The efficiency of Color Models layers at Color Images as Cover in text hiding

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Abstract

The color images are used widely as a cover in hiding of the information. Since the variety of applications of the color image there are several color models of color image. Most color models consist of three layers. The nature of the color mode of the cover plays a main role in determining the robustness and security of hiding algorithm.

The objective of this paper tests the layers, components, of the color models of cover color images, to figure out which color layer of each color model is best (less affected) to use as a cover to hide information within each color model in the hiding process. The experiments concentrate on the hiding texts in two positions of each layer, 7^{th} bits and 8^{th} bits (LSB). Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR) were used to measure the affected of hidden text in layers. The tests were done on nine colors models: RGB, HSV, HIS, HSL, HSB, YCbCr, La*b*, LUV and CMYK.

The results show that some of color models have best layer to hide text such as YCbCr, HSI, CMYK, HSL and LUV . In other color models which have been tested, there is not a distinctive layer. The layer H is the worst because any hiding leaves a clear impact on the cover image.

Keywords: steganography, color image, color models, color models transform, LSB.

1. Introduction

Digital steganography can be defined as the art of hiding data in a cover medium [1]. The cover maybe image, text, or sound. The cover is used to hide information inside it in a way that prevent any third party to even detect that there is a second information present[2]. The transfer of secret information within the cover must be done using Imperceptibility, Security, Capacity and Robustness method [3].

Images become the most frequently used as a cover in the field of steganography since they have large capacity to hide secret information within it, and possibility of random access to any pixel within the image. In addition to, transmission images are possible over the internet without harmlessness and attraction, and the difficulty for the naked eye to distinguish manipulation within cover image during embedding process [4].

The nature of the cover color mode plays a main role in determining the robustness and security of algorithm. Most of the researchers concentrate on the steganography algorithms that depend on using specific color models to get robustness, detectability and capacity of hiding data system. They don't give a special attention about the layers of the color model.

This paper produces tests on the layers of images colors models to figure out which color layer of each color model is best (less affected) which can be used as a cover to hide information within each color model in the hiding process.

2. Related work

Many studies of steganography methods have been conducted that compared between the colors models which are concerned with effectiveness in Information Hiding. Those methods dealt with each color model as an independent unit (one block), without taking in the account the layers of each color model [5] [6] [7]. [8] [3]. There is no publication concerned with the efficiency of each layer within the color models independently.

3. Image steganography

The image steganography is an array of M*N matrix. Each pixel has a numerical value that represents the color and light intensity of the pixel [9]. In the last decades, many steganography methods are proposed that use color images to hide information within them, which aims to certify high security, capacity, and robustness [10].

Many metrics are used to measure the hidden efficiency within the cover images. The most common measures are: Mean square error (MSE) and peak signal-to-noise ratio (PSNR).

4. Color Models

Color models, sometimes called color spaces or color systems, are the ways of representing colors sets mathematically. The main aim of the color spaces is to represent all colors in a standard way. Different color modes are needed for better different applications. A color is thus usually specified using three layers. These layers describe the position of the color within the color model being used.

The most common color models are RGB (Red, Green, Blue), CMYK (Cyan, Magenta, Yellow and Black), YCbCr (Luminance Component, Chroma Blue difference, Chroma Red difference), **HSB** (Hue, Saturation, Brightness), and HSI (Hue, Saturation and Intensity) which is derived from RGB color space that represents colors the way the human eyes perceive and interpret colors. [11][5].

There are equations that convert each color model to another model.

5. Transformation among color models

To convert the RGB color model to other color models, there are several formulas that is used. Following is some transformation formulas.[12][5]

5.1. Transform RGB to HSI

$$I = \frac{R+G+B}{3}$$

$$H = cos^{-1}\left[\frac{R+\frac{1}{2}G-\frac{1}{2}B}{\sqrt[2]{R^2+G^2+B^2-RG-RB-GB}}\right] \quad if\ G > B \quad or$$

$$H = cos^{-1}\left[\frac{R+\frac{1}{2}G-\frac{1}{2}B}{\sqrt[2]{R^2+G^2+B^2-RG-RB-GB}}\right] \quad \text{if B} > \text{G}$$

$$S = 1 - \frac{M3}{R+G+B}[\min(R,G,B)]$$

5.2 Transform RBG to YCbCr

$$\begin{pmatrix} Y \\ Cb \\ Cr \end{pmatrix} = \begin{pmatrix} 16 \\ 128 \\ 128 \end{pmatrix} + \begin{pmatrix} 65.481 & 128.535 & 24.966 \\ -37.797 & -74.203 & 112 \\ 112 & -93.786 & -18.214 \end{pmatrix} \begin{pmatrix} R \\ G \\ B \end{pmatrix}$$

5.3 Transform RBG to CMYK

B = min (1 – R, 1 – G, 1 – B)
C = (1 – R – B)/(1 – B)
M = (1 – G – B)/(1 – B)
Y = (1 – B – B)/(1 – B) = 1 – 1/B

5.4 Transform RBG to La*b*

$$L^* = 116(Y/Y_n)^{1/3} - 16, for \quad Y/Y_n > 0.008856$$

$$L^* = 903.3\,Y/Y_n, \quad \text{otherwise}$$

$$a^* = 500(f(X/X_n) - f(Y/Y_n))$$

$$b^* = 200(f(Y/Y_n) - f(Z/Z_n)),$$

$$\text{where} \quad f(t) = t^{1/3}, for \quad t > 0.008856$$

$$f(t) = 7.787t + 16/166, \quad \text{otherwise}$$

When, X_n, Y_n, and Z_n are the tristimulus values of the reference white point you specify using the **White point** parameter:

5.5 Transform RBG to HSV

Hue calculation:

$$H = \begin{cases} 0^\circ & \Delta = 0 \\ 60^\circ \times \left(\frac{G'-B'}{\Delta} mod 6\right) & , C_{max} = R' \\ 60^\circ \times \left(\frac{B'-R'}{\Delta} + 2\right) & , C_{max} = G' \\ 60^\circ \times \left(\frac{R'-G'}{\Delta} + 4\right) & , C_{max} = B' \end{cases}$$

Saturation calculation:

$$S = \begin{cases} 0 & , C_{max} = 0 \\ \frac{\Delta}{C_{max}} & , C_{max} \neq 0 \end{cases}$$

Value calculation:

$$V = Cmax$$

5.6 Transform RBG to HSB

$$H = \begin{cases} \left(\frac{G'-B'}{MAX-MIN}\right)/6, & \text{if} \quad R' = MAX \\ \left(2 + \frac{B'-R'}{MAX-MIN}\right)/6, & \text{if} \quad G' = MAX \\ \left(4 + \frac{R'-G'}{MAX-MIN}\right)/6, & \text{if} \quad B' = MAX \end{cases}$$

- S (saturation) = 0, if R = G = B, otherwise 255 * (M - m) / (M + m), if L < 128, otherwise 255 * (M - m) / (511 - (M + m)).

B (Brightness) = (M + m) / 2, where M is max(R, G, B) and m is min(R, G, B).

5.7 Transform RBG to HSL

Hue calculation:

$$H = \begin{cases} 0^\circ & \Delta = 0 \\ 60^\circ \times \left(\frac{G'-B'}{\Delta} mod 6\right) & , C_{max} = R' \\ 60^\circ \times \left(\frac{B'-R'}{\Delta} + 2\right) & , C_{max} = G' \\ 60^\circ \times \left(\frac{R'-G'}{\Delta} + 4\right) & , C_{max} = B' \end{cases}$$

Saturation calculation:

$$S = \begin{cases} 0 & , \Delta = 0 \\ \frac{\Delta}{1-|2L-1|} & , \Delta <> 0 \end{cases}$$

Lightness calculation:

$$L = (Cmax + Cmin) / 2$$

6 The proposed work

This paper is characterized by focusing on the analysis the layers of each color mode and study the effectiveness of hiding text in each layer (the efficiency of using each layer as a cover to hide text within it).

Also, this paper gives a comparative study of using different image colors models that is used as a cover in steganography. The image sizes were 400x400, 700x700, and 1200x1200. Different lengths of texts were hidden in the color images with different models such as 26, 30, 100, 150, and 200. The position of hiding text was in 8^{th} bit or 7^{th} bit, one of them in each test. The aim is determining which is the best image color mode used as a cover, beside try to determining which the best layer in each color model that used to hide information. A steganography algorithm designed and implemented using each color model to test the best color model and the best layer in each color model. The hiding process involves breaking down the cover color image into color model layers, each layer represent one color.

The general algorithm that was used is shown in figure 1.

Input: Color image, secret text. Output: statistical result about each color mode layer.	
1)	Read the secret text.
2)	Read color cover image, RGB color model.
3)	Select the color model
4)	Select the position of hidden text in the layer, either 8^{th} bit or 7^{th} bit.
5)	Convert the color image from RGB model to selected color model
6)	Breaking down the cover image into color space layers, each layer represents one color.
7)	Chose the layer, one layer at each time, as a cover
8)	Hide the secret text in the selected bit of the selected layer.
9)	Analysis the layer data of the color model that is used as a cover.
10)	print the results

Figure 1: The general algorithm that was used

7 Implementation and analysis

The proposed algorithm is implemented using nine different colors models. Different secret texts were hidden in different images with different sizes. To ensure the objective of comparison between those models, the same conditions for all models were used. Similar circumstances are used in models comparisons; the same image, the same hidden text, and the same position of hidden text. The study was performed using two cases for the position of hidden text independently in each layer: the least significant bit (LSB), the 8^{th} bit, and its neighbor, 7^{th} bit. To verify the result, two metrics were used, MSR and PSNR, to measure the effective of the hidden text in the cover image.

The implementation is done in two steps with two directions. The first step was hidden in 8^{th} bit of layers and performed the tests. The second step was hidden in 7^{th} bit of each layer and then performed the tests.

In the first direction; hide the text in all layers of color model equally. In the second direction hide the text in each layer of color model independently with the other layers.

At first, the text is hidden in the color image in each color model, taking in the account that the text is hidden in all layers equally.

7.1 Hiding in 8^{th} bits

The hiding is done in two aspects. First, the texts are hiding in all layer equally. Second, the texts are hiding in one layer each time.

7.1.1 Hiding in all layers

The tests results of hidden the same text in LSB of each color model are shown in the table 1. The hidden was in all layers equally.

Table 1: A comparison between colors modes

No.of character	Size of image	CMYK		La*b*		YCbCr		HSB		HSL		HSI		HSV		RGB		LUV	
		PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE
	400*400	58.1	0.101	55.844	0.1706	58.533204	0.09187	58.2636316	0.09775	58.1822059	0.0996	58.2326421	0.09845	58.2636316	0.098	58.2	0.1	58.8502206	0.0854
100	700*700	59.55	0.073	61.793	0.0434	59.9518262	0.06627	59.8653323	0.0676	58.8425992	0.08555	61.7056666	0.04425	59.8653323	0.068	59.7	0.071	62.6138548	0.0359
	1200*1200	64.33	0.024	61.691	0.0444	64.8470857	0.02147	63.6087382	0.02855	63.9078272	0.02665	64.2115354	0.02485	63.6087382	0.029	64.2	0.025	64.1796703	0.02503
	400*400	55.42	0.188	53.626	0.2844	55.8748193	0.16943	55.6630398	0.1779	54.6198733	0.2262	54.7524331	0.2194	55.6630398	0.178	55.5	0.183	55.5292197	0.18347
150	700*700	58.83	0.086	60.766	0.0549	59.2830044	0.0773	59.010801	0.0823	58.7721034	0.08695	59.8397102	0.068	59.010801	0.082	58.6	0.091	61.6779798	0.04453
	1200*1200	60.53	0.058	57.363	0.1203	61.1061622	0.0508	59.7262451	0.0698	60.4932406	0.0585	59.6767523	0.0706	59.7262451	0.07	60.5	0.058	59.124843	0.08017
	400*400	53.59	0.287	51.156	0.5022	53.5970864	0.28627	53.3225129	0.30495	52.4471289	0.37305	53.0286286	0.3263	53.8713146	0.269	53.1	0.318	53.2121319	0.3128
200	700*700	56.13	0.16	57.828	0.1081	56.4338986	0.14897	56.3321009	0.1525	56.2713001	0.15465	57.5090022	0.1163	57.4607261	0.118	55.8	0.174	59.065657	0.08127
	1200*1200	59.32	0.077	56.587	0.1438	59.5474843	0.07273	59.1014489	0.0806	59.4345012	0.07465	59.4228813	0.07485	58.7076522	0.088	59.3	0.077	58.8502206	0.0854

From table 1 and figure 2, the results show that the efficiency depend on the nature the cover image, its size and the hidden text size.

Depending on the average values of MSE and PSNR, the color models can be categories in three levels. The color model is best if the MSE value of it is lowest and largest PSNR value. This means that the model is less affected by hiding text within it. The first (best) level includes LUV, YCbCr and HSV; $0.104 \leq MSE \leq 0.111$ and $59.234 \leq PSNR \leq 58.464$. The second level is CMYK, HSB, HSI and RGB; $0.116 \leq MSE \leq 0.122$ and $58.71 \leq PSNR \leq 58.33$. The third level includes the color model L*a*b which it was lowest efficiency, MSE=0.164 and PSNR=56.574. The obtaining results confirm the results that obtained in [5] [6] [7].

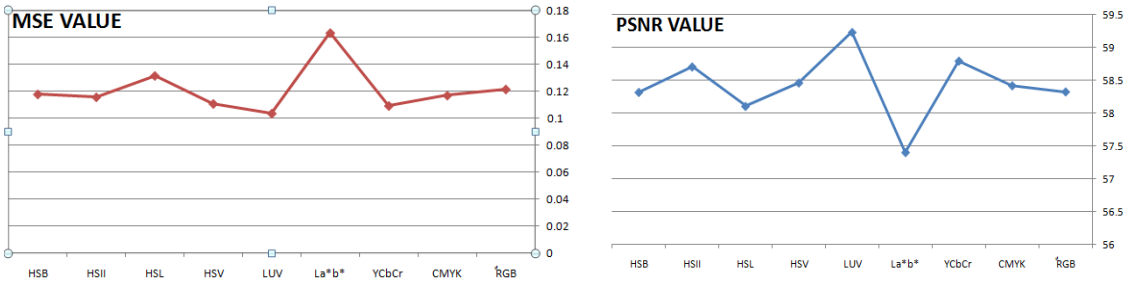

Figure 2: Compare between 6 color modes

7.1.2 Hidden in each layer independently

Analyzing the effective of hidden text in LSB at **each layer** independently to check which layer in each color model is the best are conducted. Results are shown only for three texts lengths to reduce the size of tables.

The summary of the results for the layers of the color modes: RGB, HSI, HSV, HSL2, YCbCr, CMYK, HSL, and LUV are shown in the tables 3- 10.

Table 2: RGB color models

No. of text characters	Size of image	Red		Green		Blue	
		MSE	PSNR	MSE	PSNR	MSE	PSNR
100	400 * 400	0.0915	58.5491	0.0959	58.3486	0.1117	57.684
	700*700	0.0791	59.1836	0.0743	59.4523	0.0589	60.464
	1200*1200	0.0227	64.6021	0.0264	63.955	0.025	64.1806
150	400 * 400	0.1605	56.1112	0.189	55.4012	0.1983	55.1925
	700*700	0.0997	58.1794	0.0882	58.7116	0.0865	58.795
	1200*1200	0.0587	60.4778	0.0555	60.7199	0.0591	60.448
200	400 * 400	0.3229	53.0741	0.2996	53.3991	0.3305	52.9728
	700*700	0.1905	55.3656	0.1621	56.0662	0.168	55.9108
	1200*1200	0.0758	59.3683	0.0743	59.4534	0.0804	59.1125
Average		0.122378	58.32347	0.118367	58.3897	0.124267	58.30669

Table 3: HSI color model

No. of text characters	Size of image	saturation		intensity	
		MSR	PSNR	MSR	PSNR
100	400 * 400	0.1064	57.8949	0.0928	58.4911
	700*700	0.0968	58.3038	0.0743	59.4523
	1200*1200	0.0306	63.3113	0.0227	64.6021
150	400 * 400	0.2416	54.3336	0.2108	54.9253
	700*700	0.0887	58.6861	0.0852	58.8627
	1200*1200	0.0567	60.6283	0.0603	60.3592
200	400 * 400	0.4161	51.9726	0.33	52.9801
	700*700	0.161	56.0958	0.1483	56.4542
	1200*1200	0.0714	59.6289	0.0779	59.2469
Average		0.141033	57.87281	0.122478	58.37488

Table 4: La*b* color models

No. of text characters	Size of image	L		a*		b*	
		MSR	PSNR	MSR	PSNR	MSR	PSNR
	400 * 400	0.0962	58.3316	0.1133	57.6232	0.3024	53.3588
100	700*700	0.0759	59.3618	0.035	62.7275	0.0192	65.3375
	1200*1200	0.0954	58.3682	0.0011	77.9344	0.0367	62.5211
	400 * 400	0.1747	55.7411	0.2175	54.7895	0.4609	51.5291
150	700*700	0.0956	58.3585	0.0547	60.7837	0.0145	66.5378
	1200*1200	0.2639	53.95	0.0035	72.7305	0.0934	58.4623
	400 * 400	0.3216	53.0918	0.3576	52.6309	0.8273	48.9883
200	700*700	0.1616	56.0803	0.1142	57.5884	0.0484	61.3136
	1200*1200	0.2944	53.4754	0.0105	67.9498	0.1265	57.1423
Average		0.175478	56.30652	0.100822	62.75088	0.214367	58.35453

Table 5: HSB color model

No. of text characters	Size of image	saturation		brightness	
		MSR	PSNR	MSR	PSNR
	400 * 400	0.0874	58.7494	0.1081	57.8255
100	700*700	0.0624	60.2122	0.0728	59.5437
	1200*1200	0.0351	62.712	0.022	64.7473
	400 * 400	0.1721	55.806	0.1837	55.5244
150	700*700	0.0829	58.9815	0.0817	59.0435
	1200*1200	0.0825	58.9993	0.0571	60.598
	400 * 400	0.2868	53.5896	0.3231	53.0709
200	700*700	0.1472	56.4846	0.1578	56.1824
	1200*1200	0.0863	58.8039	0.0749	59.4191
Average		0.115856	58.25983	0.120133	58.43942

Table 6: YCbCr color models

No. of text characters	Size of image	Y		Cb		Cr	
		MSE	PSNR	MSE	PSNR	MSE	PSNR
	400 * 400	0.0983	58.2401	0.1184	57.4329	0.0589	60.4632
100	700*700	0.0675	59.8715	0.0751	59.4069	0.0562	60.6708
	1200*1200	0.0312	63.2289	0.0132	66.9581	0.02	65.1467
	400 * 400	0.1727	55.7925	0.2005	55.143	0.1351	56.8588
150	700*700	0.0968	58.307	0.0605	60.3469	0.0746	59.4357
	1200*1200	0.0773	59.2807	0.0275	63.7786	0.0476	61.3896
	400 * 400	0.297	53.437	0.3206	53.1047	0.2412	54.3419
200	700*700	0.1733	55.7781	0.1587	56.1599	0.1149	57.5626
	1200*1200	0.0886	58.6922	0.0585	60.4903	0.0711	59.6488
Average		0.122522	58.06978	0.114778	59.20237	0.091067	59.50201

Table 7: HSV color mode

No. of text characters	Size of image	saturation		value	
		PSNR	MSR	PSNR	MSR
100	400 * 400	58.7494	0.0874	57.8255	0.1081
	700*700	60.2122	0.0624	59.5437	0.0728
	1200*1200	62.712	0.0351	64.7473	0.022
150	400 * 400	55.806	0.1721	55.5244	0.1837
	700*700	58.9815	0.0829	59.0435	0.0817
	1200*1200	58.9993	0.0825	60.598	0.0571
200	400 * 400	53.97	0.2627	53.7749	0.2748
	700*700	57.6296	0.1131	57.2994	0.1221
	1200*1200	57.9697	0.1046	59.5993	0.0719
Average		58.33663	0.111422	58.66178	0.110467

Table 8: CYMK color model

No. of text characters	Size of image	C		M		Y		K	
		MSR	PSNR	MSR	PSNR	MSR	PSNR	MSR	PSNR
100	400 * 400	0.1036	58.0102	0.1081	57.826	0.1024	58.0626	0.0915	58.5491
	700*700	0.069	59.7766	0.066	59.9675	0.0815	59.0524	0.0743	59.4523
	1200*1200	0.0227	64.6021	0.0264	63.955	0.025	64.1806	0.0227	64.6021
150	400 * 400	0.1873	55.4401	0.2133	54.8745	0.1922	55.3277	0.1605	56.1112
	700*700	0.0905	58.6005	0.081	59.0801	0.0838	58.9316	0.0882	58.7116
	1200*1200	0.0587	60.4778	0.0555	60.7199	0.0591	60.448	0.0587	60.4778
200	400 * 400	0.3563	52.6462	0.3397	52.8542	0.29	53.5411	0.1605	56.1112
	700*700	0.1739	55.7623	0.1531	56.3144	0.1505	56.3905	0.1621	56.0662
	1200*1200	0.0758	59.3683	0.0743	59.4534	0.0804	59.1125	0.0758	59.3683
Average		0.126422	58.29823	0.124156	58.33833	0.118322	58.33856	0.099367	58.82776

Table 9: HSL color models

No. of text characters	Size of image	saturation		Luminas	
		MSR	PSNR	MSR	PSNR
100	400 * 400	0.1064	57.8949	0.0928	58.4911
	700*700	0.0968	58.3038	0.0743	59.4523
	1200*1200	0.0306	63.3113	0.0227	64.6021
150	400 * 400	0.2416	54.3336	0.2108	54.9253
	700*700	0.0887	58.6861	0.0852	58.8627
	1200*1200	0.0567	60.6283	0.0603	60.3592
200	400 * 400	0.4161	51.9726	0.33	52.9801
	700*700	0.161	56.0958	0.1483	56.4542
	1200*1200	0.0714	59.6289	0.0779	59.2469
Average		0.141033	57.87281	0.122478	58.37488

Table 10: LUV color model

No. of text characters	Size of image	L		U		V	
		MSE	PSNR	MSE	PSNR	MSE	PSNR
100	400 * 400	0.0962	58.3316	0.0957	58.3554	0.0643	60.0852
	700*700	0.0759	59.3618	0.0164	66.0134	0.0154	66.2849
	1200*1200	0.0225	64.6502	0.0193	65.3013	0.0333	62.9468
150	400 * 400	0.223	54.6813	0.1779	55.664	0.1495	56.4182
	700*700	0.0956	58.3585	0.0188	65.4275	0.0192	65.3375
	1200*1200	0.0666	59.93	0.0575	60.5678	0.1164	57.5047
200	400 * 400	0.3886	52.2694	0.3253	53.0417	0.2245	54.6523
	700*700	0.1616	56.0803	0.0437	61.7575	0.0385	62.3157
	1200*1200	0.0675	59.8726	0.0693	59.7547	0.1194	57.3947
Average		0.133056	58.17063	0.091544	60.6537	0.086722	60.32667

The layer H ((Hue) in color models cannot used in hiding process since the hidden within it will change the color of image, such as HSB, HSI, HSL, and HSV, as shown in figure 1.

a) The cover before hidden information b) The cover after hidden information

Fig. 2: hide text in Hue layer in the HSI color mode

From the results in tables 2-10, layers of some color models are closely such as RGB, HSV, and HSB. For other models, the efficiency layers are varied for each color model as shown in Table

Table 11: Best layers in each color models

Color model	RGB	YCbCr[	HSV	La*b*	HSI	HSB	CMYK	HSL	LUV
Best layer	Layers closely	Cr	Layers closely	a*	I	Layers closely	K	L	U & V

7.2 Hiding in 7th bit

The same previous experiments are performed using the 7th bit in the cover image for hiding texts instead of using 8th bits, LSB. The tables are shortcut to reduce the sizes of tables, so that they include only the averages of results.

7.2.1 Hiding in all layers

The texts are hidden in the 7th bit of all color model layers equally at the same time. The results are shown in table12. The sort of color models from the best to worst is LUV, HSV, HIS, HSL, HSB, CMYK, RGB, L a*b*, and YCbCr.

Table 12: Color models comparison

Color Model	CMYK		La*b*		YCbCr		HSB		HSL		HSI		HSV		RGB		LUV	
	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE
Average	52.28	0.489	51.766	0.5917	51.273	0.598	52.098	0.481	52.348	0.4771	52.592	0.458	52.221	0.455	52.246	0.503	53.586	0.394

7.2.2 Hiding in each layer independently

The texts are hiding in the 7th bit of each layer independently from other layers in the color model. The results are shown in table 13.

From table 13 results, The effect of hidden texts in each layers is almost equally matched in colors models RGB, HSI, HSB, HSV, HSL. But, there are a variation in the affected in the layers of the color models CMYK, LUV, and La*b*. In CMYK, the layers C and M are the best. In La*b*, the layers L and a* are the best. In LUV, the layers U and V are the best, the value of MSE is the smallest.

Table 13: Tests mean results of 7th bits in color modes

a) RGB color mode layers

	RGB					
No. of text characters	Red		Green		Blue	
	PSNR	MSE	PSNR	MSE	PSNR	MSE
Average	52.9358	0.38882	52.8616	0.38285	52.8264	0.40341

b) HIS color mode layers

	H S I			
No. of text characters	saturation		intensity	
	PSNR	MSE	PSNR	MSE
Average	52.9358	0.38882	52.8616	0.38285

c) La*b* color mode layers

	L a* b*					
No. of text characters	L		a*		b*	
	PSNR	MSE	PSNR	MSE	PSNR	MSE
Average	52.9358	0.38882	52.8616	0.38285	48.3134	0.56954

d) HSB color mode layers

	HSB			
No. of text characters	saturation		brightness	
	PSNR	MSE	PSNR	MSE
Average	52.9358	0.38882	52.8616	0.38285

e) YCbCr color mode layers

	YCbCr					
No. of text characters	Y		Cb		Cr	
	PSNR	MSE	PSNR	MSE	PSNR	MSE
Average	52.9358	0.38882	52.8616	0.38285	57.6013	0.56022

f) HSV color mode layers

	HSV			
No. of text characters	saturation		value	
	PSNR	MSE	PSNR	MSE
Average	52.9358	0.38882	52.8616	0.38285

g) CMYK color mode layers

	C M Y K							
No. of text characters	C		M		Y		K	
	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE
Average	52.9358	0.38882	52.8616	0.38285	52.1619	0.51341	52.1372	0.5039

h) HSL color mode layers

	HSL			
No. of text characters	saturation		Luminas	
	PSNR	MSE	PSNR	MSE
Average	52.93575	0.388817	52.86163	0.38285

i) LUV color mode layers

		LUV					
No. of text characters	Size of image	L		U		V	
		MSE	PSNR	MSE	PSNR	MSE	PSNR
Average		0.13306	58.1706	0.09154	60.6537	0.08672	60.3267

Conclusion

This paper produces a study 9 color models of color images that use as a cover for text hiding to know which the best is. It includes two aspects: comparative among color models and comparing between layers of each color model. For color models, the tests results show that some color models are closely. While the color model L*a*b which it was lowest efficiency.

In some color models, there are layers less affected than other layers when hide a text within them. While there are no distinct layer from the rest in other color models. There are some mixed results when you use the 8^{th} bit, LSB, on the results instead of using the 7^{th} bit. The layer H (Hue) has most affected of hidden text within it, the color of the image will change. Layers that least affected by the process of concealment are Cr in YCbCr, a* within La*b*, I within HSI, K within CMYK, L within HSL, and U and V within LUV colors models.

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كفاءة طبقات المجالات اللونية للصور الملونة كغطاء في اخفاء النص

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الملخص

تستخدم الصور الملونة على نطاق واسع كغطاء في اخفاء المعلومات .ونظرا لتطبيقات الصور الملونة ، ظهرت العديد من النماذج اللونية للصورة الملونة. تتكون معظم نماذج الألوان من ثلاث طبقات. وتلعب طبيعة المجال اللوني للغطاء دور مهم في تحديد قوة وأمن خوارزمية الاخفاء.

يهدف هذا البحث الى فحص مكونات (طبقات) مجالات الألوان لصور الغطاء لمعرفة أي طبقة لونية في كل نموذج لوني هو أفضل (أقل تأثرا) بحيث يمكن ان تستخدم كغطاء لإخفاء المعلومات ضمن النموذج اللوني في عملية الاختباء. ركزت التجارب على اخفاء المعلومات في موقعين من كل طبقة، هما الموقع الثنائي الثامن (البت الاقل اهمية) والموقع السابع . وبعد ذلك استخدم المقياسين متوسط مربع الخطأ (MSE) والذروة إشارة إلى نسبة الضوضاء (PSNR) لقياس كفاءة كل من نماذج الألوان وطبقات كل نموذج.

تم اجراء الاختبارات على النماذج اللونية التالية : CMYK, RGB, HSV, HIS, HSL2, HSB, YCbCr, LUV, HSL La*b*, . اوضحت النتائج بان بعض المجالات اللونية فيها طبقات اقل تأثرا من اخفاء النصوص ضمنها . بينما في نماذج اخرى لاتوجد طبقة متميزة بقدرتها على اخفاء المعلومات . وكانت الطبقة H هي الاسوء لان اي اخفاء يترك تأثير واضح على الصورة الغطاء.