Department of Electrical & Computer Engineering | COMP ENG 4TN4

McMaster University | Image Processing

Assignment 5

Due Date: 2022/03/08

Assessment: 4% of total course mark

Instructions:

- For coding problems, please include the results as well as the screenshots of codes in the report
- Please upload source codes along with the report in Avenue (1 zip/rar file including codes, results and 1 PDF report file)
- The report MUST be written in Latex
- The codes MUST be written in Python language
- Please write comments for your codes!
- The explaination about the code MUST be included in the report!

Theory (50 %)

1 Harris Corner Detection, 20 %

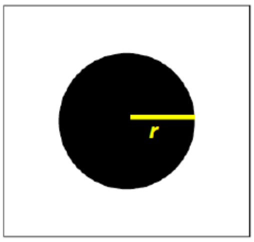
Consider the following image.

$$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 255 & 255 & 255 & 0 \\ 0 & 255 & 255 & 255 & 0 \\ 0 & 255 & 255 & 255 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix} \tag{1}$$

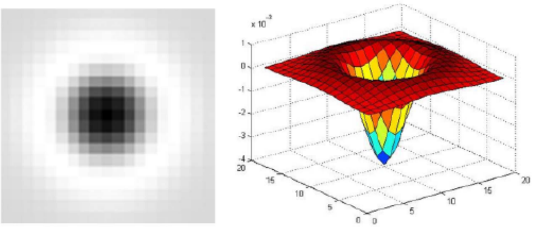
Use $[-1, 1]$ and $[-1, 1]^T$ as kernels for horizontal and vertical gradient extraction. Compute matrix M for each non zero pixel. Compute λ_{min} and λ_{max} for each pixel. By putting a suitable threshold on cornerness score function, determine corner points.

2 Scale selection, LoG, 15 %

At what scale (σ) does the Laplacian of Gaussian achieve a maximum response for a binary circle of radius r?



image



Laplacian

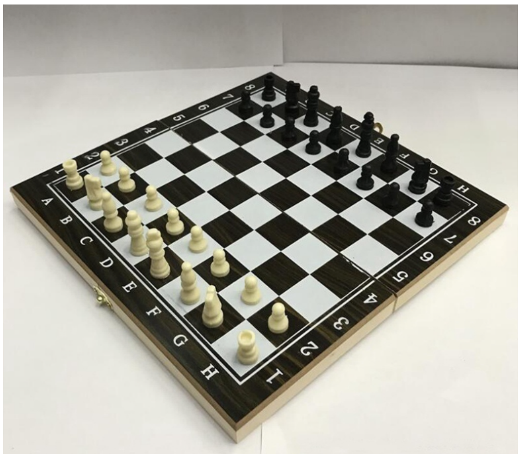
3 RANSAC, 15 %

The number of iterations, N , in RANSAC is chosen such that we can with the probability p (usually set to 0.99) that at least one of the sets of random samples do not include an outlier. Let u represent the probability that any selected data point is an inlier, and m is the required number of samples for each iteration. Compute N in terms of other parameters. For $p = 0.99$, $m = 2$ and $u = 0.7$, compute N.

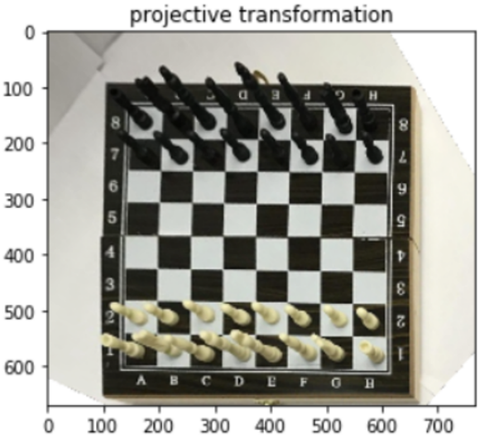
Implementation (50 %)

1 Change point of view (15 %)

Select some points in image A to compute a projective (homography) transformation that warps image A to B. Warp image A using computed homography transformation and save the results. How many points do you need to derive this transformation?



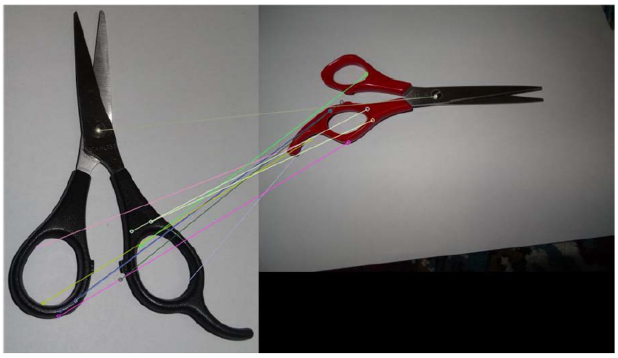
(a) A



(b) B

2 Visualize Matched points (15 %)

Extract key points and descriptors for ”image1_1.jpg” and ”image1_2.jpg”. Then find the correspondences (matches) and visualize them like the following image. You can use any keypoint extraction and descriptor method for this question.



3 Solving a puzzle (20 %)

Use ”image2_1.jpg” to ”image2_4.jpg” to achieve a complete image. These images have some intersection with each other. Therefore, you can use feature matching to find the match points then use those match points to estimate the translation between two pieces. Then you can do the same process for the remaining pieces.

The AKAZE, BRISK, ORB, FAST, SURF, SIFT can be used as the feature extraction and descriptor.

Hint: The first step is to find a match for a piece by looking at the number of matched points between that piece and other pieces.