Project 3 Part B Proposal

Dian Chen, Yu Sun

November 2, 2017

1 Abstract

We're proposing a mini project to generate non-photorealistic pictures from real photos. The motivation comes from the fact that there are tons of Apps for mobile phones these days that can render our daily life photos in multiple styles, such as cartoon, oil painting and pencil sketches, in a mere tap. It would be fun to explore and implement the postprocessing of real photos in reasonable, yet aesthetic ways. We're approaching this in a way of filter design and utilizing random noise functions. Part of our implementation would be based on a paper written by Eduardo and Manuel [1], and the rest of the designs would just come from pure brainstorm.

2 Related Work

Mobile phone Apps such as Prisma and Meitu have been quite common and popular these days with which people can easily produce stylish pictures from their own daily shots, and built-in photo editors are even getting as powerful ever. Common render styles include: cartoon, oil painting, pencil sketch, mosaic, or simply adjusting the color tone of the image. These kinds of post-processing are called "Non-Photorealistic Rendering" (NPR), which is to modify a real photo to give it a more aesthetic (or just for fun) without being natural.

The idea of non-photorealistic rendering has been out for a while, and there are primarily two classes of ways of achieving the effect. The more classic and traditional class is through filter designing, which is to intentionally design filters to catch desired patterns underlying the image and utilize the patterns coming out after the filtering. Examples include *Domain Transform for Edge-aware Image and Video Processing* by Eduardo S. L. Gastal, Manuel M. Oliveira [1], *Richness-Preserving Manga Screening* by Qu, Y., Pang, W., Wong, T., Heng, P. [2], and *Simple Art as Abstractions of Photographs* by Peter Hall and Yi-Zhe Song [3], all of which come up with distinct filters used to manipulate the raw image. Some of the work pursue real time performance on top of desirable visual effects.

The other class of methods is to use convolutional neural networks (CNN), which has grown increasingly popular in commercial Apps like Prisma. Given a image to be rendered, and given a reference style, it can render the image into the style in an amazingly compatible way. *A Neural Algorithm of Artistic Style* by Leon A. Gatys, Alexander S. Ecker and Matthias Bethge is the first paper proposing this idea, and Justin Johnson of Stanford University has an implementation in Torch. The most striking examples are rendering daily photos into styles of Vincent van Gogh's Starry Night, and of other paintings from Pablo Picasso, Monet, etc.

3 Methodology

In this project we're approaching the NPR in a way of filter design, with some ideas of shader programming borrowed from computer graphics such as utilizing random noise functions. We will try to implement some filters suggested in [1] and achieve the expected effects, as well as go completely wild with our own ideas of creating filters and manipulating the pixels.

In the paper they described a technique that can preserve edges while smoothing the images. The main idea behind the methodology is to find a domain transformation from R^5 (R,G,B,X,Y)

into lower dimensions while preserving the distances. Filtering is then applied to the transformed image. The details steps are as followed:
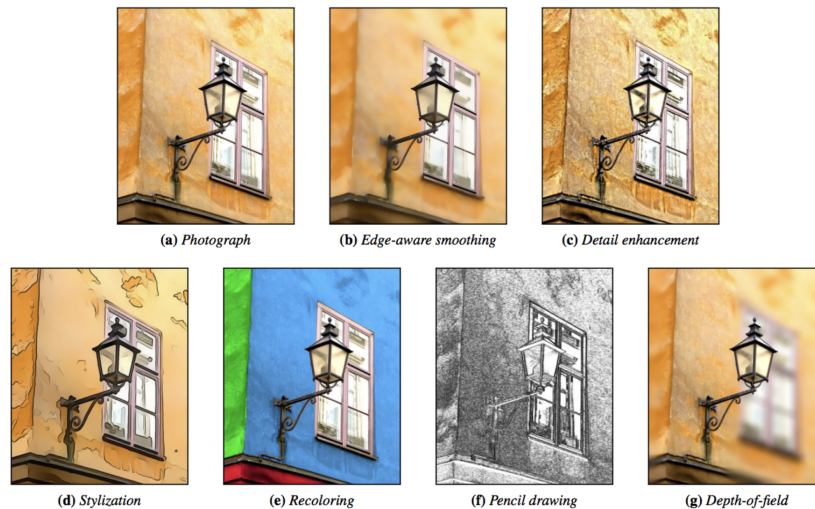
1. Compute x and y gradient, L1 norm of neighboring pixels

2. Compute x and y domain transforms

3. Perform filtering

4. Perform normalized convolution in the transformed domain

This technique is very versatile and can then utilized in different applications, and we'll explore some of them.

Worley noise is commonly used in computer graphics to produce fun effects during post-processing. The same idea can be used here to make mosaic pictures or add realistic-looking bubbles on top of the image. We will even try to use filters and manipulate pixels in a way that doesn't seem intuitive or reasonable at first glance, yet can produce interesting visual effects.

4   Expected Results and Expected Applications/Future work

The part that relies on [1] should have predictable results. The output from edge-aware smoothing filter should be a blurred version of the original image, with the edges being preserved. After that we should be able to produce Stylization or Pencil Drawing effects as suggested in the sample output provided in the paper:

(a) *Photograph*   **(b)** *Edge-aware smoothing*   **(c)** *Detail enhancement*

(d) *Stylization*   **(e)** *Recoloring*   **(f)** *Pencil drawing*   **(g)** *Depth-of-field*

As for the brainstorm part, the expected results should be like as described. We'll see what effects we can actually achieve! All of the work could be of value for apps like Prisma or Meitu.

All the implementation will be in MATLAB. We will try to integrate different rendering and display in a MATLAB GUI window with interactive buttons IF WE HAVE TIME.

5   Reference

1. Eduardo S. L. Gastal, Manuel M. Oliveira, "Domain transform for edge-aware image and video processing", ACM Trans. Graph. 30(4): 69, 2011.

2. Qu, Y., Pang, W., Wong, T., Heng, P. (2008). Richness-preserving manga screening. ACM SIGGRAPH Asia 2008 papers on - SIGGRAPH Asia 08. doi: 10.1145/1457515.1409108

3. Peter Hall and Yi-Zhe Song. 2013. Simple art as abstractions of photographs. In Proceedings of the Symposium on Computational Aesthetics (CAE '13), Stephen N. Spencer (Ed.). ACM, New York, NY, USA, 77-85. DOI: https://doi.org/10.1145/2487276.2487288