Andrei Harbachov | 301438192

CMPT 461: Computational Photography

Dr. Aksoy

Assignment 2

Poisson Blending

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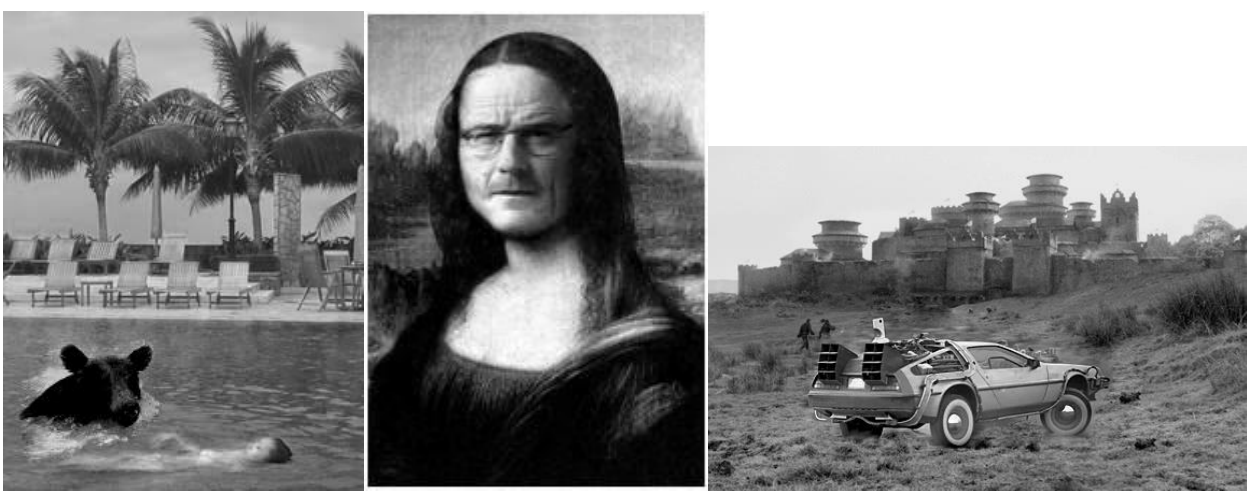
Part 1 – Discussion

This report outlines the implementation and outcomes of the Poisson image blending method described by Perez et al. in paper "Poisson Image Editing". The primary objective of the assignment was to seamlessly integrate content from a source image into a target image using the Poisson blending technique.

The primary obstacle I've encountered revolved around managing the substantial size of the matrix. Constructing matrix A seemed impractical due to its staggering size of approximately 51GB. Consequently, I've opted out for a sparse matrix representation. To address this, I used MATLAB's sparse function to optimise code performance.

To efficiently handle the task, I preallocated the vectors i, j, and v with a size of height * width * 5, accommodating the pixel and its four neighbours. When a pixel falls within the mask, I compute the indices of its four neighbours, fill vector i with ones multiplied by the current pixel, populate j with corresponding indices, and assign v with the Laplacian filter values. Additionally, vector b was populated with the discrete approximation of the Laplacian operator.

Managing boundary conditions emerged as another critical consideration. Ensuring that pixel selection stayed within image boundaries during indices computation and discrete approximation for b was achieved by leveraging MATLAB's min and max functions. This approach guaranteed that selected values always fell within acceptable bounds.



result so far

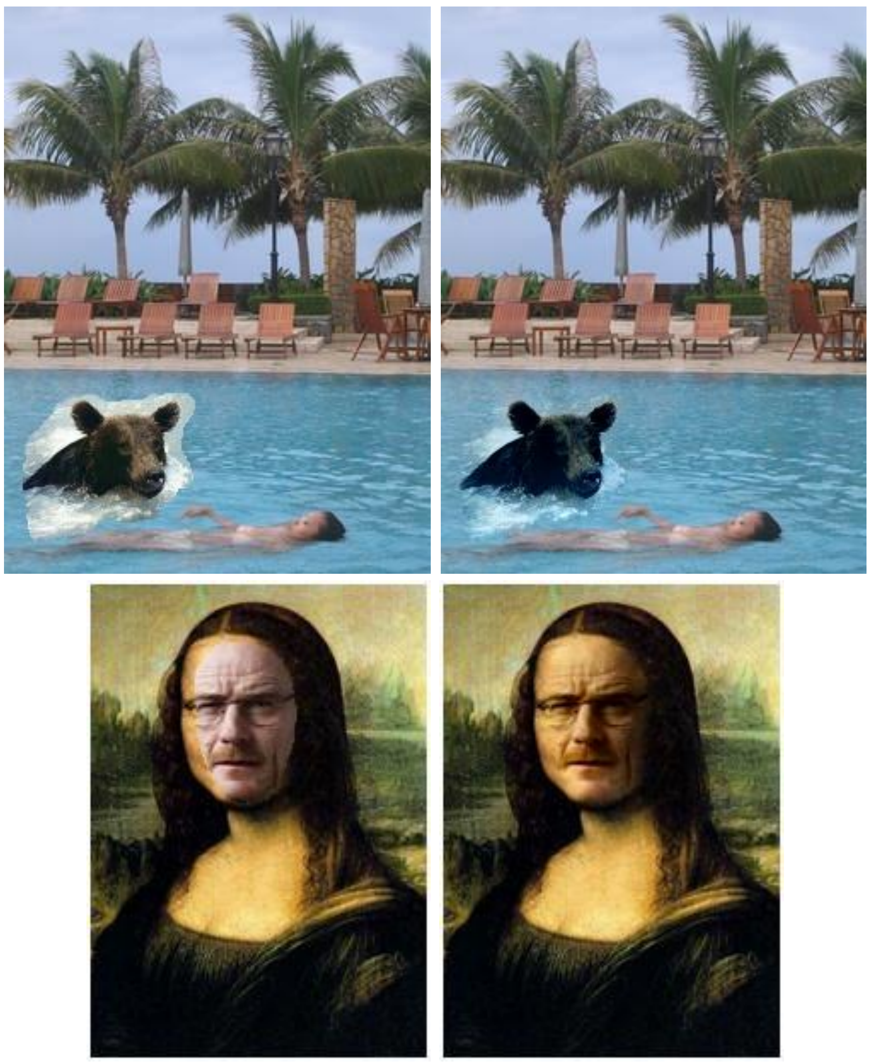
A significant oversight became apparent during the implementation process — the algorithm was initially designed for grayscale images, neglecting colour channels.

To rectify this, a loop was added on top of algorithm to iterate over each colour channel, ensuring that the blending algorithm operated effectively on colour images. Additionally, the discrete Laplacian calculation was adjusted to account for the current colour channel exclusively.

Part 2 – Results

2.1 – Provided Examples

Final implementation yields the following results:

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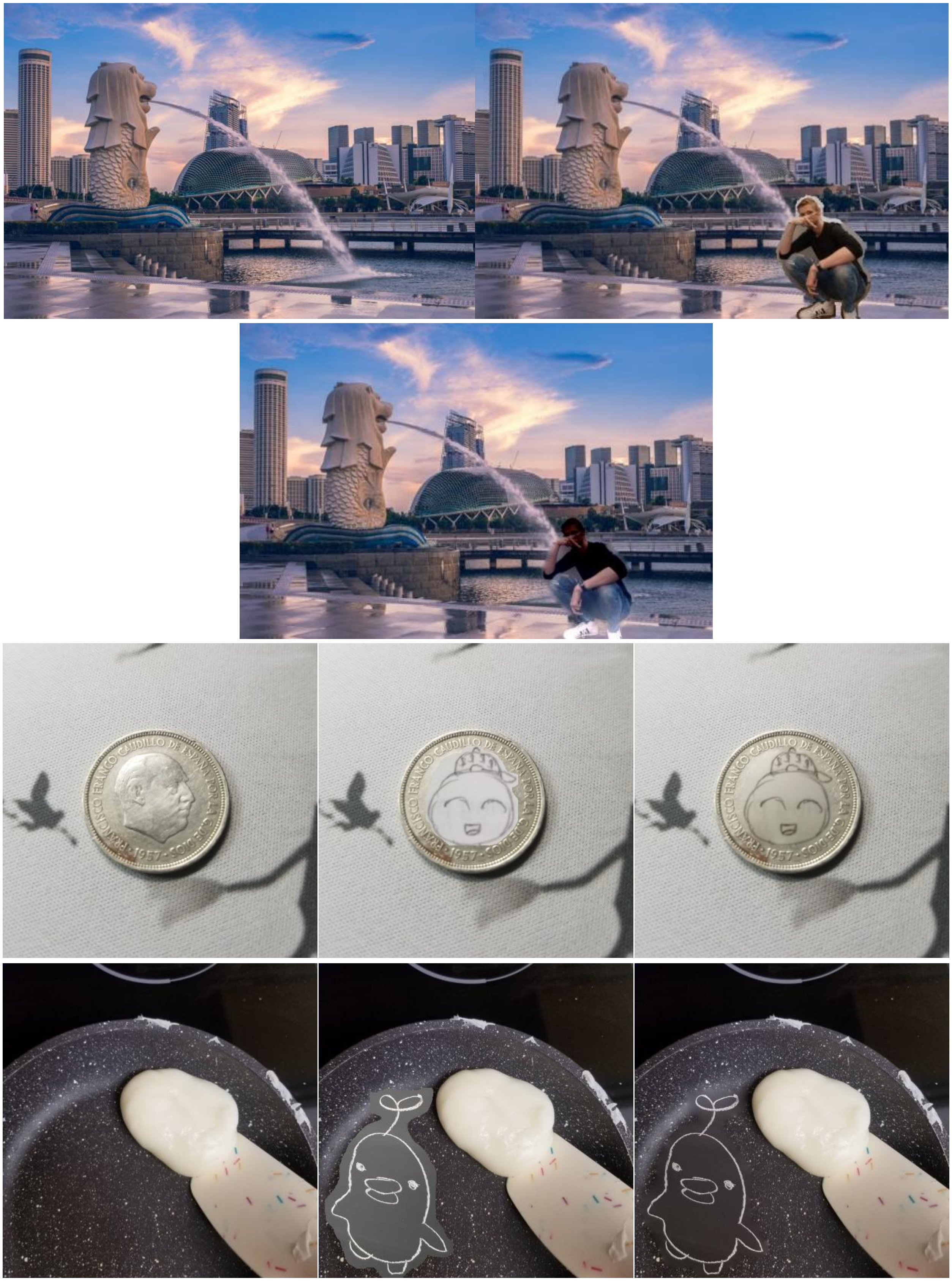
The seam between well-selected pairs of images seamlessly integrates, rendering it virtually imperceptible. However, in cases where there is a large contrast in texture between the target and source images, edges may exhibit a slight blurriness (Aeroplane and Rainbow images are a good example of this phenomenon). One notable drawback of Poisson blending is the potential for unnatural colour shifts in the source image, as it had happened with the First Singapore Custom image. This phenomenon arises as a result of preserving gradients along borders, leading inner pixels to adopt significantly altered brightness levels. In summary, with meticulous selection of source and target images, ensuring optimal placement of source image pixels, Poisson blending can proficiently fuse two images, minimising the presence of undesirable artifacts.

2.2 – Custom Examples

The target, cut and paste, and projection of source on to target using Poisson Blending.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Conclusion

The execution of the Poisson image blending algorithm effectively met the goal of seamlessly integrating content from source images into target images. While confronted with challenges during implementation, we devised solutions to surmount them, leading to efficient and precise blending outcomes.

In scenarios where the backgrounds of the source and target images are similar, the blended result appears exceptionally natural, devoid of any visible seams. However, when the backgrounds substantially differ, the algorithm faces greater difficulty in achieving a seamless image blend.