

INDIAN INSTITUTE OF TECHNOLOGY, DELHI

REPORT

Assignment 2: Corner Detection and Panorama Stitching

ARNAV TULI | ENTRY No. 2019CS10424

Course - COL780 | Prof. Anurag Mittal

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Chapter 1

Corner Detection and Panorama Stitching

1.1 Introduction

My entry number ends with $4 \equiv 0 \pmod{2}$. So, I have implemented Harris Corner Detector to detect interest points (corners) in the image. The algorithm used is same as mentioned in the paper by [Harris and Stephens \(1988\)](#). For panorama stitching, I first matched interest points between two images using proximity and sum of squared differences (SSD) approach. After matching, I found the affine transformation between the two sets of points and warped one on the other to get an image stitch.

Note: OpenCV's `estimateAffine2D()` (RANSAC) and `warpAffine()` methods are used to find the transformation between two images, and warp one onto the other respectively.

Following datasets are used for generating panorama images (*New Dataset*):

- 1 (New Hostel Building)
- 2 (IIT Hospital)
- 3 (SIT Building)
- 4 (A Statue)
- 5 (David Warner DC)

The generated panoramas can be found with their respective names [here](#).

1.2 Results

The solution has two major components: Harris corner detector (HCD) and image stitcher (IS). The following parameters are used for these components:

- Corner window size (HCD): 5
- Corner window weight (HCD): Gaussian
- Harris response parameter (HCD): 0.04
- Harris response threshold fraction (HCD): 0.01 (1% of maximum response as cut-off)
- Harris response threshold count (HCD): 3000 (only top-3000 of the remaining points (after fraction cut-off) are taken as corners)
- Non-maximum suppression window size (HCD): 5
- Proximity window size (IS): 601
- Neighbourhood window size (IS): 5 (used in SSD calculation)
- Number of corners matched to get affine transform (IS): 100
- RNG seed (IS): 1 (used in sampling 100 points)
- Cropping tolerance: 10 pixels (to avoid *stitch* lines in the cropped image after warping)

1.2.1 Panoramas

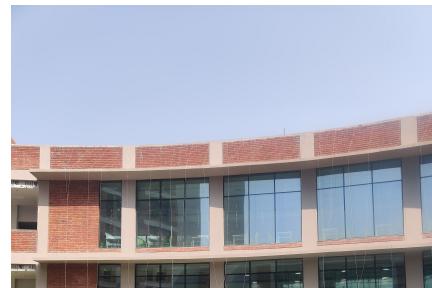


Figure 1.1: New Hostel Building



Figure 1.2: (a) IIT Hospital, (b) SIT Building, (c) A Statue and (d) David Warner DC



(a)

Figure 1.3: David Warner DC but with *zero* crop tolerance (one *stitch* line is visible)

Chapter 2

Appendix: Code Overview

There are three code files `main.py`, `cornerDetector.py` and `imageStitcher.py`. The code assumes the following directory structure:

```
directory
└── Dataset/
    ├── 1/
    ├── 2/
    ├── 3/
    ├── 4/
    └── 5/
└── main.py
└── cornerDetector.py
└── imageStitcher.py
```

`main.py` has support for the following command line arguments:

- `--dir`: Dataset directory (1, 2 etc.)
- `--p_radius`: Proximity radius for brute-force matching
- `--n_radius`: Neighbourhood radius for SSD calculation
- `--sample_count`: Number of points matched per stitch
- `--window_size`: Harris corner detector window size (for matrix calculation)
- `--k`: Harris response parameter ($\det(H) - k * \text{tr}(H)$)
- `--thresh`: Harris response threshold fraction
- `--top_k`: Harris response threshold count (top k)
- `--nms_radius`: Radius used for non-maximal suppression
- `--seed`: RNG seed
- `--tolerance`: Crop tolerance
- `--gaussian`: Flag used to turn on gaussian weights in Harris matrix calculation

Run command: `python main.py < args >`

Output: Final panorama image is saved in the current working `directory`.