COMP0026 (Image Processing) Coursework III: *Poisson Image Editing*

COMP0026 Team

Tobias Ritschel, Niloy Mitra, Mirghaney Mohamed, Hengyi Wang Daniele Giunchi

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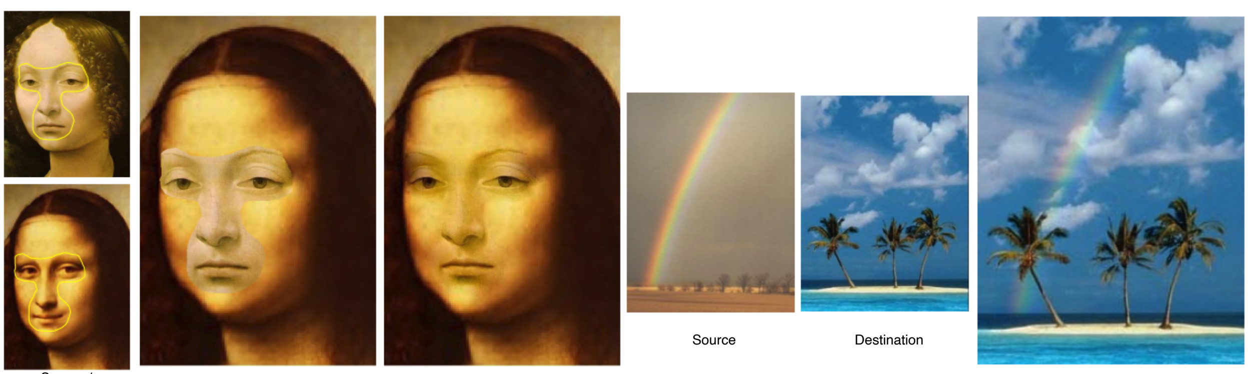
You will create a python Jupyter notebook.

The total points for this exercise is **100**.

Please refer to Moodle for the due dates.

In this coursework, we will be learning about image editing focusing on cloning, gradient based editing, etc. The paper you are going to read and implement is a classic in this topic. The coursework is based on the *SIGGRAPH 2003* paper **Poisson image editing** by P. Pérez, M. Gangnet, and A. Blake.

You can probably get patchy implementations if you search on the web. Please, *do not* go down that path. You have only access to the paper and to slides and you are free to discuss the paper (not implementation) with your classmates.



Source / Destination | Cloning | Seamless Cloning | Source | Destination | Seamless Cloning

1 Select a grayscale image (25 points)

Mark out a region R using a polygon (you can use functions like `matplotlib.path` and `cv2.fillpolly`) (**5 points**). Remove the selected region and fill it in using Equation (2) in the paper (**10 points**). You are solving for unknown intensity values inside the region R. Test the method in smooth regions and also in regions with edges (high-frequency) (**5 points**). Also report the behavior as the size of the selected region increases (**5 points**).

2 Seamless cloning for grayscale images (50 points)

Now we are ready to try 'seamless cloning'. The relevant Equations are (9) to (11). Perform both versions (a) importing gradients and (b) mixing gradients

(a) Importing gradients (20 points). The basic choice for the guidance field is the gradient of the source image.

$$\mathbf{v} = \nabla g$$

And now the Poission equation with Dirichlet boundary condition becomes:

$$\Delta\mathbf{f} = \Delta\mathbf{g} \quad \text{over } \mathbf{\Omega}, \text{ with } f|_{\partial\Omega} = f^*|_{\partial\Omega}$$

And for discrete implementation we have:

$$\text{for all } \langle p, q\rangle, \mathrm{v}_{pq} = g_p - g_q$$

(b) Mixing gradients (20 points). Sometime it is desirable to combine properties of the target image with those of the source. To this end we can define our guidance field as a combination of source and target gradient fields. But we can washout the textures, instead for each point in Ω we can return the stronger variations of both.

$$\text{for all } \mathbf{x} \in \mathbf{\Omega}, \mathbf{v}(\mathbf{x}) = \begin{cases} \nabla f^*(\mathbf{x}) & \text{if } |\nabla f^*(\mathbf{x})| > |\nabla g(\mathbf{x})|, \\ \nabla g(\mathbf{x}) & \text{otherwise.} \end{cases} \tag{2}$$

And for discrete version:

$$\mathrm{v}_{pq} = \begin{cases} f^*_p - f^*_q & \text{if } |f^*_p - f^*_q| > |g_p - g_q|, \\ g_p - g_q & \text{otherwise.} \end{cases}$$

Select two images you like to edit and show result that demoinstarted well the effect with one sentence of explanation for each (**10 points**).

3 Seamless cloning for color images (10 points)

Repeat task 2a for color images. You have to process red, green, and blue components separately (**10 points**).

4 Selection editing effects (15 points)

Implement only one of the selection editing effects described in Section 4 of the paper (**15 points**):

- Texture flattening
- Local illumination changes
- Local color changes
- Seamless tiling