

Task 0.2 - Camera Calibration

In this task, we will learn how to calibrate our camera and obtain the **Camera Matrix** and **Distortion Matrix**.

Need for Camera Calibration

When we obtain images from our webcam, we need to compensate for the inherent distortions that may occur in the image. Straight lines may appear curved, or some parts of the image may appear closer than expected. These type of distortions may appear in any camera regardless of cost and quality.

In Augmented Reality applications, in addition to tracking objects that appear on the screen, we are sometimes also required to obtain the position and orientation of the objects with respect to the Camera. In order to calculate these parameters, we need to know two intrinsic parameters associated with the camera. These parameters are the **Camera Matrix** and the **Distortion Matrix**.

Camera Matrix - It is a 3x3 Matrix which contains information about the intrinsic parameters of camera such as focal length and optical centre.

Distortion Matrix - It is a 5x1 horizontal vector which contains 5 values also known as **distortion coefficients**. These values define the relationship between the distorted and undistorted image.

More information on Camera Calibration can be found at the following link :
<https://goo.gl/hmH6wS>

Steps to Calibrate Camera

Please follow the steps given below:

1. Preparing the Checkerboard

- Open the *checkerboard.pdf* in the Task 0.2 folder and take a print out on A4 size paper.
- Paste the checkerboard on a rigid piece of cardboard or acrylic sheet as shown in Fig 1.

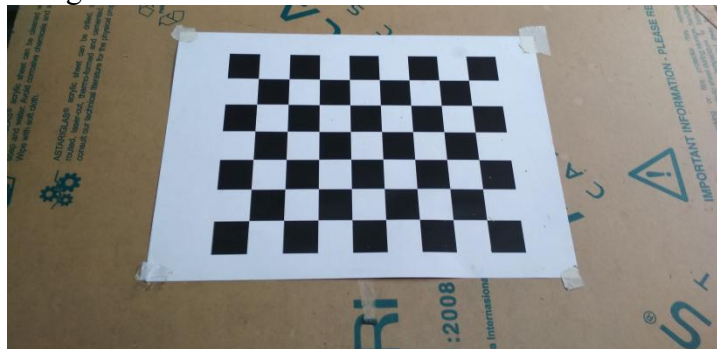


Figure 1

2. Capture Pictures of Checkerboard from Camera

- In Task 0.2 Folder, Right click on *savesnaps.py* and select **Edit with IDLE**. This will open the python file in IDLE environment.
- Pay attention to the first 5 lines of the code.

```
import numpy as np
import cv2
cap = cv2.VideoCapture(0)
ctr = 0
max_ctr = 200
```

- In line 3, you may modify the parameter passed to `cv2.VideoCapture(0)`. “0” stands for the default webcam connected to Laptop or Desktop. This number may vary for you if you have connected an external USB Webcam to your system.
- Line 5 specifies the number of pictures we want to capture. You may modify this parameter to 50 or 100 as per your requirement.
- Save changes made in the file and go to Run > Run Module. This will start executing the python script and you should see the webcam feed appear on screen.
- Bring the checkerboard in front of the webcam. As soon as the checkerboard is detected by the script, a picture is captured and a counter is incremented. You need to capture pictures of the checkerboard from different angles as shown in Fig 2.

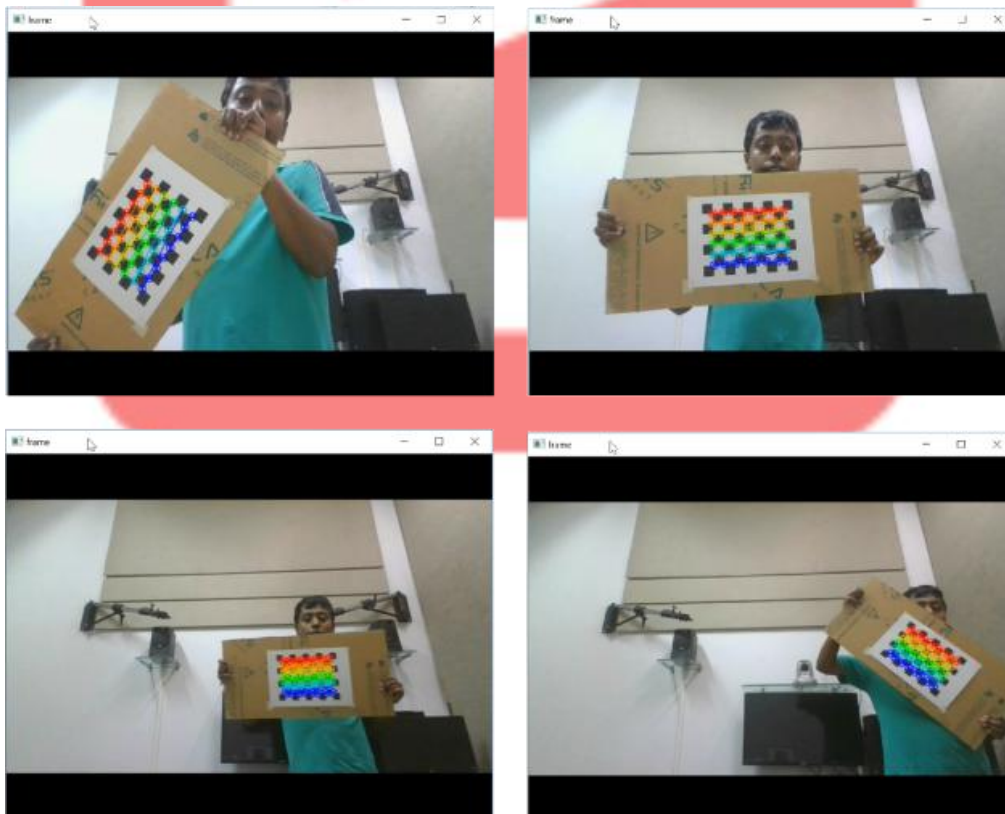



Figure 2

- Continue until script completes execution.

3. Calibration

- In Task 0.2 Folder, open the *calibrate.py* file using IDLE.
- Go to Run > Run Module and start script execution.
- Wait for the script execution to finish. Script execution tends to take some time depending on the amount of pictures taken during Step 2.
- Once script execution is completed, your python console should resemble Fig 3.



```
Python 3.5.4 Shell
File Edit Shell Debug Options Window Help
Python 3.5.4 (v3.5.4:3f56838, Aug 8 2017, 02:17:05) [MSC v.1900 64 bit (AMD64)]
on win32
Type "copyright", "credits" or "license()" for more information.
>>>
= RESTART: C:\Users\ERTS 1\Desktop\Thirsty Crow\Task 0\Task 0.2\calibrate.py =
[[357.46239819 0. 352.12833066]
 [ 0. 375.74864022 234.77715091]
 [ 0. 0. 1. ]] [[-1.10476126 4.60719557 0.0469166
 0.0363146 -6.02204228]]
>>> |
```

Figure 3: Python Console

- If you check the Task 0.2 Folder now, you will see that a new file with name *Camera.npz* has been created. The calculated values of Camera and Distortion Matrix are stored in this file

Submission Instructions

- ✓ Once you have completed camera calibration, take a screenshot of the python console (similar to Figure 3) and rename it as "*Task_0_2_output.png*".
- ✓ Also make sure the *Camera.npz* file has been generated by your python script.
- ✓ Check the *Submission Instructions.pdf* for further instructions on how to upload your Task 0.