

Robotics: Assignment IV

(Team Assignment)

Robot Arm Manipulation

Due: 2023/12/04 13:00 pm (NO LATE SUBMISSION)

Up to this point, you've acquired knowledge in robot arm kinematics and fundamental image processing techniques for object detection in images. This assignment challenges you to apply this knowledge by creating a program that enables the robot arm to effectively pick up blocks. **Your task involves using the TM Robot's eye-in-hand camera to identify and sequentially pick up three *randomly positioned* blocks.** Additionally, you will receive a 10% bonus score if your program can successfully stack these blocks.

Following are some issues that need to be considered while completing this assignment:

1. The relationship of the coordinate systems between the camera and robot arm base.
2. The pose of the end-effector is described as (X, Y, Z, A, B, C) . Here, (X, Y, Z) represents the end-effector position in the Cartesian coordinate. However, what does (A, B, C) stand for? Try to manipulate the arm with a computer program to figure it out. (Hint: A, B , and C represent a set of Euler angles. Please indicate their rotation axes and order.)
3. You are required to perform object detection that involves calculating the centroid and the principal angle, as in Assignment III (b)."

A basic python code for connecting the robot arm is provided. To process images, you may also need OpenCV. You could use C/C++, but you'll have to handle the connection by yourself.

If you come across any technical challenges, feel free to resolve them through discussions with your team members or the TAs. Document the solutions in your report, as gradings will be determined by the TA's evaluation of both your demo and report.

Submission

1. Live demo
 - You have to demonstrate your program to the TAs before 12/04.
2. Source code and report
 - Only one team member should upload your source code and report (hw4_report.pdf) in a zip file to NTU Cool. The report should include the program design rationale, problem, and solution, as well as work distribution among your team members.

Grading

The grades for Assignment 4 are based on the following three components:

1. Report (60%)
 - a. Describe how you designed the program to accomplish the given task. (30%)
 - b. Share any challenges faced during development. (20%)
 - c. Outline the solutions implemented to address these challenges . (10%)
2. Demo (40%)
 - a. The robot arm can successfully pick up the blocks one by one. (30%)
 - b. (Bonus) Stack up 3 blocks. (10%)
3. File name (5%)
 - a. The file name of assignment 4 is valid. (4%)
 - b. The submission file is a zip file. (1%)

If the TAs are unable to execute the code you submitted, it could result in a score deduction. If you don't follow the rules for equipment booking, you'll lose points based on how serious the situation is.

Equipment Booking

Please ensure to reserve your desired time slot through our [Equipment Booking Form](#) prior to usage. A Teaching Assistant (TA) will be available to provide guidance to your team during the initial use of the robot arm.

Safety Rules

1. Make sure you read and follow the safety rules.
2. Keep your hand on the emergency stop button at all times, as a precaution.
3. If there are any collisions causing the robot arms to stop, contact the TAs right away.
4. If the robot arm gets damaged during use, contact the TAs immediately.
5. Do not try to fix the issues mentioned above on your own.
6. Teams violating the above rules will receive a penalty of grade deduction. (including arm collisions and damages)
7. Failing to tell the TAs about damages to the robot arms will mean a grade of 0 for the assignment.