

ECE 470: Lab 1

The Teach Pendant

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1 Introduction

This lab explores the use of the teach pendant to control the UR3 robot. This is done through a simple task which involves moving and stacking blocks on the tabletop. Additionally, the use of suction feedback is explored to determine if a block has been successfully grasped. An emphasis was placed on how to manipulate the blocks to create a neat stack of them at the end of the task.

1.1 Task

This task involves searching for blocks at three possible locations. If a block is located, it will be moved using the gripper to a fourth storage location. There will be two blocks arranged in the two of the three locations and they should be picked up and stacked neatly in the storage location. If a block is not found at a location, the robot should move on to the next location until all blocks have been found and stacked or all locations have been checked. The arrangement of the four locations can be seen in Figure 1.

1.2 Suction Feedback

Suction feedback is provided by a vacuum sensor attached to the suction gripper. When the gripper successfully attaches to a block, the device gives a digital high reading. When suction is off or there is no block to grip, the sensor gives a digital low reading. We can use this feedback to determine if we have successfully gripped a block at a given location.

2 Method

Using the teach pendant, the UR3 robot was programmed to complete the task described in Section 1. The first step was the creation of the critical waypoints to position the arm. Waypoints were created for each of the possible block locations seen in Figure 1. In addition to locating the blocks on the tabletop, waypoints were created approximately 10cm above each of them to aid in clean movements. The stacking location required an additional waypoint to allow for stacking the blocks that were picked up.

With the waypoints created, the logic of checking them was implemented. Each block location was explored sequentially. To avoid disturbing the block, the arm was first positioned using a waypoint above the block, then lowered on to it. After contacting the block, the gripper was turned on and the suction feedback sensor was tested. In this step, it was important to wait a short time after turning on the gripper to check the sensor status as it takes time for the sensor to register the change. If the block is properly gripped, it was moved to the stacking position and carefully placed. If the block was not present or gripped improperly, the program moved on to the next position. This process was repeated

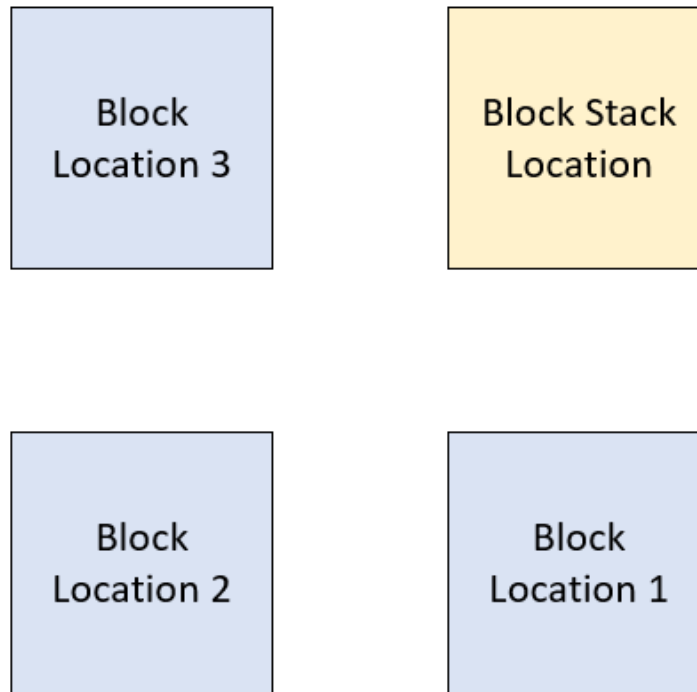


Figure 1: A simple block and storage location arrangement as seen from above

for each of the three potential block locations until all the blocks were stacked. During the process, it was necessary to keep track of the number of blocks in the stack so the blocks could be properly placed. To do this, a variable was created and incremented each time a block was stacked. Prior to stacking, this variable was checked and based on its value, the block was placed at either the high or low waypoint in the stack.

One of the challenges of this lab was neatly stacking the blocks. Several techniques helped achieve this:

- Precisely locating the waypoints and always placing the blocks in the correct location on the table.
- Avoid rotating the block during movement.
- Make use the gripper spring mount when gripping or releasing the block. This prevents the block from shifting during grasping and releasing.
- Using intermediate waypoints to avoid collisions during movement.
- Approaching blocks from above to prevent moving the block during gripper contact.

The successful operation of the program was demonstrated to the teaching assistant.

3 Conclusion

In this lab we explored the use of the teach pendant to control the UR3 robot. We also learned how to use suction feedback to determine if the robot has successfully gripped a block. Through this simple

task, we were able to move and place blocks on the table and create a neat stack of blocks. We were able to gain experience in using the UR3 robot and learn how to move objects around and get the accurate results that we desired.