Generation of Pencil Sketch App

Group - 1

Group Members :

- Prasad Kshirsagar - 2016csb1041
- Siddharth Nahar - 2016csb1043

INTRODUCTION

- Pencil sketch drawings are a very popular form of art.In a typical pencil sketch image, only the most characteristic lines of the underlying subject are drawn,using a dark color on a white background.

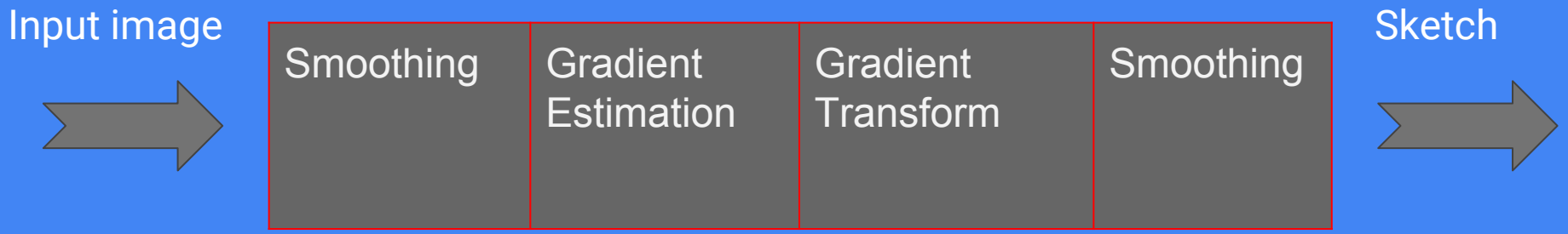
- Pencil sketch drawings are in some sense similar to pen-and-ink drawings.

Pencil Sketch Images

Properties Of Pencil Sketch

- Objects are depicted by contours, which are long and significant edges.
- Edges are drawn in dark, with the darkness roughly proportional to the local gradient,while the background is kept purely white.
- Textured regions can be depicted by a collection of short lines/edges.

Steps To Follow



Step 1: Smoothing

- In general, an unprocessed image may contain excessive noise, which reacts strongly to the subsequent gradient estimation.
- Therefore, as the first step, the input image is smoothed by a Gaussian low-pass filter, just as the pre-processing of the Canny’s edge detector.

Step 2: Gradient Estimation

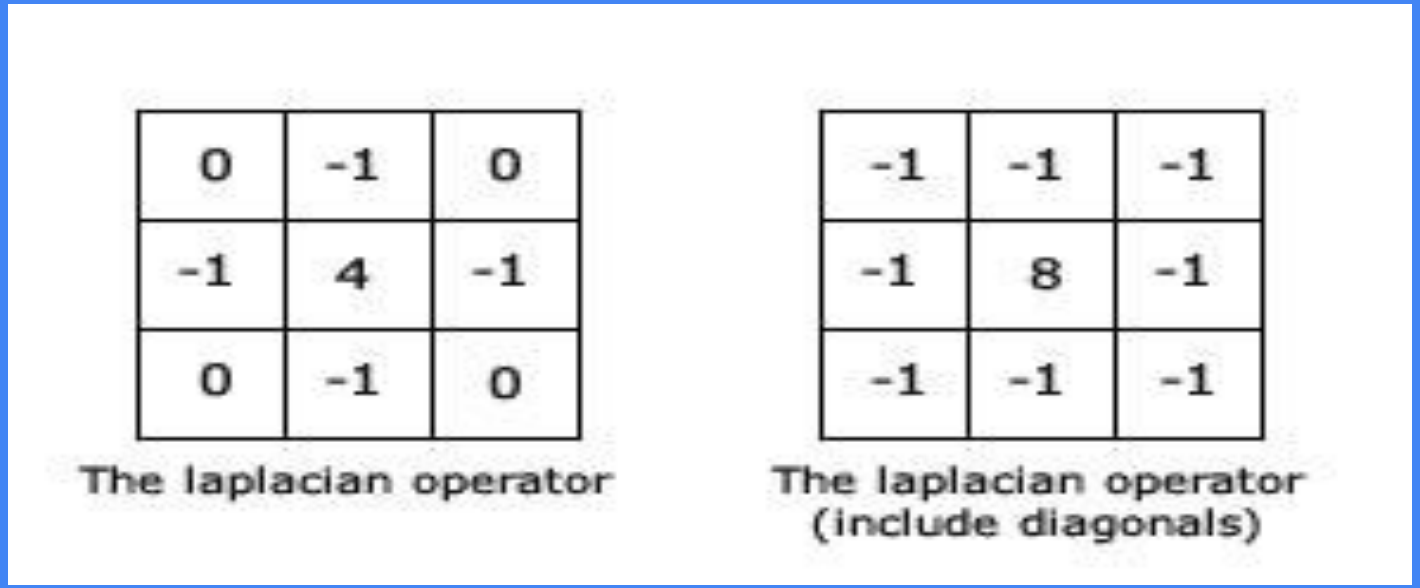
- Next task is to detect points of significant gradient (roughly speaking, the edges).
- As noted above, not only the locations of the edges but also the gradient at those locations should be kept. For illustration purpose, we use the following Laplacian operator for gradient estimation.

Step 2 : Gradient Estimation

- We have checked our results on two methods of gradient estimation. The methods are as follows :

1. Laplacian Operator :
   - Advantage - It can detect all types of edges.
   - Disadvantage - As it is second order derivative, It is much sensitive to noise. It checks the gradient in very small neighbourhood.

Laplacian Operator



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

The laplacian operator

-1	-1	-1
-1	8	-1
-1	-1	-1

The laplacian operator (include diagonals)

Step 2 : Gradient Estimation

- Method 2 :
  To remove the discrepancy of noise sensitivity and small neighbourhood of laplacian operator, we can efficiently use this method.

- Algorithm :
  g(x,y) = (v1-v2) / Distance (x,y)..... g(x,y) = gradient (x,y)

Step 2 : Gradient Estimation

- Algo (Continued …) :

```
Function g_d(p)                                  // d = {left,right,up,down}
    Maxg = 0;
    For each point pi  in the direction d, from near to far :
            g = g (p,pi);
            if(|g| > |Maxg|)
                Maxg = g;
    return Maxg;
```

Step 2 : Gradient Estimation

- (Continued ……)

1. g_x(p) = g_left(p) + g_right(p)
2. g_y(p) = g_up(p) + g_down(p)

- And final gradient for point p is given by :

$$g(p) = \begin{cases} g\_x(p) & \text{if } |g\_x(p)| >= |g\_y(p)| \\ g\_y(p) & \text{otherwise} \end{cases}$$

Intermediate Images

- Note that, even with the smoothing operation in Step 1, one can still find that, from Fig. (b), there are excessive noisy details still visible in the image, making it dissimilar to a pencil sketch. This is especially the case since we used the Laplacian operator, which is very sensitive to noise.

- To get a succinct pencil sketch image, we need to eliminate most of the details.

- To this end, in practice we threshold the gradient image before applying the transformation.

Step 3: Gradient Transform

Thresholding of Image :- To remove noise added due to Gradient Operation,we threshold the image.

$$g(p) = \begin{cases} 0 & \text{if } |g| <= T \\ g & \text{otherwise} \end{cases}$$

Step 3: Gradient Transform

To achieve the objective of linking darker pencil color to edges of larger gradient, we apply the following transform :

$$g = \begin{cases} 120 - g, & \text{if } g > 0 \\ 255 & \text{otherwise.} \end{cases}$$

where 120 is an empirically-chosen parameter, which can be user-adjustable in the software.

Step 4 : Final Smoothing

- The results from the previous three steps typically give the visual effect of a pencil sketch, except that there may be many broken contours that appear to be unnatural.
- To alleviate these problems, we adopt another smoothing step to further blend the contours with the background and to link the broken contours.

Some Results

Possible Drawbacks

- Initial smoothing step takes on average 5x5 mask. If there is excessive noise, there may be possibility that, we won’t get the desired results.
- Images containing low contrast at required places due to illumination problems or shadows , then there may be problem in edge detection. So, results would be not be appropriate.
- As Thresholding parameter is empirical parameter ,it may vary slightly from image to image.

Thank You !