COMP4801 Final Year Project

# Seamless Image Editing

## Detailed Project Plan

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In our project, we planned to (1) Implement the code base for drag and drop pasting paper; (2) Come up with a new algorithm to search for the optimal boundary for blending.

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# 1. Project background

Image composition, which is the process of creating a new image by imposing an object or a region from a source image to a target image, is a large component of image editing. Poisson image editing [1] has been proposed in 2003 as an effective approach for seamless image composition. By solving Poisson equations using the user-specified boundary condition, Poisson image editing blends the colors from both image without visible discontinuities around the boundary.

The effectiveness of Poisson image editing, however, largely depends on how user draws the boundary. Drag and drop pasting [2] in 2006 proposed a method to optimize the boundary condition based on a shortest closed-path algorithm in {r,g,b} color space, and it improved the composition quality by searching for optimal boundary within the user-specified one.

In our project, we planned to (1) Implement the code base for drag and drop pasting paper; (2) Come up with a new algorithm to search for the optimal boundary for blending.

# 2. Project objective

Traditional Poisson image blending process [1] will first set the boundary colors equal to the target image, and blend in the image according to the gradients of the source image. There has been massive research done to optimize the result of Poisson image composition. To obtain better seamless composition, we need to take the target image into consideration on the boundary conditions. The less original color difference along the region boundary between the source image and the target image, the better the results will be.

Our objective of the project is to search for an optimal boundary within the user-specified one (the region of interest), and outside the real object (the object of interest) user cares about. The cumulative original color space difference should achieve the global minimum along the new boundary. We focus on the difference of the image substance and object reflectance, and we want to remove the lightness and shading effects of the image since these effects will influence how the original colors are presented.

In theory, the image composition will have a better result given the boundary based on our objective. Provided the boundary with less original color difference between the source image and the target image, the blended result will be closer to the original effect of the source image. Therefore, the blending will make the resulting images in the right gradient direction of the real object

user cares about, instead of pushing the effects away from the colors they meant to be in the resulting image.

Drag and drop pasting method [2] has done the boundary optimization in 2006. They focus on the difference in {r,g,b} color space. We will implement the code base for the drag and drop pasting as our first milestone.

However, the drag and drop pasting method has its limitations. (1) Their cost energy function computes the costs based on the L2-norm form and adds in a scalar factor k. Along the boundary, the color space of the source image has certain threshold k away from that of the target image, which may result in the blending results moving threshold k away from their original color space; (2) k is a scalar value, and it appears in the cost function after the L2-norm of the three channels is computed. Same k differences can represent different meanings in the color space. For example, two pixels can have more difference in r channel, and the other two pixels have more difference in g channel, while these two groups may share the same color difference k because of the L2-norm.

Therefore, we want to improve on the existing approaches and focus more on the difference of the image substance and object reflectance.

# 3. Project methodology

The implementation of drag and drop pasting and our algorithm will be likely to include the following steps.

## 3.1. Image segmentation

The image segmentation tools are generally available on the open source website. We need to look for the suitable method that could facilitate our implementation. Customization is necessary for the open tools.

## 3.2. Boundary optimization

This is the core of our algorithm, as well as the drag and drop implementation.

- **Drag and drop pasting**

The implementation steps will include cost matrix calculation, graph construction and optimal path search. The process is an iterative algorithm, and should involve automation scripts and iterative function calls. We are likely to leverage the resources available in Matlab libraries.

- **Our algorithm**

This process will include new boundary energy function, and potentially new iterative steps to search for the optimal boundary based on the function.

## 3.3. Poisson image editing

The Poisson image editing code is partially available on the open source website. However, we need to customize the implementation on top of the existing one, in order to cater to the needs of our project.

# 4. Project schedule and milestones

The project schedule will span from September 1, 2015 to Mid-April, 2016.

| | **Deadline** | **Milestone** | **Description** |
|---|---|---|---|
| 1. | October 31, 2015 | Read & understand paper (1) Poisson image editing [1]; (2) Drag and drop pasting [2]. | The project is based on the theoretical background of these two papers. |
| 2. | November 30, 2015 | • Implemented the code base for Poisson image editing in Matlab.<br>• Look for methods & tools for image segmentation. | The code bases for Poisson editing and image segmentation are partially available on the open source websites. However, the code base needs to be modified and customized for our project. |
| 3. | Mid-January, 2016 | Implemented the code base for drag and drop pasting paper. | The code base will be implemented in Matlab from scratch, and completed before the mid-term review. |
| 4. | February 29, 2016 | Come up with our new algorithm and implement the code base. | New algorithm creation and related code implementation. |
| 5. | March 31, 2016 | Finish experiments and testing. | Massive trials & corrections on our algorithm at this stage. |
| 6. | Mid-April, 2016 | Wrap up the project and finish the reports and related course materials. | Related materials include reports, website, presentation, posters, etc. |

*Table 1: Project schedule and milestones*

# 5. References

[1] P. Perez, M. Gangnet and A. Blake, "Poisson Image Editing," 2003.

[2] J. Jia, J. Sun, C.-K. Tang and H.-Y. Shum, "Drag and Drop Pasting," 2006.