HW4 Part 1 Write Up

Algorithm:

1. Given two images, X and Y compute the SIFT key points and descriptors.

2. With the descriptors x and y, compute the matching and use ratio test to highlight good matches between X and Y. If the number of matches is 40 or higher, fraction of keypoints that match from each image is 0.015 or higher, then move onto Fundamental matrix computation

3. Compute the Fundamental matrix, F, using the good matches from step 2 and apply outlier pixel distance threshold of 5 pixels, RANSAC algorithm, 95% confidence interval, and 500 max iterations to obtain inlier matches. If percent of inliers obtained is 15 percent or higher, move to next step

4. Compute the Homography matrix, H using the inlier matches from step 3 to find the mapping from image 2 to image 2. Apply outlier pixel distance threshold of 30 pixels, RANSAC algorithm, 95% confidence interval, and 500 max iterations to obtain the inlier matches and matrix. If the percent of inlier matches is 70 percent or higher, then move on alignment

5. The alignment step uses a right stitching algorithm to warp the second image onto an empty mosaic image that has the dimensions of the second image plus the first image. Then the first image is then overlayed onto the mosaic.

6. Blend the mosaic to get rid of seam from overlay using a 2 weighed matrices (1 for each image) that are weights based on their distances from their centers. Overlapping pixels are then weighted with a combination of weights from each image

Threshold Decision:

Considering that each image with each image set should move forward after the initial SIFT matching, I based my SIFT keypoints matches threshold off my table of results by looking at the minimum SIFT matches that a pair of images needs along with the fraction of matches in each image. The minimum was 40 matches and fraction of matches for each is 0.015 or higher. For the same scene decision, I used a thershold of 15 percent inliers retained since the minimum percent in the table for F percent was 16 percent. For alignment threshold, I used a threshol d of 70 percent since the minimum was 71 percent in the table. In general a higher threshold is good for this step since the allignment requires that a good number of matching keypoints from the H matrix step be retained since more inliers implies a better projective transform.

Calendar

Description automatically generated

Given image sets tabulated results

Non-match caught at scene check

Here are some examples of image pairs that shouldn’t match and were caught by the algorithm:

drink-machine-image2\_vcc-entrance-image3\_SIFT.JPG

A picture containing text

Description automatically generated

drink-machine-image2\_vcc-entrance-image3\_FM.JPG

A picture containing text

Description automatically generated

Number of Matches: 132

Fraction of keypoints in image1 with matches: 0.028007638446849142

Fraction of keypoints in image2 with matches: 0.26883910386965376

Number of inliers from Fundamental Matrix estimation: 16

Percentage of inlier matches: 12.121212121212121

Percentage of inlier matches too low. Not the same. Moving to next image pair

This image pair is an example of a pair that got past the initial matching thereshold step, but then it was caught by the fundamental matrix inlier threshold fraction amount

The algorithm I have written is not perfect, hence the next example where non matches were considered to be matches from the same scene:

drink-machine-image2.JPG\_office-IMG2537\_SIFT.JPG

A picture containing text, indoor

Description automatically generated

drink-machine-image2.JPG\_office-IMG2537\_FM.JPG

A picture containing text, indoor, shelf, store

Description automatically generated

drink-machine-image2.JPG\_office-IMG2537\_H.JPG

A picture containing text, indoor, shelf, store

Description automatically generated

Testing hw4\_data\not-match\drink-machine-image2.JPG and hw4\_data\not-match\office-IMG2537.JPG

Number of Matches: 202

Fraction of keypoints in image1 with matches: 0.0428601739868449

Fraction of keypoints in image2 with matches: 0.33060556464811786

Number of inliers from Fundamental Matrix estimation: 38

Percentage of inlier matches: 18.81188118811881

Number of inliers from Homography estimation: 14

Percentage of inlier matches: 36.84210526315789

Percentage of inlier matches too low. Not the same. Moving to next image pair

This image pair was able to make it through the SIFT matching threshold, same scene threshold check, but then failed at the alignment check for mosaic creation

Blending Successes and Failures:

tree-mrc-image2\_tree-mrc-image3

A tree in front of a building

Description automatically generated with medium confidence

This example image pair did really well in terms of using the blending algorithm.

Vcc-entrance-image1\_vcc-entrance-image3

A picture containing text, place of worship

Description automatically generated

Shading in image 2 along with alignment creates problems. Overall it looks like a good blend

tree-mrc-image2\_tree-mrc-image4

A picture containing outdoor, grass

Description automatically generated

This pair did really bad in terms of blending. We can see a seam for sure!

Simple overlaying actually works better in this case:

A picture containing text

Description automatically generated

A picture containing calendar

Description automatically generated

Blending failure with Image 1 and Image 3 from Office set

A picture containing graphical user interface

Description automatically generated

Blending failure with Image 2 and Image 3 from Office set

Strengths:

Is able to perform well on the given matching image sets with exception of (Office\_image1, Office\_image3) and Office\_image2, Office\_image3) and implements a weighted average blending step that attempts to blend based in overlapping regions with weight from both images.

Weakness:

Blending should be more intelligent in terms of handling shading discrepancy between 2 images.