Task 3B: Camera Calibration

blogpost-style , task-3

Smit 1 January 11, 2023, 2:12pm

@sd_22_s2

Task 3B : Camera calibration

Aim

To interface USB camera that is provided with hardware kit with ROS and calibrate it

Procedure :

Testing usb camera

- Before using the camera for any purpose, lets prepare the camera physically. The camera is a bare bone PCB so it is possible that it can be damaged while using. To solve this, we have provided a plastic box to enclose the camera. Follow the image given below to identify the plastic box in the hardware kit.

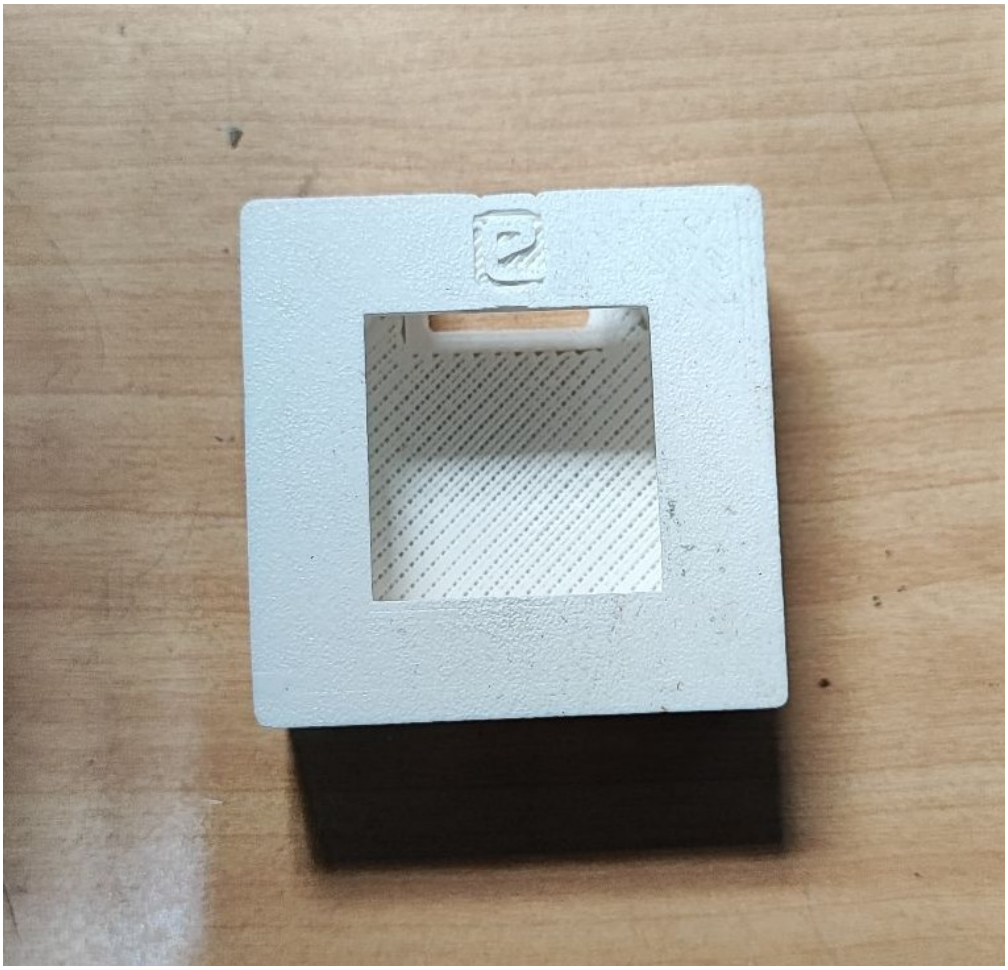

Figure 1 : Camera enclosure box

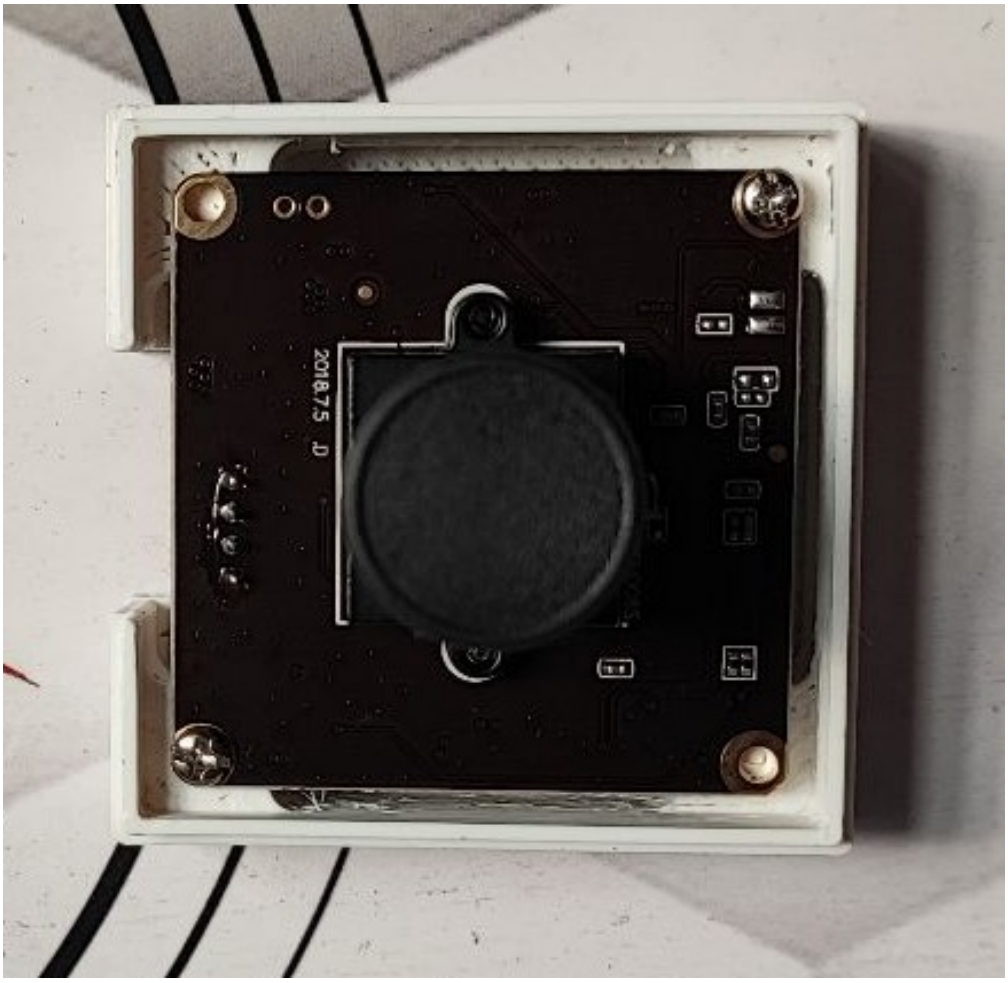

Figure 2 : Nut bolt attachment

- Fit the camera as shown in the Figure 2. Use small M2 nut and bolts to connect the camera. Just 2 nut bolts can be used as shown in the figure. After attaching the screws, you can close the lid and the camera is now protected. For sticking the camera to ceiling, use double side sticky tape.

Figure 3 : Camera enclosure

- Testing the camera : Connect the USB wire to camera and other end to laptop/pc. To test the camera, you need a image viewer in linux. One of the camera viewer is guvcview. To install, follow this command on terminal

```
sudo apt install guvcview
```

  To open guvcview, type guvcview on terminal. Go to video section and select USB camera. This will test the camera.

Interfacing usb camera with ROS

- Next step is to interface the camera with ROS as we will be fetching the image and processing via rosnodes. To do this, we will be using a ros package named `usb_cam`. Usually this package comes pre installed with `ros-noetic-desktop-full`. Just to be sure, you can re install the package by typing

```
sudo apt install -ros-noetic-usb-cam
```

- Next step is to identify the camera device. Type

```
ls /dev/video*
```

This will list the video devices attached to your system, to identify the usb camera, disconnect the camera and run the command, and then reconnect the camera and run the same command to check which device is getting added after connecting the camera. For eg. the usb camera is *video2*. I[date ros package of sentinel_drone from github and find a new launch file named usb_cam_SD.launch.

```
roscd sentinel_drone
git pull origin main
```

Go to launch folder of sentinel_drone and edit the launch file usb_cam_SD.launch and in place of video1 put video2. To open this launch file. After editing the video device, launch the usb_cam_SD.launch file

```
roslaunch sentinel_drone usb_cam_SD.launch
```

This will start a window of the usb camera and publish the topics with camera image frames similar to simulator camera in gazebo. You can now use the topic /usb_cam/image_raw.

Attaching camera to ceiling

- Attach the camera to the ceiling using double side tape. Make sure the height of ceiling from the floor is minimum 10 ft. Little more than 10 ft is better, you can go till 12 ft. Depending on the height of ceiling, you will need to change the camera resolution. For smaller ceiling height (~ 9ft-10ft) you need to set resolution at 1280x720. For higher ceiling height, you can use 1920x1080. To change this resolution, check the usb_cam_SD.launch file and follow comments.

Camera calibration

> Please note Images in this file are for representation purposes only

- To use the camera frames for image processing tasks, we need to remove the fish eye effect in the camera which is responsible for curved lines near the edge of the images seen from sub cameras. Hence it is necessary to calibrate our USB camera. Notice the difference between Figure 4 and Figure
- Figure 5 is the desirable image frame we need for image processing.

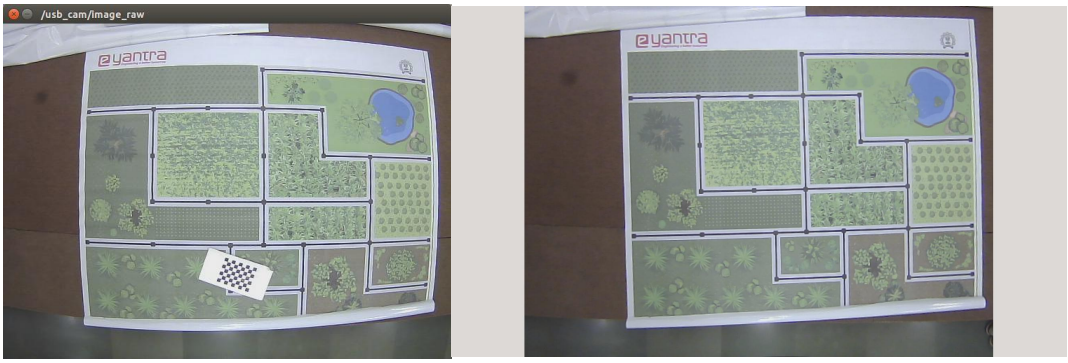

Figure 4. Fish-eye Image Figure 5. Calibrated Image

- Camera Calibration Process:

1. You will need a checkerboard in order to calibrate your camera. Print out the image given on **this link** (This will either download the pdf or view it)…

2. You must install the camera calibration package in ROS. Open a terminal and type the following command (Type the commands):

```
rosdep install camera_calibration
sudo apt-get install ros-kinetic-image-proc
```

3. Run the following two commands on separate terminals:

```
roslaunch sentinel_drone usb_cam_SD.launch
rostopic list
```

You should see ‘/usb_cam/image_raw’ and ‘/usb_cam/camera_info’.

4. Next, run the following command:

```
rosrun camera_calibration cameracalibrator.py --size 8x6 --square 0
```

5. You should now see a new window as shown in Figure 6.

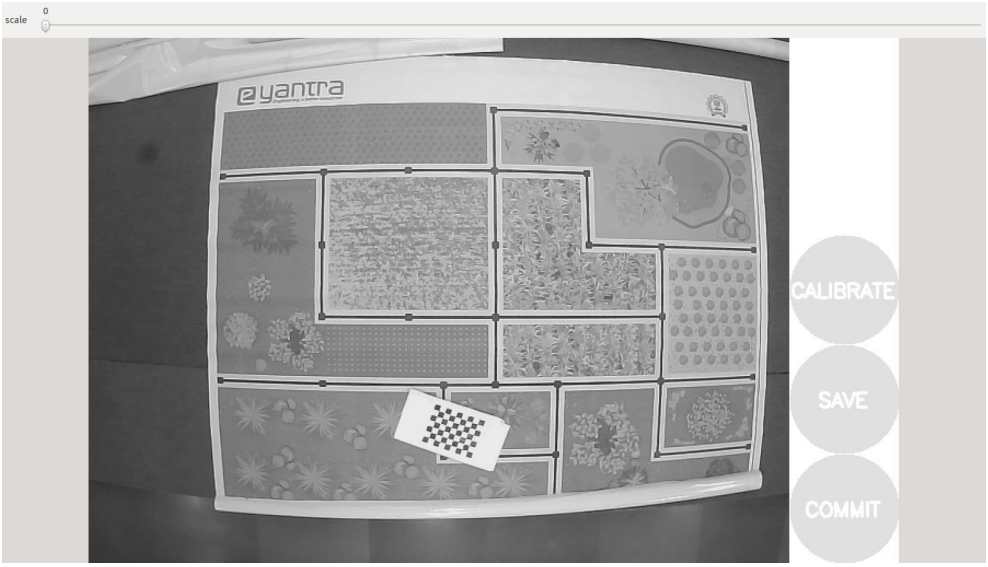

Figure 6. Camera Calibration Window

6. Hold up the checkerboard in front of the camera. A zig-zag line should be displayed on the checkerboard. You must now perform the following calibrations by the completing the given steps:
   a. X axis – Move the checkerboard left to right and right to left.
   b. Y axis – Move the checkerboard top to bottom and bottom to top.
   c. Size – Move the checkerboard close to away and away to close from the camera.
   d. Skew – Tilt the checkerboard in all directions

> Note: The more sample you take, the better is the output.

The following figures elaborate on this:

Figure 7. Size Calibration

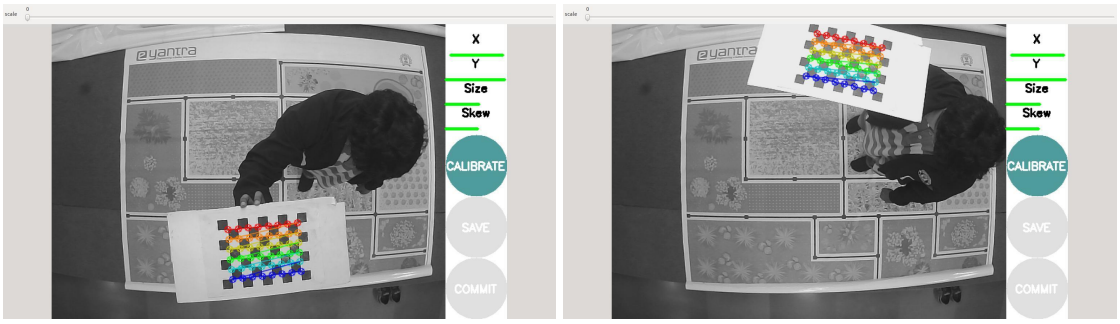

Figure 8. Y axis calibration.

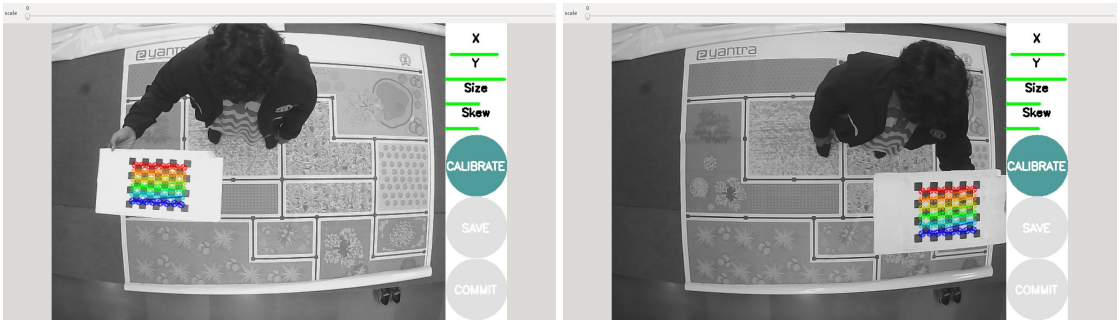

Figure 9. X axis calibration

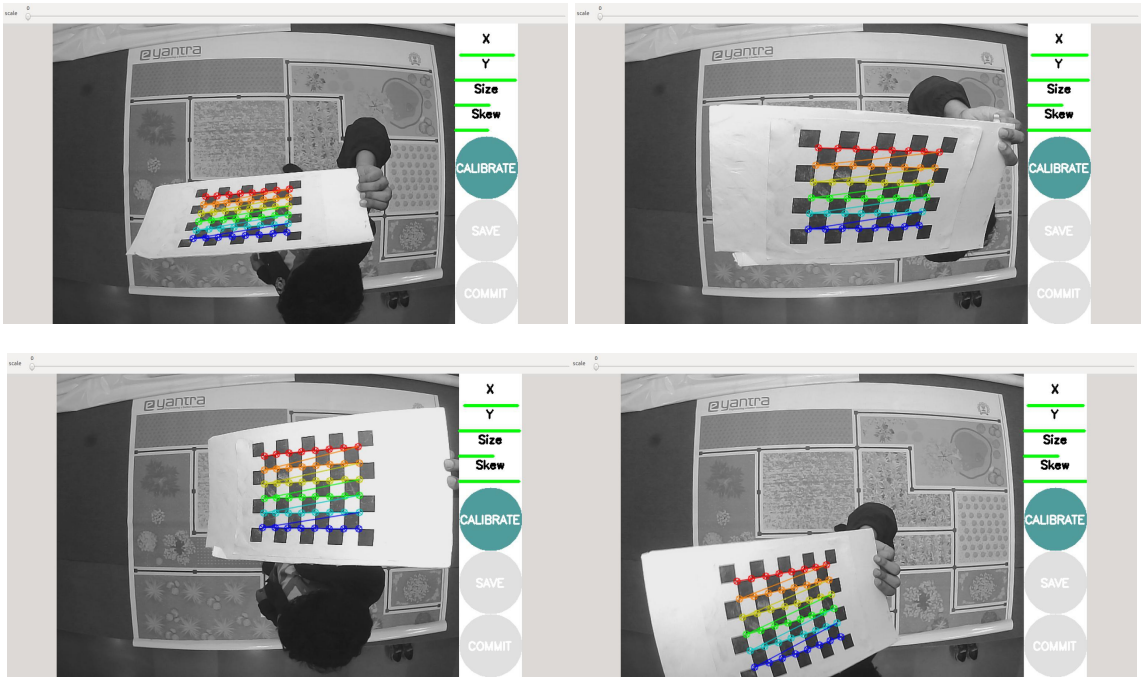

Figure 10. Skew Calibration

7. You must perform all these steps until you get maximum green for X, Y, Size and Skew in both directions on the panel on the right-hand side. When complete, your final progress should look like Figure 11.

Figure 11. Complete Calibration

8. When you get green progress for X, Y, Size and Skew, your ‘CALIBRATE’ button will be highlighted. Click that button in order to generate the calibration matrix. This might take some time so please wait while it generates the matrix. It might appear your computer has hung, but that is not the case.

9. Once the calibration matrix is generated, the ‘SAVE’ and ‘COMMIT’ button are highlighted. Hit ‘SAVE’ and then ‘COMMIT’. This saves your matrix.

Submission

- After calibrating, restart the usb_cam_SD.launch file and run `image_proc` node that converts a fish eye image to rectified image

```
roslaunch roslaunch usb_cam_SD.launch
rosrun image_proc image_proc image_raw:=/usb_cam/image_raw camerain
rosrun image_view image_view image:=/image_rect_color
```

  This will display the rectified image, take a screenshot of this image view and submit in place of task 3B.

Deadline

Deadline for submitting this task is **22nd January 2023 23:59**

All the best !

1 Like

Smit Unlisted 2 January 11, 2023, 2:12pm

Smit Closed 3 January 11, 2023, 2:12pm

Smit Listed 4 January 19, 2023, 10:10am