INFOMCV Assignment 1
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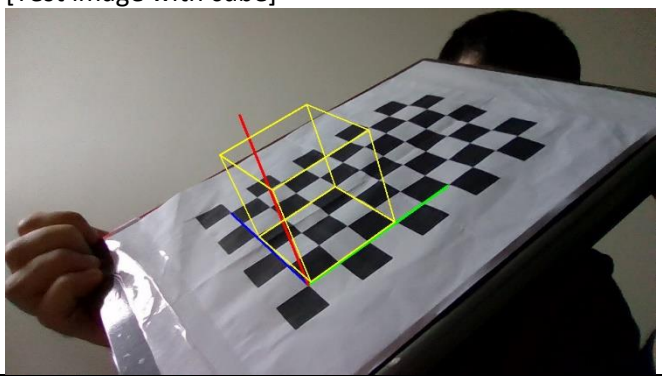
Calibration

Run 1:

$$K = \begin{bmatrix} 1.104e+03 & 0 & 5.911e+02 \\ 0 & 1.128e+03 & 4.669e+02 \\ 0 & 0 & 1 \end{bmatrix}$$

Image resolution = 1280x720

[Test image with cube]

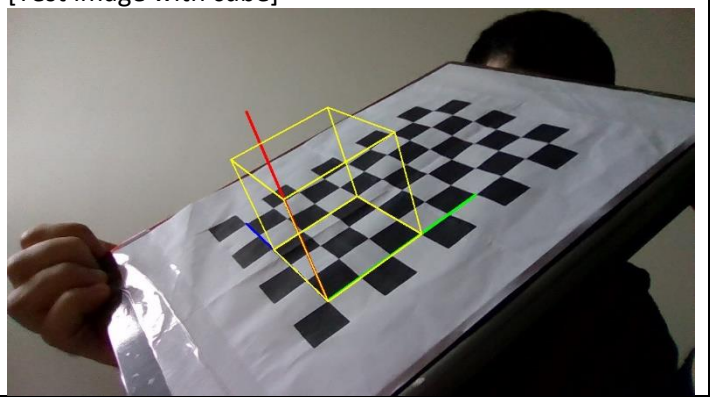


Run 2:

$$K = \begin{bmatrix} 946.396 & 0 & 692.958 \\ 0 & 948.596 & 332.478 \\ 0 & 0 & 1 \end{bmatrix}$$

Image resolution = 1280x720

[Test image with cube]

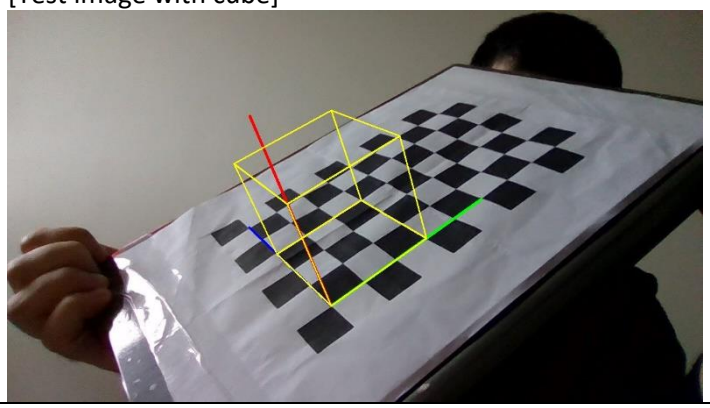


Run 3:

$$K = \begin{bmatrix} 933.646 & 0 & 652.483 \\ 0 & 936.597 & 323.419 \\ 0 & 0 & 1 \end{bmatrix}$$

Image resolution = 1280x720

[Test image with cube]



Discussion

In run 1 we see that the parameters of the focal length have the greatest values compared to those in run 2 and 3 while the x-axis optical center parameter value is smaller than the other 2 runs and the y-axis optical center parameter value is larger than the other 2 runs. We also observe that the

cube drawing is slightly off by a few pixels. This can be explained by the inaccuracies created from manual annotation process which varies per individual. As for run 2, its focal length parameters are significantly smaller compared to run 1. This can be explained by the fact that fewer images are used for the camera calibration process which results in lower parameter values, although the quality does not suffer when drawing thw cube and the world axes. Lastly, for run 3 the values of both the focal length and the optical center parameters decrease compared to run 2. Again, this is a direct result of the fewer training images used for calibration, although these differences are minute and do not affect the quality of the drawings.

Choice tasks

CHOICE 1)
We implement the option to have real-time performance with the webcam in the online phase. For that we use the VideoCapture function from the OpenCV library where as long as the user does not press the bottom “Q” video stream of the webcam will be processed and whenever the chessboard comes into view the cube and world axes will appear on it in the appropriate place. This feature could be suseptible to poor lighting conditions.

CHOICE 2)
In order to iteratevely check the quality of the image a “checkQuality” function is put. That function, for each image, estimates the sharpness of the chessboard in the grayscale image returning two outputs, the estimated scalar values of avergae sharpness, average minimum brightness and average maximum brightness and a map of the estimated sharpness across the image. Given these values the function now checks if the first 3 values are beyond a certain thresholds treshold the function will return True which results in skipping over that image ,effectively rejecting it, otherwise return False. Since in the manual corners it is possible to assume that the user ensure the accuracy of the points beforehand, the check is made only when the corner detection is made automatically (ret == True)

CHOICE 3)
In order to improve the localization of the corner points in the manual interface, following the input of the coordinates of the 4 corners, all inner points of a 2D grid not tilted were computed using linear interpolation. Subsequently, the height and width were calculated from the 4 manually inserted corners to obtain the orig_points, which are the coordinates of an ideal rectangle with the same dimensions as the tilted one. Finally, through the 'getPerspectiveTransform' function in OpenCV, the rotation matrix is extracted from the orig_points to obtain the manually inserted corners. Using this matrix via 'cv.perspectiveTransform', it is applied to the uniform_points, obtaining the internal points of the chessboard while also considering perspective.

CHOICE 4)

We implement a function that sharpens the images and helps increase the number of pictures for which the findChessboardCorners function can find the corners automatically. This is achieved by applying the filter2D function from OpenCV with a sharpening 3x3 kernel over the desired image. Although this function was not used in the code for this assignment due to the limitation of training images (and the ratio of automatic and manual images) it will be beneficial in future code.