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Week 6 Lab

Part 2:

Objective: The objective for part two was similar to that of part one, focusing on camera calibration using OpenCV. However, this phase presented additional challenges as the edges of the chessboard were less distinguishable compared to those in the first part. Additionally, the chessboard images in this part were laid flat, contrasting with the varied orientations seen in the previous images. This difference in positioning necessitated a more nuanced approach to detect and accurately process the chessboard corners for calibration.

Code Description:

In part two of the project, the code was adapted to calibrate another camera using images of a flat-laid chessboard with less distinguishable edges. The process began with setting termination criteria for sub-pixel accuracy in corner detection.

A systematic approach was used to identify the optimal chessboard size for calibration, iterating over sizes from 7x11 to 11x11. For each size tested, the following steps were executed:

- Image Processing: Each image was converted to grayscale to facilitate chessboard corner detection.
- Corner Detection: OpenCV's findChessboardCorners was employed to locate corners, which were then refined to subpixel accuracy.
- Data Collection: Upon successful corner detection, 3D object points and 2D image points were collected.
- Calibration: If corners were detected, calibrateCamera was used to compute the camera matrix and distortion coefficients, which were printed for review.
- This method ensured thorough testing and provided robust calibration results, crucial for the specific challenges presented by the flat-laid and indistinct chessboard images in part two of the project.

```
Trying chessboard size: 7x11
Successful detection with chessboard size: 7x11
Camera Matrix:
 [[566.00585507   0.         234.73699962]
 [  0.         566.93146848 328.30905167]
 [  0.           0.           1.        ]]
Distortion Coefficients:
 [[-0.04385794  0.81318625  0.00691434 -0.00650737 -2.05157198]]
Re-projection error: 0.07843734672311983
```

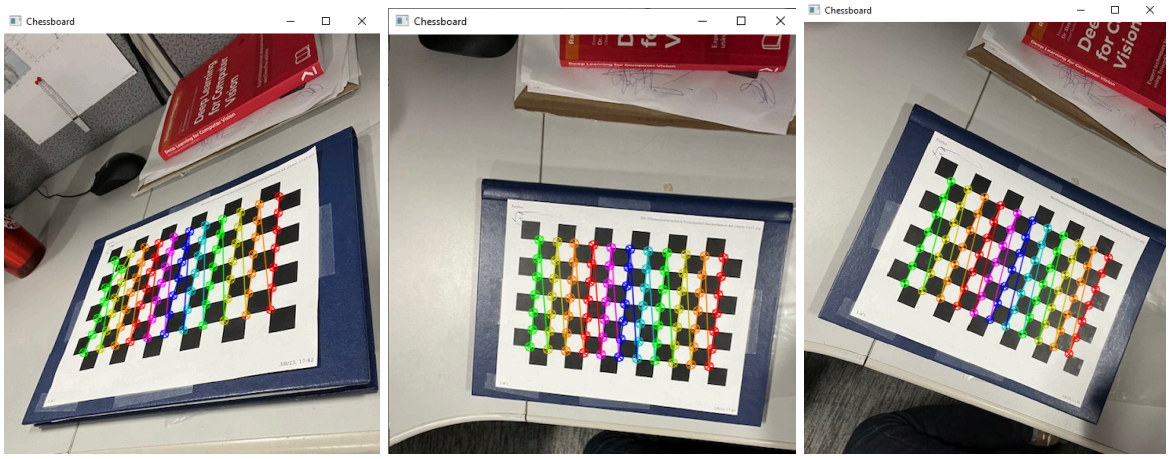

Figure 4. Camera calibration results

The final calibration used a 7x11 grid, providing the most accurate results due to its extensive coverage and greater distribution of corners across the image. This size also performed well across most reference images.

Interestingly, calibration was also achieved using smaller grid sizes, such as 5x5, 7x5, and 7x10. Also, the results from the 5x5 and 7x10 grids were similar to those from the 7x11 grid. However, the 7x5 grid produced significantly different values, indicating less reliable calibration for that size.

Successful detection with chessboard size: 5x5

Camera Matrix:
[[521.16844083 0. 233.6749422]
[0. 521.51053745 313.44563008]
[0. 0. 1.]]
Distortion Coefficients:
[[-0.71715949 0.88324616 -0.12494781 0.091705 -0.34868928]]

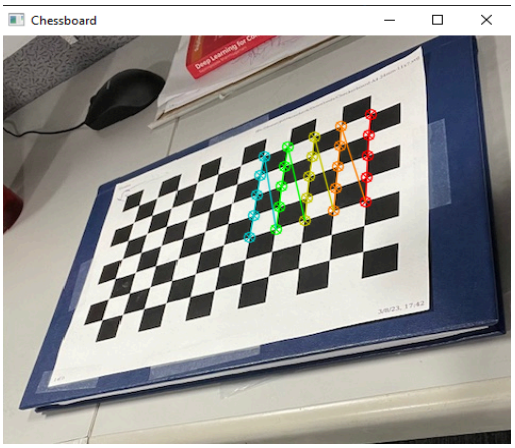

Figure 5. Size: 5x5 Camera calibration results

Successful detection with chessboard size: 7x5
Camera Matrix:
[[8.12765664e+02 0.00000000e+00 2.36138571e+02]
[0.00000000e+00 1.04180583e+03 3.25327206e+02]
[0.00000000e+00 0.00000000e+00 1.00000000e+00]]
Distortion Coefficients:
[[-8.29921675e-01 5.14469710e+01 1.81565541e-02 -6.79887228e-03
-1.22603475e+03]]

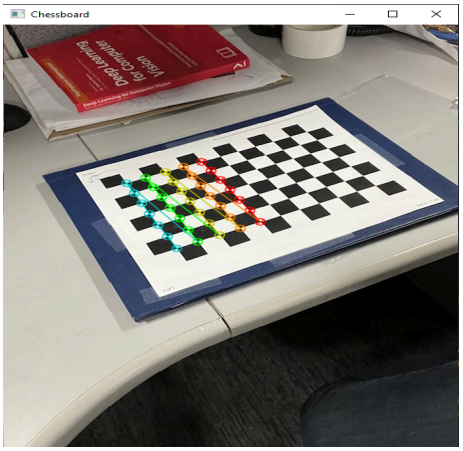

Figure 6. Size: 7x5 Camera calibration results

Successful detection with chessboard size: 7x10
Camera Matrix:
[[524.18859118 0. 224.04669787]
[0. 524.50760682 315.38952315]
[0. 0. 1.]]
Distortion Coefficients:
[[-2.58360548e-02 1.60512620e-01 -2.67250806e-04 -1.49132836e-02
6.52584269e+00]]

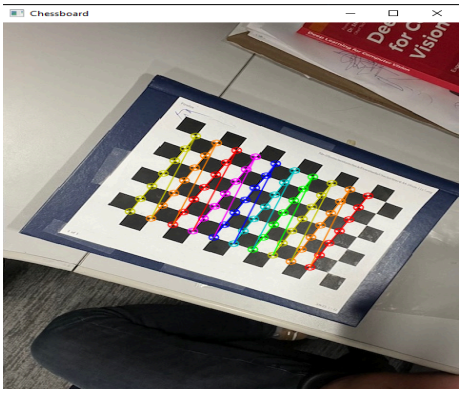

Figure 7. Size: 7x10 Camera calibration results