Rico Mossinkoff - 12805157
Ewoud Vermeij - 11348860
Hannah Lim - 10588973
Yke Rusticus - 11306386

Assignment 4
Image Alignment and Stitching

Introduction

In this assignment we will practice image alignment and image stitching.

For image alignment we will make use of the existing function of VLFeat to find the matching point in the images. After finding the key points we will create a function RANSAC to find the best transformation of an image on another image based on these key points. Finally with the best transformation we will transform the first image so that it is in the coordinate space of the second image.

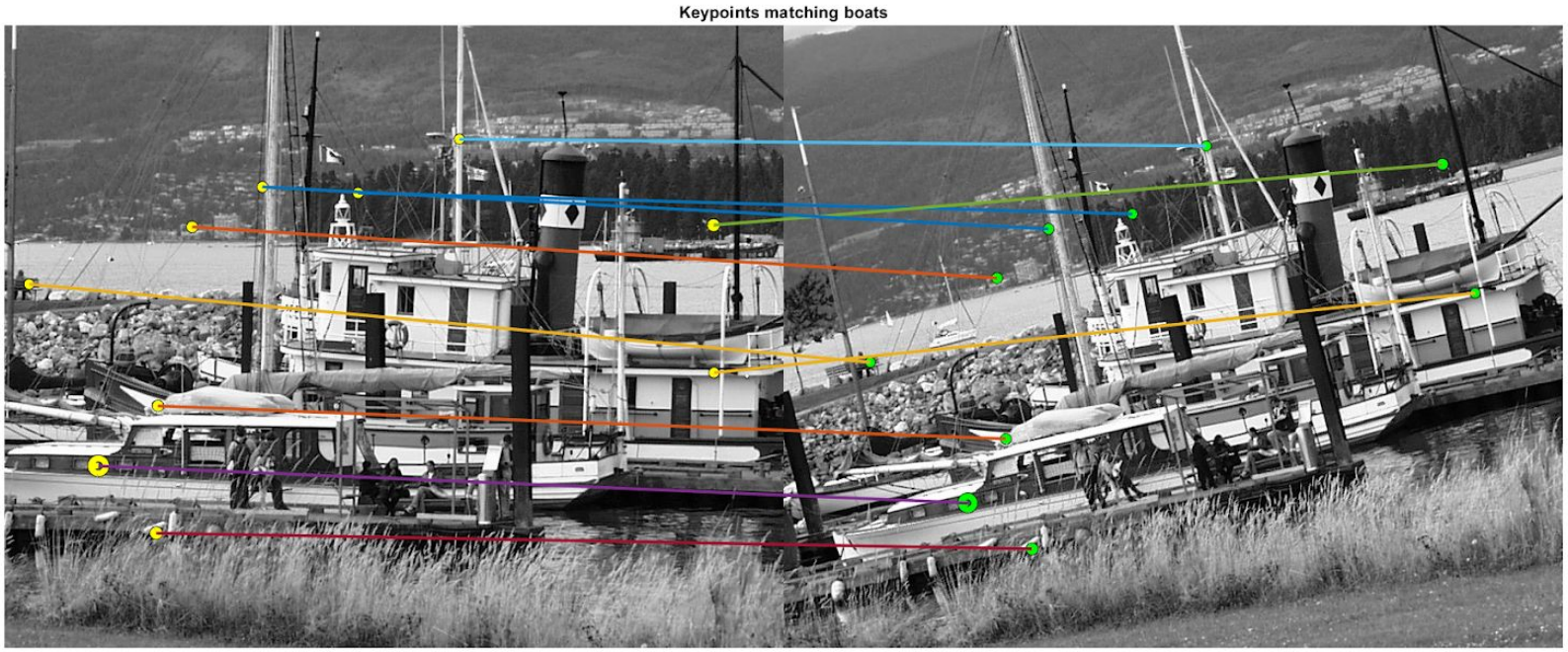
After we have created a function that computes the best transformation between two images, we will try and stitch the images together based on the matching points. The goal is to create a generative function able to stitch any two images.

1. Image Alignment

Question - 1

1. See attachment file keypoint_matching.m

2. See attachment file kp_matching_demo.m



3.

Rico Mossinkoff - 12805157
Ewoud Vermeij - 11348860
Hannah Lim - 10588973
Yke Rusticus - 11306386

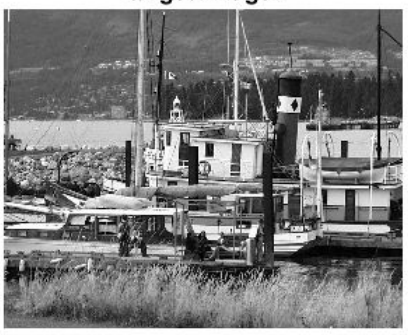
Transformed image.

target Image.

Original Image.

Transformed image.

target Image.



Original Image.

See attachment file RANSAC.m and RANSAC_demo.m

Question - 2

1. **How many matches do we need to solve an affine transformation which can be formulated as shown in Figure 1?**
   Each match (x,y) and (x',y') results in two equations according to

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} m_1 & m_2 \\ m_3 & m_4 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} t_1 \\ t_2 \end{bmatrix}$$

   However, we have six unknowns: m_1, m_2, m_3, m_4, t_1, t_2. In order to solve for all six parameters, we need in total a minimum of six equations. Therefore, we need three distinct matches to solve for the affine transformation.

2. **How many iterations on average are needed to find good transformation parameters?**

   It depends on the desired quality of your transformation. How "good" your parameters depends on the number of inliers you find, but also on the visual accuracy of your transformation, i.e. whether it looks alright. In our case we found that for a relatively small number of iterations, say 5 - 10, the number of inliers for a given transformation becomes constant.

2. Image Stitching

Question - 1

1. See attachment file stitch.m
2. See attachment file stitch_demo.m

Rico Mossinkoff - 12805157
Ewoud Vermeij - 11348860
Hannah Lim - 10588973
Yke Rusticus - 11306386

Image 1.

Image 2.

Stitched image

Conclusion

In our quest to image alignment and transformations we achieved success. Using VLFeat to perform SIFT operations, Ransac to find the best affine transformation between two images and imwarp to actually transform the images in such a way that the matches of the images are well aligned worked quite well.

Image stitching was more challenging for us. Finding matches between images and transform one of the images according to the found matches worked out well. Stitching the images together was the more challenging task. We were unable to find a generative way to stitch any pair of two images together and therefore ended up with a more hardcoded way of stitching the two images of the yellow tram together. In the end the stitched images of the yellow tram got us a very good result. First, we used the coordinates of the match points to adjust the right image such that the match points were of equal height. Next, we “slided” the images into each other such that the x coordinates of the match points were aligned. The result is a very well stitched image.