Robotic engineer – Applications
Take-home

1. Design

A client is looking for a pick and place solution using a collaborative robot. The company is asking you to do an initial design selection and a proof of concept.

Here is the information provided by the client to design their solution:

- 2 workpieces:
  - A carboard box
    - Width: 300mm
    - Length: 400mm
    - Height: 300mm
    - Weight: 7kg
  - A wooden cube
    - Width/Length/Height: 40mm
    - Weight: 0.5kg

- Workpiece needs to be picked from table A and placed on table B at position shown on figure 1.
- Workpieces are always perfectly centered on table A.
- Table A and Table B height are the same as the robot pedestal (Can use the floor for section 2).
- Table A and Table B can be placed anywhere in the footprint shown in figure 2 and can have any orientation (floor normal axis).
- Because of that, the client wants his operator to be equipped with a simple calibration sequence that position these tables in the robot frame.
- The client is looking for a collaborative robot because he wants the application to be installed without any external safeguard.
- He’s also looking for an easy-to-use programmable interface for the robot because there is a possibility for the robotic system to be repurpose next year.

- The client is open to do a gripper change over for his different workpieces, but he would prefer of the process is easy and toolless.

With these informations, answer these questions to prepare a design proposition to the client, there is no perfect answer to these questions, the goal is to evaluate the thought process.

1. What cobot would be best fitted for the client between the:
    a. Doosan M1013
    b. Doosan H2515
    c. UR3e
    d. UR10e
    e. CRX 10iA

You can use robot payload, reach, ease of use and any other relevant features to justify your selection. (See documentation in the take-home folder)

2. What gripper or grippers do you think would work for this solution?

You can select any grippers, or you can use the gripper documentation provided with the take-home. Justify your selection.

3. Describe the calibration procedure that an operator can go through on a daily basis after moving the tables in the application footprint.

Optional question:

What are the restrictions and internal safeguards of the cobot that allows it to be used without any other external safeguard?

2. Program

The client is now asking for a proof of concept, in this section you can select a different robot and gripper than the one used in section 1. This POC is focusing on the wooden cube workpiece and no tables are required.

Using ROS (any distribution with any components you choose), implement a simple 'pick and

place' program for a robot arm of your choice (panda, UR, Doosan or Fanuc).

Position your robot at the origin of your simulation environment along with a small cube placed somewhere within the robot's reach.
Designate a location in the environment that will be the 'drop zone'.
The cube's initial position and 'drop zone' position are arbitrary but must be far enough away from each other to allow the robot to traverse from one end of its range to another (see the attached picture as an example) while also remaining within reach of the robot arm you chose.

You will create a script that will tell the robot to pick up the cube and place it at the 'drop zone'. Before placing this cube in the 'drop zone' the cube must be rotated by 180 degrees so that the cube's "up" vector will be facing the opposite direction, i.e. the cube's 'up' vector is pointing towards the floor.

The script should output the following:

1) Starting position of the cube
2) Destination of the cube (the 'drop zone').
3) Every 500 ms, the small cube's position
4) Every 500 ms, the small cube's 'up' vector

It is your choice how to output this information (eg. in a cli or gui)

Optional challenges include:

- Create a UI that allows the user to control various aspects of this simulation. You can choose to implement one or more of the following:
  - robot's starting position (starting configuration of robot joints)
  - cube's starting position
  - duration time of pick and place process
  - reset the position of the cube and/or robot
  - start/stop the ‘pick and place’ operation
  - whatever else you think would be cool
- Add the two tables to the simulation and program the calibration sequence described in section 1.3.

Please briefly document your work. You could share a github repository with us, instructions of how to set up and run the processes and/or or a video of your task working.

We hope you enjoy the challenge!

Appendix

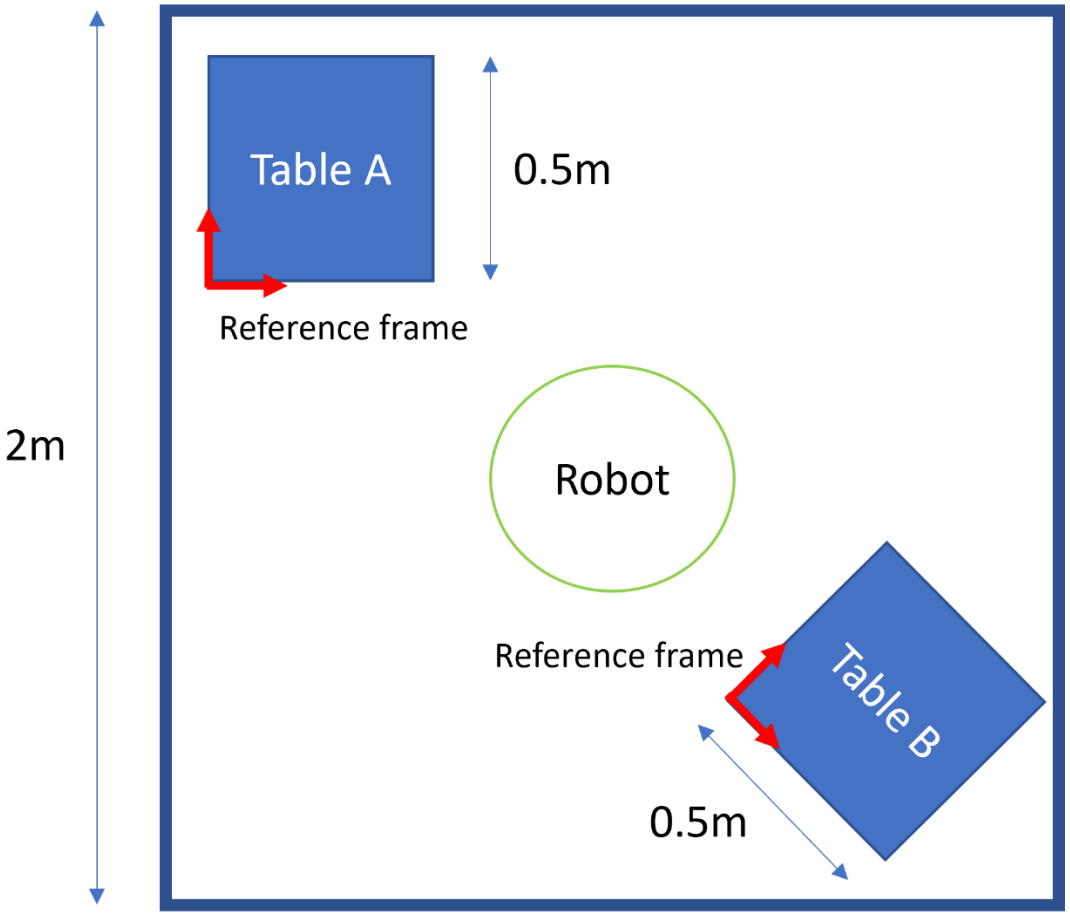

Figure 1, application footprint

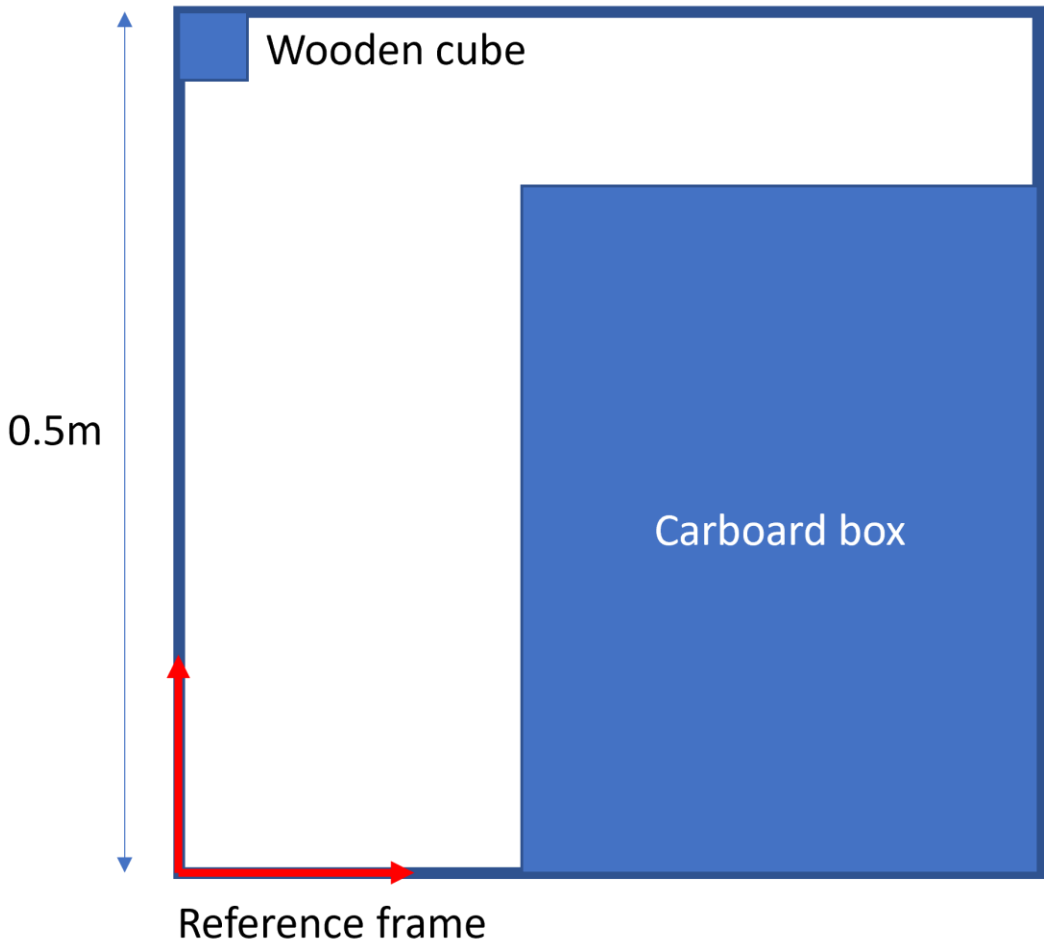

Figure 2, Table B workpieces place position

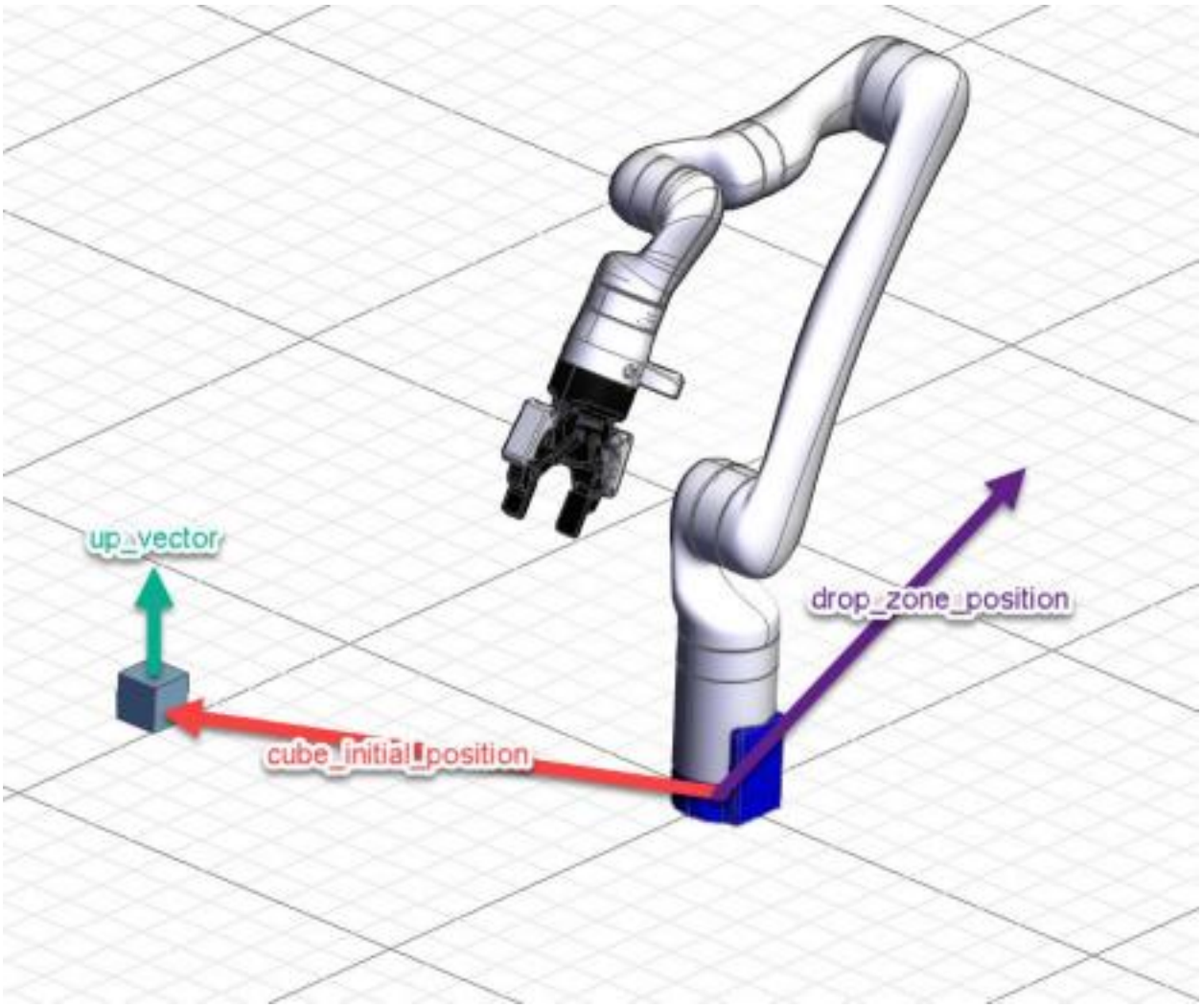

Figure 3, Simulation example