

필터링과 선형보간을 이용한 색연필스케치영상 생성

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COLOR PENCIL SKETCH IMAGE GENERATION BASED ON FILTERING AND LINEAR INTERPOLATION

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ABSTRACT

In this paper, we present a method to automatically generate a color pencil sketch image from a photo. First the image is converted into a sketch using a gradient estimation and then the color pencil sketch is produced by linear interpolation with original image and the sketched image. The experimental results show that the final image has a visual aspect of a color pencil sketch like image.

Keywords: color pencil sketch, drawings, linear interpolation

1. Introduction

Pencil sketch drawings are a very popular form of arts that act as most fundamental pictorial languages to abstract human perception of natural scenes. In a typical sketch image, only the most characteristic lines of the underlying subject are drawn, using a dark colour (pencil) on a white background (paper). In that context, certain degree of variation in the darkness of the pencil is typically used to depict various types of transitional boundaries (edges) and shadows in the original scene.

There are two different mechanisms used in computer-generation of pen-and-ink drawings depending on the input object. The first one is based on 3D geometry [1], which generates pen-and-ink images from 3D geometry or through human interaction. The main advantage of that method is that they place the main strokes along the contours of the surfaces; they can also convey the 3D forms of the surfaces because they have full access to the 3D geometry and viewing transformation. The second one is based on image [2]. It offers some advantages such as reducing the tasks of geometric modelling and of specifying surface reflectance properties. Furthermore it allows more complicated models to be illustrated because obtaining high-quality pictures is much easier than constructing 3D models of the scene due to the popularity of digital cameras and internet sharing.

In this paper, we propose a method of automatically generating a color pencil sketch from an input image using the second mechanism above, and our concern is the photo with human subjects. From an input colour image, the system starts by generating a pencil sketch image using a filtering algorithm and then combines a sketched image with the original image to generate the color pencil sketch image.

In section 2, we discuss the related work. Then, in Section 3, we introduce the proposed method to generate a color pencil sketch. Section 4 shows the experimental result and finally conclusion is discussed in section 5.

2. Related work

A lot of researches were conducted to approximate artistic style, such as pen and ink illustration [1][3]. Painting with brush strokes mainly focuses on simulating the effects of certain drawing tools, without taking into consideration the content of the picture, while proper artistic stylization requires some understanding of the main content in the picture that need to be emphasized. This section surveys the previous work on pencil sketching and color pencil sketching based on input image. [4], extracted binary edges of an input image using a Wavelets Transform (WT) technique, to enhance the variations in texture and tone, they applied a two binarization steps and a noise removing step.

[5], applied a gradient computation on an input image followed by some proper transformation to achieve the best effects. [6] manually selected the facial region from portrait input image, to shade and enhance the areas, they used a bilateral filtering to get the base and detail layer and then they apply the stroke to non-face regions to render the silhouette, creases and some dark regions.

[7], transformed an image into a color pencil sketch by doing the color shift as an optimization problem and define an energy function on candidate colors of all regions, trying to integrate information from a pre-drawn color pair's database, artist drawing rules and reference information from the input image to obtain a globally optimal color shift solution. [8] used two main steps to produce stroke layer and tonal texture and apply an algorithmic combination of these two maps containing important structure information and mimicking a human drawing style, the sketch obtained get colored by taking the generated grayscale pencil sketch as the brightness layer, i.e., the Y channel in the YUV color space and

re-mapping YUV back to the RGB space. Our method differs from that in that, it is automatic, and we linear interpolate the color in RGB colour space directly but they used Y channel in the YUV colour space, and re-map YUV back to the RGB space and we got the color of the sketch from the original image.

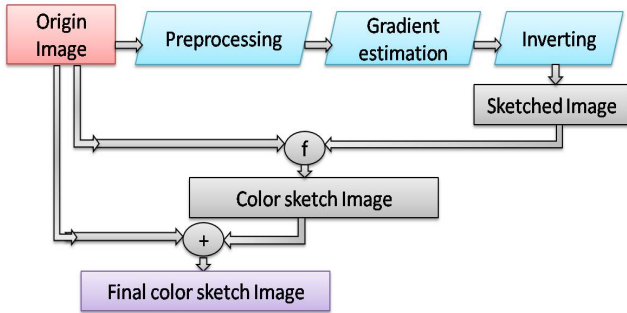


Figure 1: Overview of the color pencil sketch system

3. Proposed Color pencil sketch system

In this section, the process of generating a color pencil sketch is discussed. Figure 1 shows the overview of the proposed algorithm. The proposed approach to generate a color pencil sketch is divided into two steps: Pencil sketch generation from an input image and Sketched image to Color pencil sketch image.

A. Sketch Generation from an input image

a. Image preprocessing

This is the step taken before the major image processing task. The input image is first converted to gray scale image, and then smoothed to enhance the low frequency signal to be used in edge detection. To conduct an image smoothing process, averaging filter is used to replace each pixel by the average of pixels in a square window surrounding this pixel using 3X3 average mask.

b. Edge detection

In order to detect the edges of a preprocessed image, the sum of second derivatives in both directions have been performed that is laplacian filter.

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$$

It is implemented by the following mask

0	-1	0
-1	4	-1
0	-1	0

That method is more advantageous to first derivatives in that, it is an isotropic filter i.e. invariant under rotation [9].

By applying the Laplacian mask shown above to the image, since the laplacian operator produces both positive and negative gradient to roughly detect the edges, we choose the positive one as shown below using the threshold as 0.

$$i = \begin{cases} i & \text{if } i > 0 \\ 0 & \text{Otherwise} \end{cases}$$

In this manner i will be set to i if it is greater than zero and to zero otherwise.

c. Image inversion

The result from the previous two steps typically gives the visual effect of the edges detected in a black background (negative picture). To alleviate this problem, we adopt another image processing technique further to get a sketched image, that process is the image inversion. The effect of this process gives the output image that looks like a pencil sketch.

B. Sketched image to color pencil sketch

The proposed method of generating a color pencil sketch is obtained by using linear interpolation algorithm between two images, i.e. sketched image and original image.

The proposed linear interpolation algorithm is described from the figure given below.

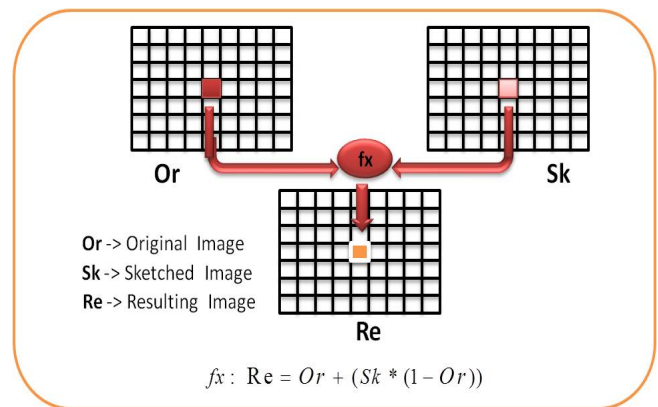


Figure 2: Proposed algorithm to generate a color pencil sketch from Original and sketched image.

For each pixel color in one image i.e. original (Or), there is a linear combination in the corresponding pixel color in another image i.e. sketched image (Sk), following the given general formula:

$$\frac{Re - Or}{1 - Or} = \frac{Sk - 0}{1 - 0} \quad (1)$$

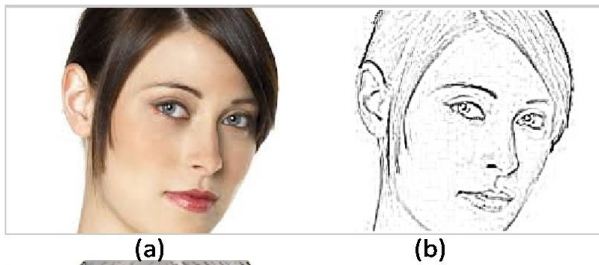
The unknown RE image that is the resulting color pencil sketch is obtained by evaluating the equation (1); the resulting function is given below.

$$Re = Or + (Sk * (1 - Or)) \quad (2)$$

The proposed equation (2), have been used to generate a color pencil sketch image from original image and sketch image. To enhance the color of the sketched image, we conduct an image fusion between the original image and the resulting image from interpolation process as shown on the figure 1.

4. Result

We implemented the proposed method in MATLAB and evaluated the result image. The method generates the color pencil sketch like image as shown in Figure 3. The basic outlines are clear and seem to be drawn with a pencil and the color is light that seems to be painted by the water color. But there is no feeling like that men drew. For that it needs for man- made textures (hatching) to be added.



(1) Photo by David Saffir , 2009 [10]



(2) Photo by swanky, 2009 [11]

Figure 3: Results: (a) original image, (b) sketched image, (c) resulting color pencil sketch image

5. Conclusion

Pencil sketch drawing is a pictorial language for the art, and it is not easy to come up with a color pencil sketch from a photo, this paper proposes the algorithm of automatically generating a color pencil sketch from a photo. The proposed method is based on linear interpolation between a sketch image and the original image, and filtering. The experimental results show that the proposed method can generate pencil sketch drawing image from photos with human subjects.

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