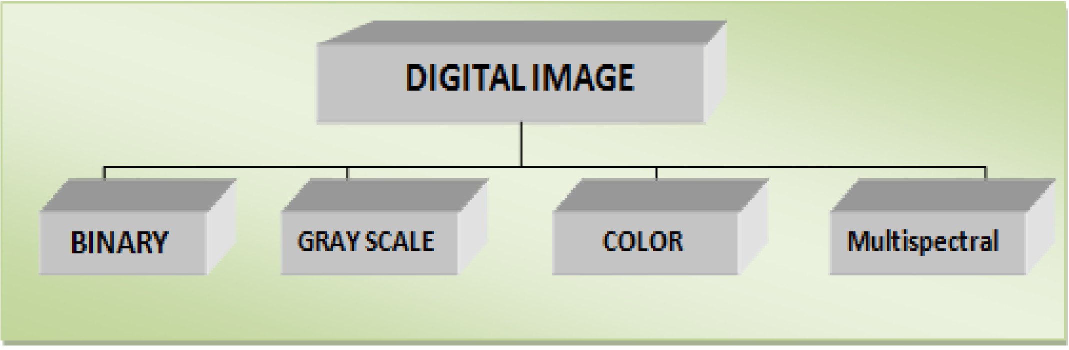


Figure (1) : Digital image

The number of bits used in the image representation varies from one type to another, the most commonly used images are true color digital images that use 24 bits to represent each pixel in the image, while the binary image needs one bit per pixel, and the gray image needs 8 bits per pixel [19].

4. proposed algorithm

in the following steps of a proposed algorithm is explained:

- first step : Reading a color image of any color model and converting it to an RGB color model or a frame that can be taken from a video.

- **Second step** : The RGB color model is divided into three layers (Red, Green,Blue)

- **Third step:** The message that will be sent is read at this point and can be written with different lengths.

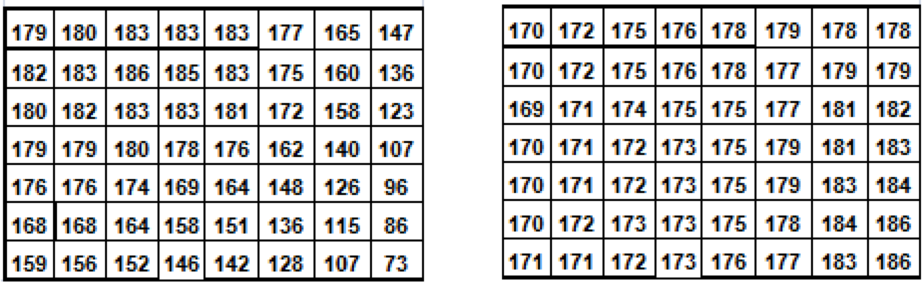
- Fourth step: The message to be sent is encrypted based on **the equation**

Cipher Text= (Plain Text + Key) MOD 26 …….……..(1)

following explains the method:

- Let the message contains the word ('AHMED')
- Convert the character to ascii code (' AHMED') ……….> (' 65 72 77 69 68')
- Encryption key is selected using the value of pixel in the second layer or the third layer .

If the value of the first pixel In the second layer is greater than the value of the first pixel In the third layer this value can be used as a key to encrypt the first character figure (2) shown value of segment of low and medium contrast layers.



179	180	183	183	183	177	165	147
182	183	186	185	183	175	160	136
180	182	183	183	181	172	158	123
179	179	180	178	176	162	140	107
176	176	174	169	164	148	126	96
168	168	164	158	151	136	115	86
159	156	152	146	142	128	107	73

170	172	175	176	178	179	178	178
170	172	175	176	178	177	179	179
169	171	174	175	175	177	181	182
170	171	172	173	175	179	181	183
170	171	172	173	175	179	183	184
170	172	173	173	175	178	184	186
171	171	172	173	176	177	183	186

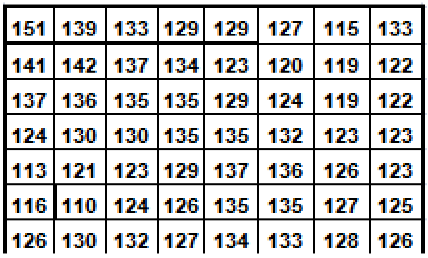
Figure (2): segment of low and medium contrast layers

By seeing the values of the layers, the first letter will be encoded with a key of 179 but the second letter will be encoded with a key of 180. The third letter will be encoded with a key of 183 whereas the fourth letter will be encoded with a key of 183. Eventually, the fifth letter will be encoded with a key of 183 and this is continued with the same method up to the last character in the message.

Fifth step: After the massage is encrypted, its ascii code of character is converted to binary number, for Example: the first character ' A' is convert to ascii code ('65') after that, it is encrypted by the above suggested algorithm. The result of the encrypted algorithm is converted to a binary number, as clarified below:

('A') …>(65…>encryption algorithm…>(72)… >(01001000)

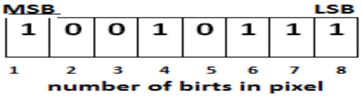
Sixth step: The characters of the message are embedded in one layer of the image. This layer is chosen by measuring the value of contrast. The layer that has the highest contrast value is the one used to cover the embedded message. However, in case two layers or all of them have the same contrast value, the choosing process depends on this order: Red first, then green and finally Blue, figure (3) shown value of segment of high contrast layers.



151	139	133	129	129	127	115	133
141	142	137	134	123	120	119	122
137	136	135	135	129	124	119	122
124	130	130	135	135	132	123	123
113	121	123	129	137	136	126	123
116	110	124	126	135	135	127	125
126	130	132	127	134	133	128	126

Figure (3): segment of high contrast layers

Take the value of the first pixel in the high contrast layer and convert it to a binary number, the first pixel has a value equal to (151) which will be represented by a binary

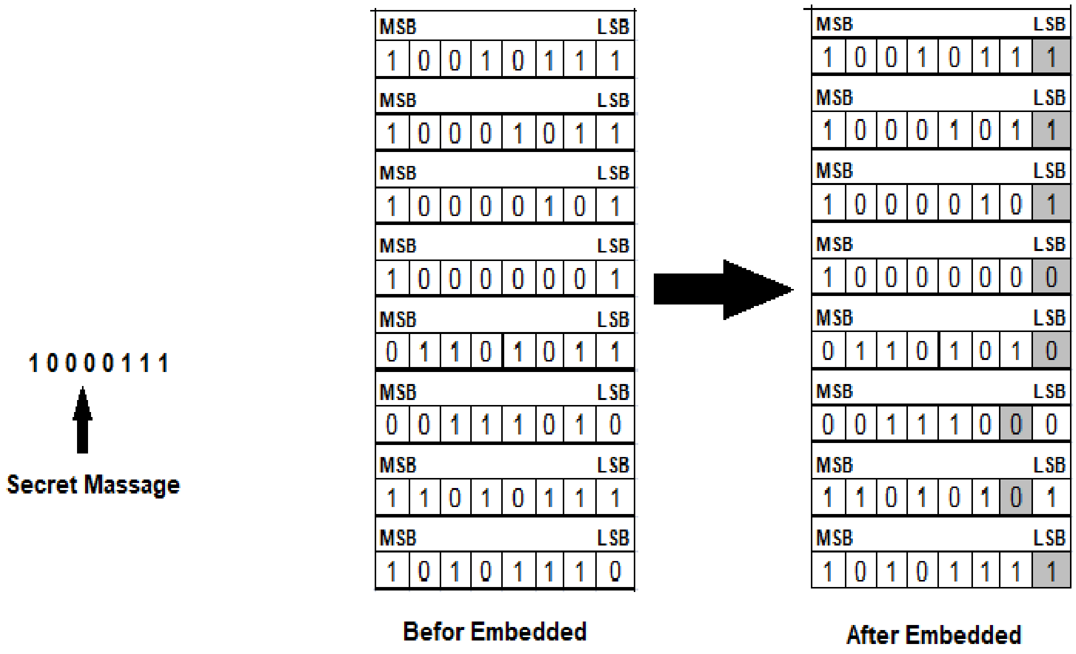


MSB LSB

1	0	0	1	0	1	1	1
1	2	3	4	5	6	7	8

number of birts in pixel

Compare the value of bit number (1) with the value of bit number (2), if the value of bit number (1) is equal to the value of bit number(2), the bit of the secret message is embedded in bit number (8) or else embedded in bit number (7). Figure (4) shown statues of pixel in cover layer after and before embedded secret message, figure (5) show the applied proposed algorithm on different images.



Befor Embedded (MSB … LSB)	After Embedded (MSB … LSB)
1 0 0 1 0 1 1 1	1 0 0 1 0 1 1 1
1 0 0 0 1 0 1 1	1 0 0 0 1 0 1 1
1 0 0 0 0 1 0 1	1 0 0 0 0 1 0 1
1 0 0 0 0 0 0 1	1 0 0 0 0 0 0 0
0 1 1 0 1 0 1 1	0 1 1 0 1 0 1 0
0 0 1 1 1 0 1 0	0 0 1 1 1 0 0 0
1 1 0 1 0 1 1 1	1 1 0 1 0 1 0 1
1 0 1 0 1 1 1 0	1 0 1 0 1 1 1 1

Figure (4) : statues of pixels in stego cover

Figure (5): image after and before embedded message

4.1 Extract embedded message

In the following steps of extract embedded message**.**

Step one : read stego image **.**

Step two: divided stego image to three layer (high , medium and low) contrast layer , after their detect cover layer of high contrast .

Step three: extract embedded message used the same comparative method that used in embedded message method**.**

Step four: calculate the key of decryption used the same method that used in encryption method **,** and used the following suggest method to decryption message

$$\textit{Plain Text} = (\textit{Cipher Text} - \textit{Key}) \quad \textit{MOD } 26 \;\ldots\ldots\ldots\ldots(2)$$

5. Result

This algorithm is applied on multi different images by using five different texts with three different lengths. and used three measure (MSE , PSNR and Correlation) And their equations are explained below[14][20].

$$MSR = \frac{1}{mn}\sum_{i=1}^{m}\sum_{j=1}^{n}(input\ image(i,j) - outputimage(i,j))2 \quad \ldots\ldots\ldots\ (3)$$

$$PSNR = 10 * log\left(\frac{255^2}{MSR}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

$$CORR = \frac{\sum_m\sum_n\left((I-\bar{I})(O-\bar{O})\right)}{\sqrt{(\sum_m\sum_n(I-\bar{I})^2)(\sum_m\sum_n(O-\bar{O})^2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

Table (1) shows the results of the application of the proposed algorithm on the higher-contrast layer and its use as a cover to conceal the data, Table (2) shows the results of the application of the proposed algorithm on the median -contrast layer and its use as a cover to conceal the data,

Table(1): Applied algorithm on High contrast layer

Image	No. Character	HIGH - CONTRART		
		MSE	PSNR	CORR
Img1	80	1.85714	45.4763	0.9999
	120	1.89115	45.397	0.9989
	240	1.94285	45.2803	0.9967
	300	1.97373	45.17793	0.9914
	400	2.1321	44.8427	0.9881
Img2	80	1.9863	45.1841	0.9976
	120	2.064	45.0171	0.9932
	240	2.13333	44.8742	0.9912
	300	2.3172	44.48117	0.9891
	400	2.5671	44.03638	0.9854
Img3	80	1.61428	46.82	0.9987
	120	1.7714	45.68	0.9956
	240	1.9619	45.23	0.9930
	300	2.1323	44.84232	0.9910
	400	2.3432	44.43271	0. 9882
Img4	80	1.7653	45.66262	0.9981
	120	1.8762	45.39801	0.9974
	240	1.9986	45.12354	0.9932
	300	2.3451	44.42919	0.9901
	400	2.5433	44.07683	0.9876
Img5	80	1.7651	45.66311	0.9981
	120	1.8014	45.5747	0.9953
	240	2.143	44.82058	0.9921
	300	2.321	44.47405	0.9891
	400	2.5161	44.12352	0.9862

Table(2): Applied algorithm on median contrast layer

Image	No. Character	MEDIAN CONTRAST		
		MSE	PSNR	CORR
Img1	80	1.99285	45.1700	0.9989
	120	2.01360	45.1250	0.9983
	240	2.03809	45.0725	0.9957
	300	1.993467	45.13471	0.9884258
	400	2.153421	44.79951	0.9851357
Img2	80	2.0642	45.0171	0.9970
	120	2.08163	44.9807	0.9899
	240	2.84761	43.4986	0.9889
	300	2.340372	44.43795	0.9861327
	400	2.592771	43.99316	0.9824438
Img3	80	2.01360	45.1250	0.9976
	120	2.02857	45.0928	0.9922
	240	2.05	45.0472	0.9901
	300	2.153623	44.79911	0.988027
	400	2.366632	44.3895	0.985235
Img4	80	1.782953	45.6194	0.995106
	120	1.894962	45.3548	0.994408
	240	2.018586	45.08033	0.99022
	300	2.368551	44.38598	0.98713
	400	2.568733	44.03361	0.984637
Img5	80	1.782751	45.6199	0.995106
	120	1.819414	45.53149	0.992314
	240	2.16443	44.77737	0.989124
	300	2.34421	44.43084	0.986133
	400	2.541261	44.08031	0.983241

The results of applying the proposed algorithm to the low contrat layer are explained in Table (3)

Table(3): Applied algorithm on Low contrast layer

Image	No. Character	LOW CONTRAST		
		MSE	PSNR	CORR
Img1	80	2.09285	44.9574	0.99935
	120	2.20952	44.72181	0.9923
	240	2.14965	44.84110	0.9898
	300	2.013205	45.09192	0.9835
	400	2.174742	44.75673	0.9721
Img2	80	2.80952	40.589156	0.9892
	120	2.83673	40.52433	0.9853
	240	2.90714	40.06096	0.9823
	300	2.363544	44.39517	0.983165
	400	2.618442	43.95037	0.979488
Img3	80	2.05034	45.09228	0.9875
	120	2.12380	44.893643	0.9856
	240	2.96428	40.23275	0.9811

	300	**2.174946**	**44.75632**	**0.985054**
	400	**2.390064**	**44.34671**	**0.982271**
Img4	**80**	**1.800606**	**45.57662**	**0.992111**
	120	**1.913724**	**45.31201**	**0.991416**
	240	**2.038572**	**45.03754**	**0.987241**
	300	**2.392002**	**44.34319**	**0.984159**
	400	**2.594166**	**43.99083**	**0.981674**
Img5	**80**	**1.800402**	**45.57711**	**0.992111**
	120	**1.837428**	**45.4887**	**0.989328**
	240	**2.18586**	**44.73458**	**0.986147**
	300	**2.36742**	**44.38805**	**0.983165**
	400	**2.566422**	**44.03752**	**0.980283**

After obtaining the results, the results were analyzed as shown in the figures below. Figure (6) shows the performance of the proposed algorithm with (MSE). And Figure (7) shows the performance of the proposed algorithm with (PSNR)

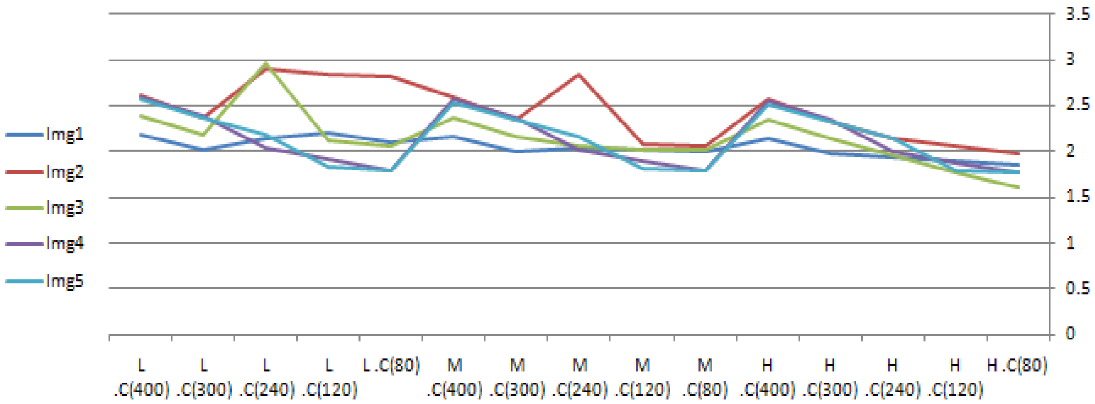


Figure (6) : MSE Performance

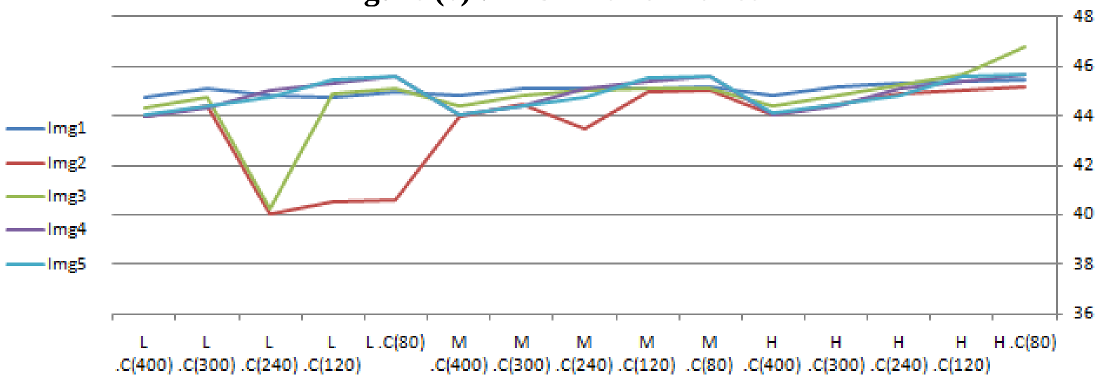


Figure (7) : PSNR Performance

Figure (8) shows the performance of the proposed algorithm with (correlation).

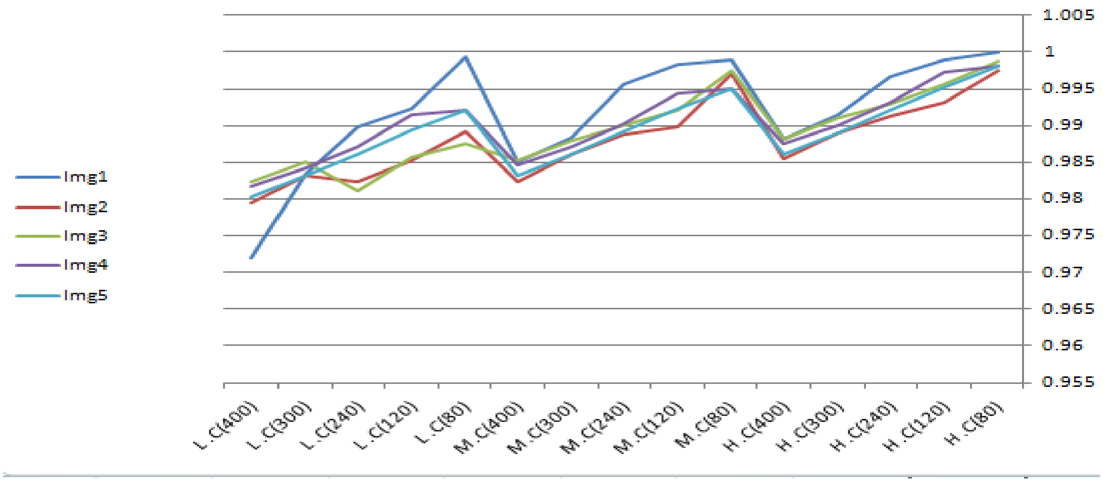


Figure (8) : Correlation Performance

6.Conclusion

The preservation of the confidentiality of important information is one of the most important topics, which is one of the most important fields in which the researchers work to increase the security of these data, through the study presented in this research and the use of three images of a different nature and hide three texts in different lengths show that the high-contrast class be more efficient when used as a cover in hiding confidential information and it becomes clear that whenever the text to be hidden with a short length is the result of hiding better, the relationship between the length of the text to hide and the efficiency of hiding is an reverse relationship where it is clear through the tables of results and forms of performance criteria of the measure that the text length (80) gives better results than other texts in all the images that were adopted in this research, one of the most important features offered by the proposed algorithm is that it depends on the properties of the image used as a cover, so that the embedding process and the selection of the encryption key changes with each image. But the drawback of this proposed algorithm when used the same image as a cover to embedded message in this state when the third person (hacker) can extract the hidden message, the proposed algorithm reveals.

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