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A Digital Oil Painting Approach

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Abstract

In this paper, we present a method which gives oil painting effect for color images. In general, oil painting method is a process of painting with pigments that are bound with drying oil. The oil painting is widely adopted for artist who utilizes different oils. The proposed method uses digital painting approach and makes an original image painted with oil. The main purpose of oil painting is to generate visually friendly image. The conventional oil painting method requires large computations and long execution time. However our proposed method needs less complexity due to its simplicity. Performance comparison is provided that proves the reliability of our proposed method.

Keywords: *Oil painting, block size, color image, embossing effect*

1. Introduction

The oil painting (OP) is a procedure of painting with pigments that are bound with drying oil [1-3]. An artist can adopt different oils in the same painting depending on specific pigments [4,5]. The OP can be implemented by digital painting using computer [6-8]. In this paper we proposed OP method for color images.

The goal of OP process is to make an original image looks like an oil painting [9,10]. This process is also found in Photoshop, but the possible effect is limited. One of issues of OP is that time consumption is quite long and the process is non-linear. Therefore, once generating the OP image, it is hard to recover the original image.

In this paper, we propose a new OP method which effectively generates oil effected color images [11-13]. We generate OP images using five methods (min, max, minmax, median, and histogram based). The embossing process is applied to original image and the result images are added to method selected output image.

Section 2 presents a proposed method. Simulation results are shown in Section 3. The objective and subjective performances are compared in this section. We use three objective performance metrics, PSNR, MSE, and FSIM. Conclusion remarks are given in Section 4.

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2. Proposed Method

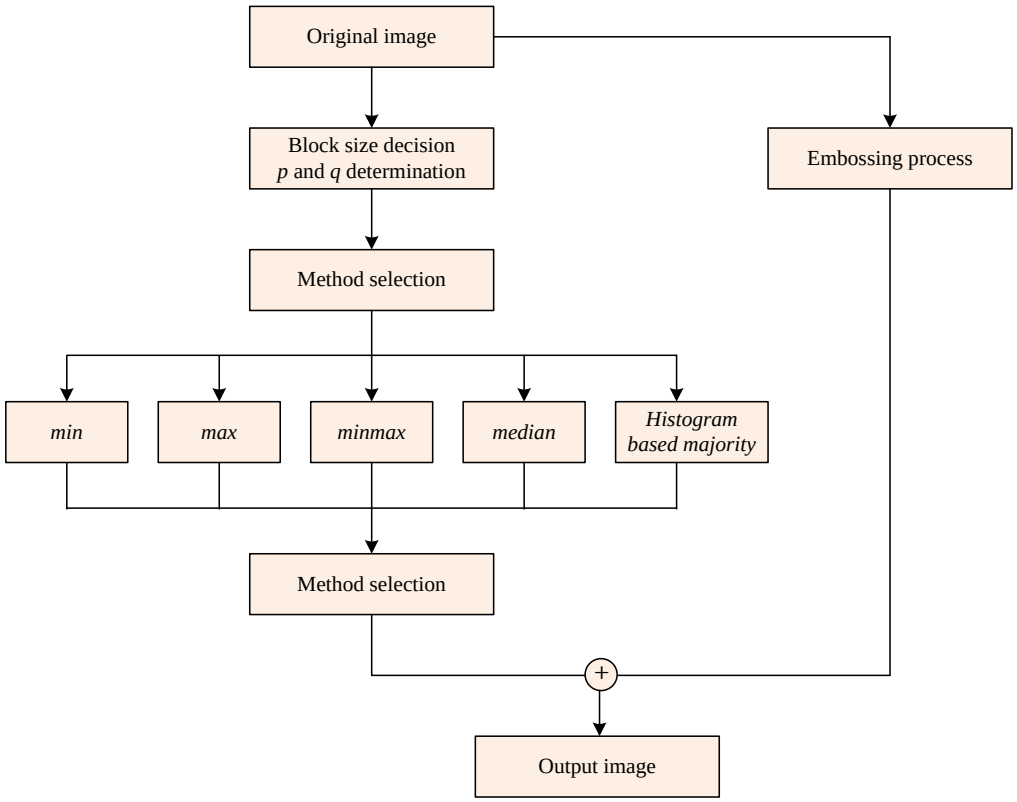


Figure 1. Block Diagram of the Proposed Oil Painting method

Figure 1 shows a block diagram of the proposed method.

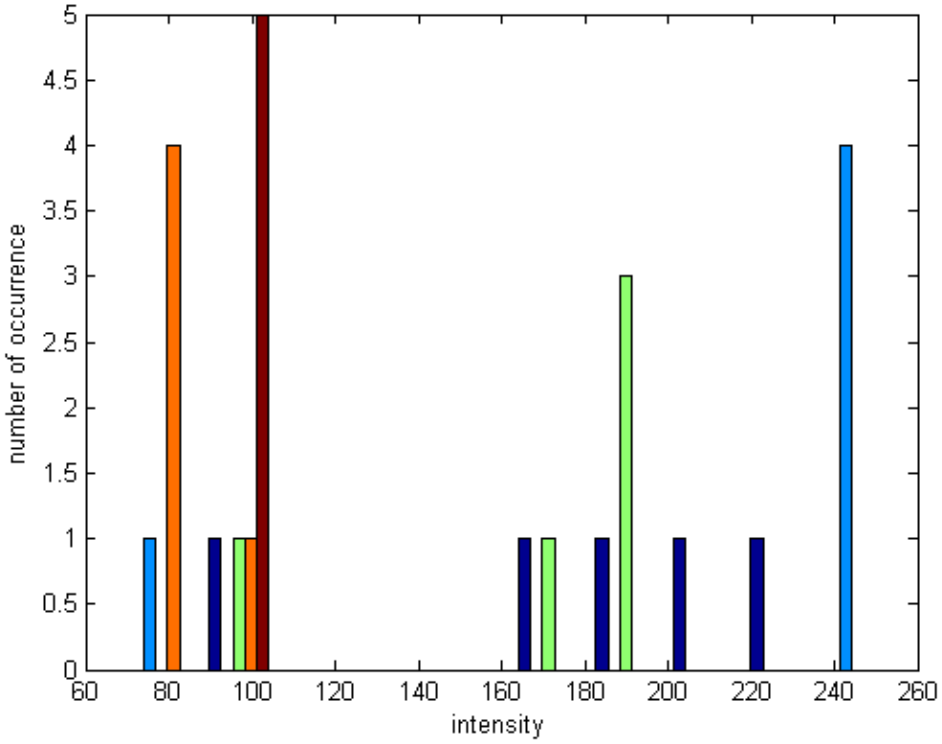
The propose method consists of several steps. First of all, the system decides block size by choosing height (p) and width (q) values of blocks. Then, the system chooses the method to adopt. Five methods are considered in this paper, and they are min, max, minmax, median, and histogram based method. 'min' method returns the smallest intensities in a block. In the same manner, 'max' method finds the biggest value in a block. 'minmax' method returns the average value of min and max results. 'median' method performs median filtering of the given block in two dimensions, where median filtering is a nonlinear approach which makes a block as 1 dimensional signal and find the center value. Finally, histogram based method investigates the number of occurrence of each intensity, and find the majority value.

Figure 2 shows an example. For Kodak image #1, we consider p and q are 5 and 5, respectively. The pixel location of block is (507,763). Figure 2(a) shows original image of #1 Kodak image where circle in yellow tells the block location. Figure 2(b) shows 25 intensity values of the given block, and Fig. 2(c) shows the number of occurrence of each intensity.

(a)

202	255	186	70	100
226	255	186	70	100
189	255	194	69	100
163	255	175	76	100
91	74	91	101	99

(b)



(c)

Figure 2. (a) Original #1 Kodak Image, (b) 5x5 Block, and (c) Number of Occurrence of EachIntensity

As one can see, output values of min (V_{min}), max (V_{max}), minmax (V_{minmax}), median (V_{median}), and histogram based method (V_{hist}) are shown in Table 1.

Figure 3 shows the result images based on Table 1. Figure 3(a) shows the original image of 'flower.' Figure 3(b) is the V_{hist} result. Figs. 3(c-e) are red, green, and blue channel embossing images. Fig. 3(f-i) show min, max, minmax, and median filter images.

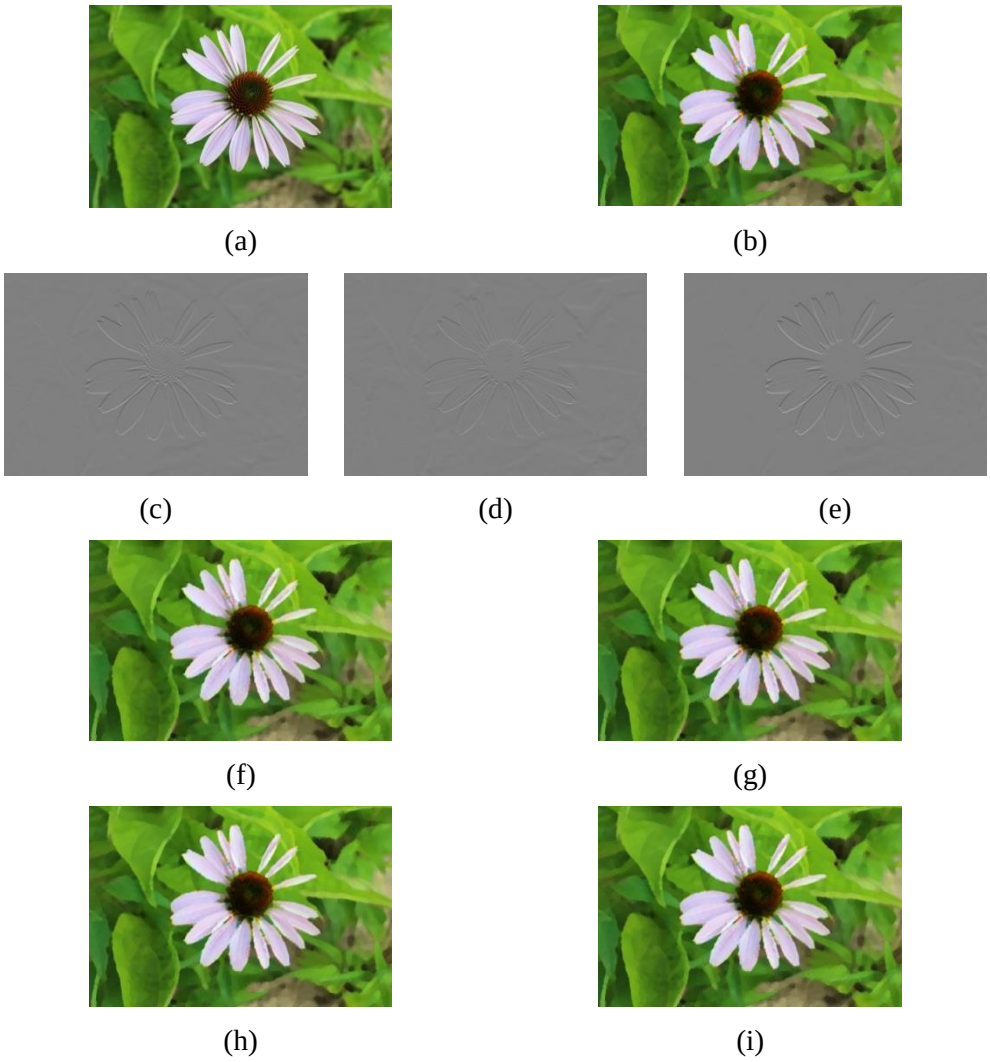
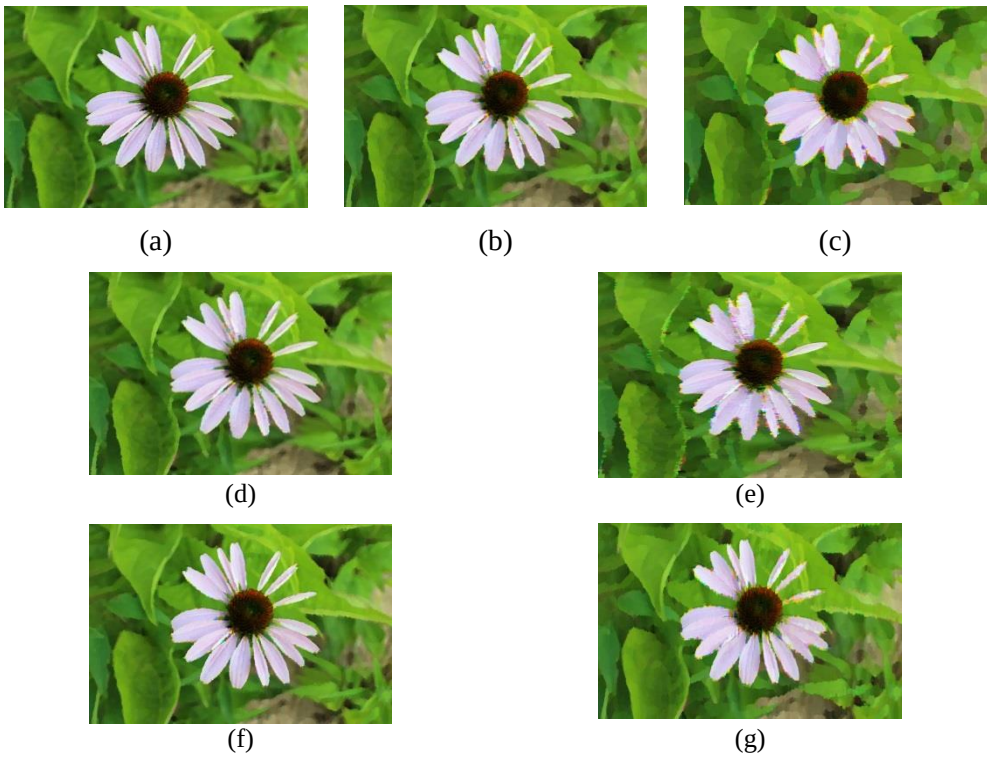


Figure 3. (a) Original Image, (b) Vhist Result, (c) Red Channel Embossed Image, (d) Green Channel Embossed Image, (e) Blue Channel Embossed Image, (f) Vmin Method, (g) Vmax Method, (h) Vminmax Method, and (i) Vmedian Method

Table 1. Output Value for each Method

Method	Process	Output value
V_{min}:	choose the minimum intensity:	69
V_{max}:	choose the maximum intensity:	255
V_{minmax}:	choose the average intensity of minimum and maximum intensities:	162
V_{median}:	choose the median result intensity:	101
V_{hist}:	choose the majority value in histogram-wise:	100



(a) (b) (c)

(d) (e)

(f) (g)

Figure 4. Examples of Difference p and q. (a) (p,q)=(5,5), (b) (p,q)=(10,10), (c) (p,q)=(20,20), (d) (p,q)=(5,10), (e) (p,q)=(5,20), (f) (p,q)=(10,5), and (g) (p,q)=(20,5).

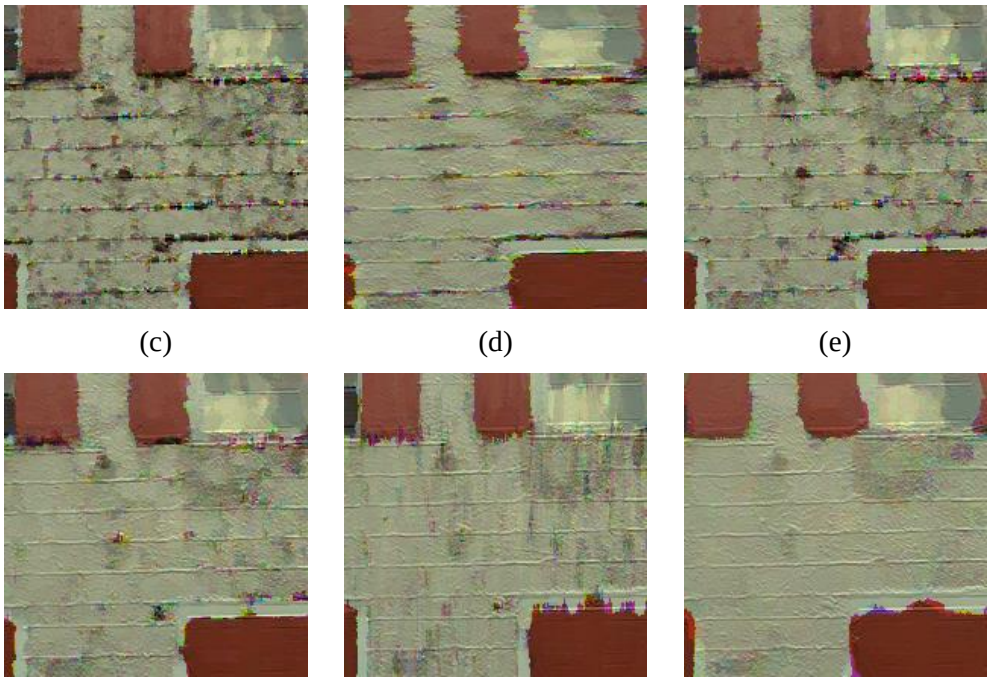
Block size has two parameters, *p* and *q*, which are width and height size of block. We assumed size senariros as shown in Fig. 4.

3. Experimental Results

In our simulation, some scenarios were tested for assessing the performance of the presented method. We compared the objective and subjective image qualities of different (*p*,*q*) combinations: (*p*,*q*)=(3,3), (*p*,*q*)=(5,5), (*p*,*q*)=(5,20), (*p*,*q*)=(7,7), (*p*,*q*)=(10,10), (*p*,*q*)=(20,5), and (*p*,*q*)=(20,20). We used 18 Kodak images, #1-#18. To assess the performance of objective visual quality, peak signal-to-noise ratio (PSNR) and mean squared error (MSE) are applied.

Figures 5 and 6 show the implemented results on Kodak #1 and #2 images with (*p*,*q*) combinations. By changing (*p*,*q*) parameters, oil painting effect are altered.

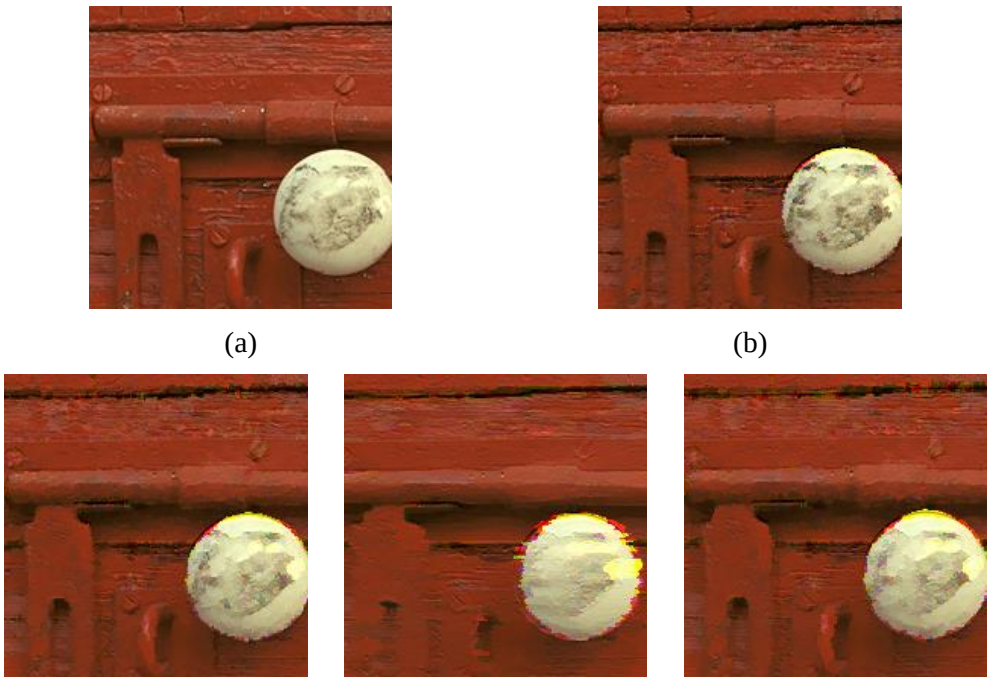
(a) (b)



(c) (d) (e)

(f) (g) (h)

Figure. 5. Implemented Results on Kodak #1 Image with: (a) Original Image, (b) (p,q)=(3,3), (c) (p,q)=(5,5), (d) (p,q)=(5,20), (e) (p,q)=(7,7), (f) (p,q)=(10,10), (g) (p,q)=(20,5), and (h) (p,q)=(20,20)



(a) (b)

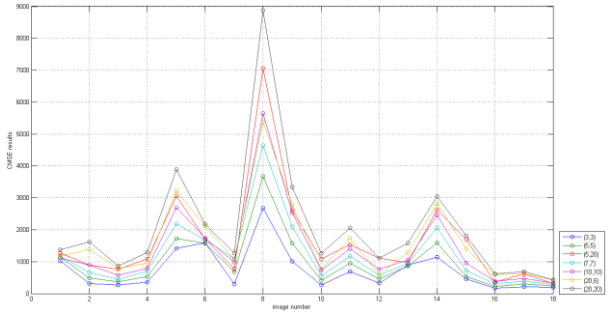
(c) (d) (e)

(f) (g) (h)

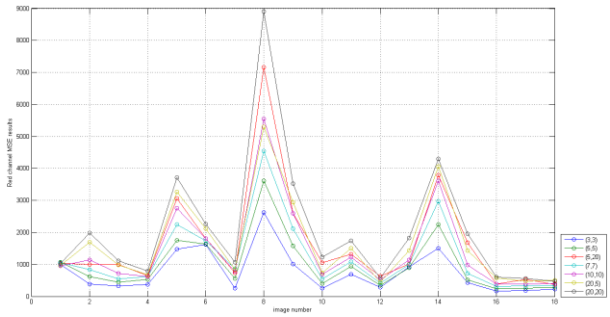
Figure. 6. Implemented Results on Kodak #2 Image with: (a) Original Image, (b) (p,q)=(3,3), (c) (p,q)=(5,5), (d) (p,q)=(5,20), (e) (p,q)=(7,7), (f) (p,q)=(10,10), (g) (p,q)=(20,5), and (h) (p,q)=(20,20)

Figure 7 shows MSE results for 18 Kodak images. Figs. 7(a-d) are MSE results of color, red, green, and blue channel images.

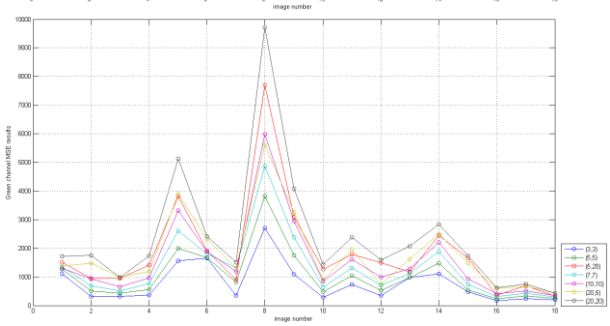
(a)



(b)



(c)



(d)

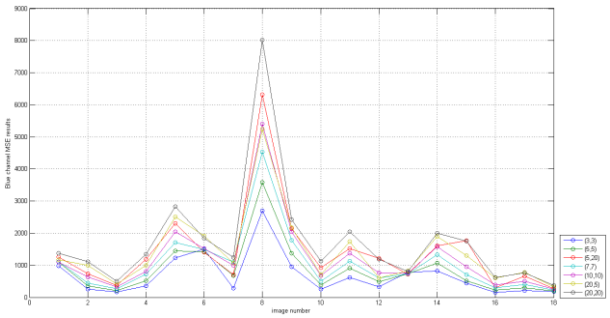


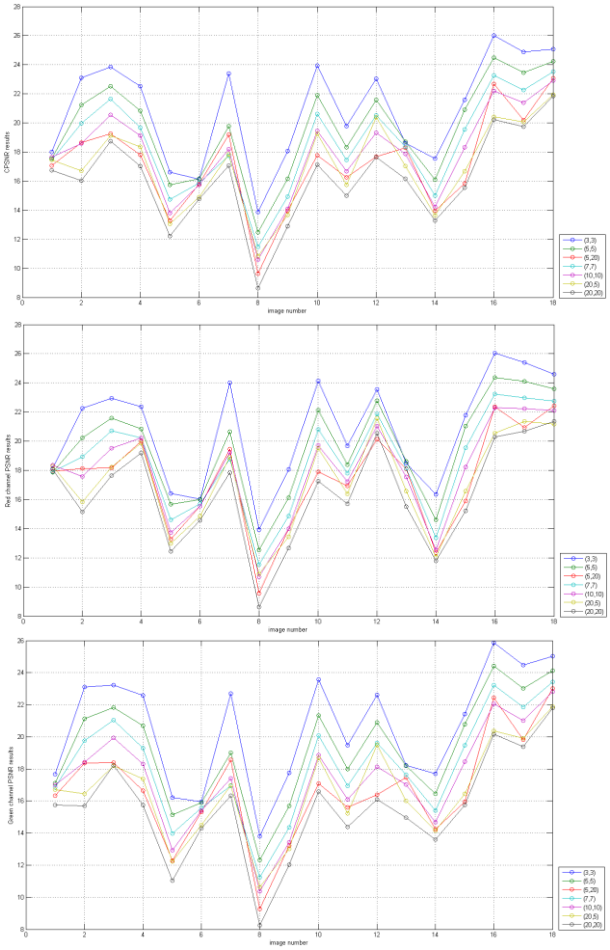
Figure. 7. MSE Results for 18 Kodak Images: (a) Color MSE, (b) Red Channel MSE, (c) Green Channel MSE, and (d) Blue Channel MSE

In the same manner, PSNR results can be found in Fig. 8. Figures 8(a-d) are PSNR results of color, red, green, and blue channel images.

(a)

(b)

(c)



(d)

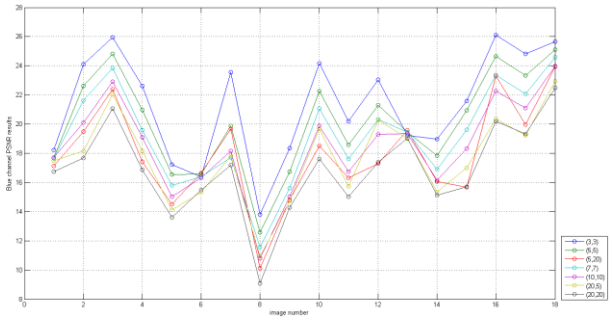


Figure. 8. PSNR Results for 18 Kodak Images: (a) Color PSNR, (b) Red Channel PSNR, (c) Green Channel PSNR, and (d) Blue Channel PSNR

On top of PSNR and MSE results, we adopted two other objective performance assessment metrics: FSIM and FSIMc. Tables 2 and 3 show FSIM and FSIMc results. The (p,q) conditions are provided and different (p,q) combinations give different performance. Note that 1 stands for the ideal result, and as the number is closer to zero, the performance is getting worse. From results provided in Tables 2 and 3, (p,q)=(3,3) gives the best performance.

Table 2. FSIM Comparison

Image #	(3,3)	(5,5)	(5,20)	(7,7)	(10,10)	(20,5)	(20,20)
1	0.7607	0.6843	0.6247	0.6385	0.6099	0.6281	0.5922
2	0.8188	0.7397	0.6838	0.7032	0.6812	0.6676	0.6532
3	0.8645	0.8054	0.7277	0.7750	0.7536	0.7015	0.7111
4	0.8293	0.7604	0.7018	0.7289	0.7153	0.7097	0.7016
5	0.7435	0.6725	0.5819	0.6312	0.6079	0.5809	0.5686
6	0.7803	0.7196	0.6621	0.6895	0.6657	0.6536	0.6328
7	0.8287	0.6614	0.6945	0.6379	0.6507	0.6562	0.6292
8	0.6744	0.5866	0.5289	0.5605	0.5423	0.5421	0.5195
9	0.7651	0.6664	0.6045	0.6296	0.6054	0.5950	0.5553
10	0.8056	0.7137	0.6359	0.6760	0.6565	0.6583	0.6234
11	0.7841	0.7008	0.6293	0.6568	0.6271	0.6151	0.5798
12	0.7903	0.7269	0.6728	0.7008	0.6855	0.6887	0.6628
13	0.7808	0.7346	0.6972	0.7095	0.6966	0.6900	0.6696
14	0.7594	0.6822	0.6226	0.6493	0.6263	0.6219	0.6077
15	0.8656	0.8375	0.7607	0.8083	0.7857	0.7889	0.7573
16	0.8538	0.7841	0.7455	0.7475	0.7256	0.6974	0.6963
17	0.8535	0.7879	0.7053	0.7450	0.7183	0.7070	0.6977
18	0.8414	0.7722	0.7548	0.7425	0.7267	0.7109	0.6962
Average	0.8000	0.7242	0.6686	0.6905	0.6711	0.6618	0.6419

Table 3. FSIMc Comparison

Image #	(3,3)	(5,5)	(5,20)	(7,7)	(10,10)	(20,5)	(20,20)
1	0.7503	0.6711	0.6113	0.6259	0.6002	0.6182	0.5811
2	0.8151	0.7357	0.6788	0.6986	0.6758	0.6605	0.6448
3	0.8619	0.8026	0.7239	0.7721	0.7505	0.6982	0.7069
4	0.8255	0.7554	0.6911	0.7225	0.7075	0.7004	0.6889
5	0.7326	0.6586	0.5632	0.6152	0.5899	0.5610	0.5463
6	0.7710	0.7076	0.6513	0.6761	0.6535	0.6392	0.6210
7	0.8232	0.6535	0.6849	0.6237	0.6292	0.6344	0.6103
8	0.6638	0.5749	0.5152	0.5481	0.5302	0.5316	0.5058
9	0.7557	0.6550	0.5918	0.6170	0.5924	0.5807	0.5397
10	0.7999	0.7074	0.6290	0.6697	0.6502	0.6517	0.6159
11	0.7782	0.6942	0.6240	0.6503	0.6215	0.6074	0.5730
12	0.7855	0.7214	0.6640	0.6945	0.6776	0.6817	0.6534
13	0.7705	0.7234	0.6866	0.6984	0.6859	0.6767	0.6560
14	0.7496	0.6696	0.6048	0.6345	0.6104	0.6032	0.5877
15	0.8612	0.8322	0.7534	0.8025	0.7795	0.7800	0.7484
16	0.8503	0.7802	0.7408	0.7434	0.7213	0.6920	0.6907
17	0.8494	0.7830	0.6995	0.7401	0.7136	0.7014	0.6919
18	0.8375	0.7678	0.7496	0.7376	0.7213	0.7049	0.6904
Average	0.7934	0.7163	0.6591	0.6817	0.6617	0.6513	0.6307

4. Conclusions

This paper proposes an oil painting technique for color images. Generally speaking, oil painting approach is a procedure of painting with pigments that are bound with drying oil. The goal of the proposed method is to create visually friend oil painting images. Experimental results prove that our proposed method is reliable and give satisfied results. Objective and subjective performance comparison is provided.

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