

CMPT 361 Assignment 2

Due time: July 6th, 23:59:59. Total marks: 20. Marks for late assignments will be discounted by 10% each day. That is, if you are one day late, your marks will be multiplied by 0.9, two days late by $0.9 \times 0.9 \dots$

Object/Face Detection using Harris Corners and SIFT-like Descriptors

(20 marks in total)

1. Prepare Data: (3 marks in total)
 - 1.1. Prepare three sets of photos, two sets for two objects (one easy and one harder), and one set of your face. For each set, prepare at least four images. One image should contain just the single object/your face. The second image should contain the same object/face with some very different objects/faces. The third one should contain the same object/face with some other similar objects/faces, the object/face of interest should have some feature variations caused by changes in viewpoint/illumination/makeup etc. The last image should be really challenging, containing the same object/face with significant changes in features, and similar objects/faces in the same image. The general idea is to prepare a dataset spanning a range of difficulty levels from easy to hard for the feature matching task later.
2. Detect Harris Corners: (2 marks in total)
 - 2.1. Implement a Harris corner detector with a few tuneable parameters. (1 mark)
 - 2.2. Analyze the performance of your algorithm, in terms of different parameter settings and the resulted number/quality of detected features. Support your analysis with qualitative data, i.e., visualize the corners on your images in the report. Then freeze your code with the “optimal” parameters you have found for later tasks. Please also write the matlab commands in the report that the TA can use to reproduce your results. (1 mark)
3. Develop SIFT-like Descriptors and Feature Matching: (8 marks in total)
 - 3.1. Develop SIFT-like descriptors for Harris Corners. That is, you don't need to implement SIFT-detectors. (4 marks)
 - 3.2. Implement a feature matching method that can match detected corners based on their SIFT-like descriptors. (2 marks)
 - 3.3. Tune the parameters of your algorithms to achieve the best results you can get. Write in your report with supporting results: first with matched features visualized so that the TA can inspect them in a qualitative way, and then report quantitative metrics such as precision/recall/f-score. Please also write the matlab commands in the report so that the TA can reproduce your results. (2 marks)
4. Develop an object/face descriptor: (7 marks in total)
 - 4.1. Based on the philosophy that you have learned from SIFT descriptors, design a basic higher-level descriptor that can help you detect the same type of objects

- or human faces, given an image of the object or a human face. E.g., detect all water bottles or detect all human faces in an image. (3 marks)
- 4.2. Improve your algorithm so that your descriptor can detect the particular object/face among similar objects/faces. E.g., detect a particular water bottle in a few water bottles, detect your face in a family photo. (2 marks)
 - 4.3. Describe your ideas/algorithms in your report, analyze their performance and discuss why or why not they work, with supporting qualitative analysis. Please also list the matlab commands so that the TA can verify your claims. (2 marks)

Submission

Please submit a zip file with student number and your name (i.e., **300000001_TerryFox.zip**). The zip file should contain all your matlab code, images, and a report in pdf format. **Do not reuse code from other sources.** You can reuse ideas from others, with proper references in your report. You can only use external software to perform tasks not related to this assignment, such as resizing your images or converting their formats. You should not use functions from the Matlab computer vision toolbox, which provide some of the functionalities that we ask you to implement for this assignment.