

Visual SLAM Run Instructions

I. Description

This project is to develop a SLAM algorithm running on Raspberry Pi with camera. The SLAM algorithm does both mapping and localization (location and orientation) at the same time using only a camera. In addition, colored landmarks can be recognized during navigation.

II. Environment

Linux Ubuntu 18.04

g++ 7.3.0

OpenCV 2.4.13.6 (Required at least 2.4.3)

Eigen 3.3.4 (Required at least 3.1.0)

III. Camera Calibration

Need a Chessboard.

Modify the following values in default.xml (config/default.xml) before running the camera calibration:

- Board size
- Square size
- Input (camera ID)

Running the calibration:

```
cd build
./camera-calibration
```

Pressing g to start the calibration. "camera_data.xml" will be generated.

Using the camera matrix and distortion coefficients information in the generated xml file after calibration.

```
<Camera_Matrix type_id="opencv-matrix">
  <rows>3</rows>
  <cols>3</cols>
  <dt>d</dt>
  <data>
    1.0139156903798416e+03 0. 6.3950000000000000e+02 0.
    1.0139156903798416e+03 3.5950000000000000e+02 0. 0. 1.</data></Camera_Matrix>
<Distortion_Coefficients type_id="opencv-matrix">
  <rows>5</rows>
  <cols>1</cols>
  <dt>d</dt>
  <data>
    3.0868096428950792e-01 -4.6673155807986282e+00 0. 0.
    1.7144248712467402e+01</data></Distortion_Coefficients>
```

The corresponding variables are as below:

- Camera matrix = $[fx, 0, cx, 0, fy, cy, 0, 0, 1]$
- Distortion coefficients = $[k1, k2, p1, p2, k3]$

Now, we need to adjust the parameters in webcam.yaml (config/webcam.yaml) according to the calibration.

```
# Camera calibration and distortion parameters (OpenCV)
```

```
Camera.fx: 902.878172
```

```
Camera.fy: 902.878172
```

```
Camera.cx: 639.500000
```

```
Camera.cy: 359.500000
```

```
Camera.k1: 0.032793
```

```
Camera.k2: -0.479938
```

```
Camera.p1: 0
```

```
Camera.p2: 0
```

```
Camera.k3: 0.822335
```

```
# Camera frames per second
```

```
Camera.fps: 30.0
```

```
# Color order of the images (0: BGR, 1: RGB. It is ignored if images are grayscale)
```

```
Camera.RGB: 1
```

IV. Visual SLAM

After the camera calibration, adjusting the parameters for the camera, and unzipping the vocabulary file, we can simply run the following command to start the program:

```
cd build
```

```
./main
```