

README

Project 4: Calibration and Augmented Reality Spring 2024

CS 5330 Northeastern

Professor Bruce Maxwell, PhD

Group Member Names:

- Joseph Nelson Farrell
 - Harshil Bhojwani
-

Links/Urls:

https://northeastern.zoom.us/rec/play/eVsXL1KIAwmPj87eFdcDAVrTNNczApLvEq5_EauwajsW12EVJEXK0C7k8fZF5nqvOtwSTZkrQ9wb_xY.Uks3sV8OLcNRJzSi?canPlayFromShare=true&from=my_recording&continueMode=true&componentName=rec-play&originRequestUrl=https%3A%2F%2Fnortheastern.zoom.us%2Frec%2Fshare%2FlyylbOCAS2n55FWxjsnpv-fxS-iKNp7PA-P-VqZRu2UIE7C7gk0ksPA6nXPIIPcm.GcPTLRI4esZXtgkP

This is a link the video demo (it is also in the report):

Operating System & IDE:

- MacOS
 - Visual Studio Code
-

Time Travel Days:

- 2
-

Executing the Program:

This requires your iPhone be connected to your computer.

It also requires a checkerboard pattern to use as the target.

A different target can be used for steps 11 - 12; Harris corner detection.

Step 1: Run calibrate.cpp

To execute the program that will calibrate the camera the user has to run this executable:

```
./ar
```

Step 2: Save Images with Features Detected

Next, the user has to select frames to use in calibration. To select frames the user must press:

s

This will add the last frame where all the points were detected in the checkerboard to a vector called `points_set`.

Step 3: Calibrate Camera

To calibrate the camera the user must press:

c

This requires `points_set` contains at least 5 frames. If it does not contain 5 frames the user will see this message:

```
No, no, no...We need at least 5 frames!  
We only have: 0
```

Then the user must press any key to continue selecting frames.

If 5 frames are the present, the user will see this message:

```
_____  
Distortion Coefficients: Pre Calibration  
Empty
```

```
_____  
Camera Matrix: Pre Calibration  
1 0 960  
0 1 540  
0 0 1
```

```
_____  
Distortion Coefficients: Post Calibration  
0.36583, 1.50272, -0.0225171, 0.115271, -6.56414,
```

```
_____  
Camera Matrix: Post Calibration  
2181.94 0 1217.47  
0 2047.72 594.423  
0 0 1  
_____
```

```
Reprojection Error = 1.65882
```

This indicates the camera has been calibrated and the data stored in the camera matrix and distortion coefficients vector have been saved to a `calibration_data.csv`.

The user is now free to quit the program and run `project_points.cpp`, the AR program.

Step 4: Exit ./ar

To exit press:

```
q
```

Program Terminates.

Step 5: Generate AR with project_points.cpp

To create the augmented reality objects the user now needs to execute this executable:

```
./pr
```

Step 6: Display World Axes in 2D

To display the AR projected axes the user must press

```
a
```

This will display the world axes: x, y, and z, on the target.

Step 7: Display Diamond

To display an AR floating diamond the user must press:

```
d
```

This will display a diamond hovering over the target.

Step 8: Display Rectangles

To display AR rectangles the user must press

```
r
```

This displays rectangles on the target.

Step 9: Extension - Display Mountain Scene

To display the AR mountain scene the user must press

```
c
```

The displays an AR generated mountain scene that completely obscures the target.

Step 10: Exit ./pr

The user can run the program as many times as they wish and switch between displays.

To exit press:

```
q
```

Program Terminates.

Step 11: Display Harris Corners

To display the Harris corners on a target the user must run this executable:

```
./hr
```

This will display the Harris corners corners found in the source image.

Step 12: Exit ./hr

To exit press:

```
q
```

Program Terminates.