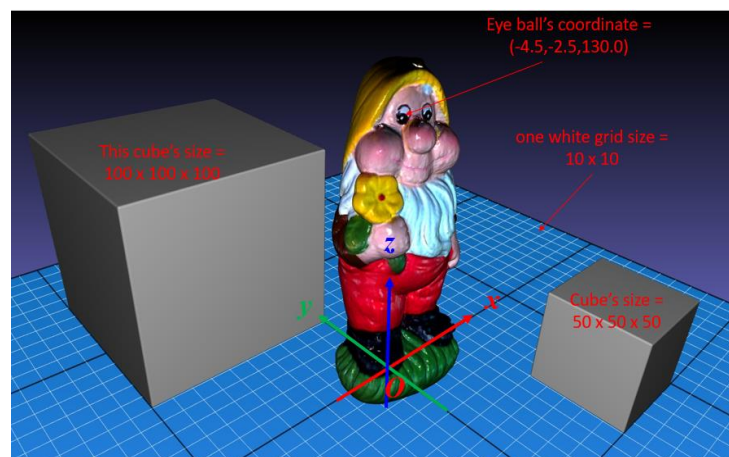


Date Due : 2021. May. 24th, PM11:55 ◦

Description :

1. Writing a program for estimating the distance between the right eye ball of Santa-Claus and camera's position from known cues. You need to calculate projection matrix and retrieve extrinsic parameter of the camera, then, provide a reasonable value to answer how far Santa-Claus is (choose your tools, ex. C++/C, Python, openCV, Matlab).
2. In a 3D environment, we setup one camera and took one photo as the below figure. So far, we know there are two boxes having known sizes (one is 50x50x50, the other is 100x100x100) and being well aligned to coordinate's axes. Each white grid size on the ground is 10 x 10. The camera is calibrated in advance, so the intrinsic parameter is given. The 3D coordinate of the right eye ball of Santa-Claus is (-4.5, -2.5, 130.0) comparing to the origin O .



The intrinsic parameter (3x3 matrix):

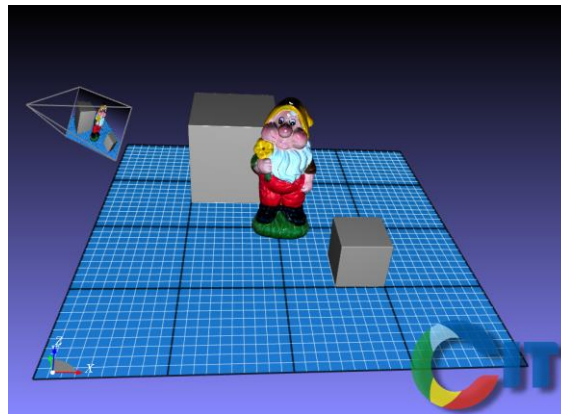
```
[1308.36 0.00 780.00  
0.00 1308.36 480.50  
0.00 0.00 1.00]
```

3. To answer it, please manually select proper and enough 2D points on image (and retrieve their corresponding 3D coordinates as well) for the calculation of “projection matrix”, and try to avoid the degenerated cases. (Please show me all points you have selected in the image). Finally, you can estimate the distance (as a vector) between the target and camera.
4. Deliverable: There are two types of data you should provide: 1) Source code in C++/C or Matlab, with simple comment. and execution file if available (.exe). 2) One page description (including the figures of selected points and the results of **projection matrix** and **distance vector**) saved in ppt, doc, or pdf file format. You do NOT need to write too many sentences in the description file.

Please zip all your files, then, upload to moodle (<http://moodle.ntust.edu.tw/>) by due 05/24 PM11:55.

HINT:

1. The 3D layout and where camera is would be helpful, as below image.
2. Ideal answer of distance in length is **244.55**, if you need to verify your estimation (But I do not provide the distance in vector form, please calculate by yourself).



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