Assignment 4 (20 Marks)
MCEN90028 Robotics Systems 2021

Marking Rubric

1   Overview

Constructing the robotic manipulator capable of moving the pieces on a chessboard is the primary task in this project, hence most marks will be allocated to this entry.
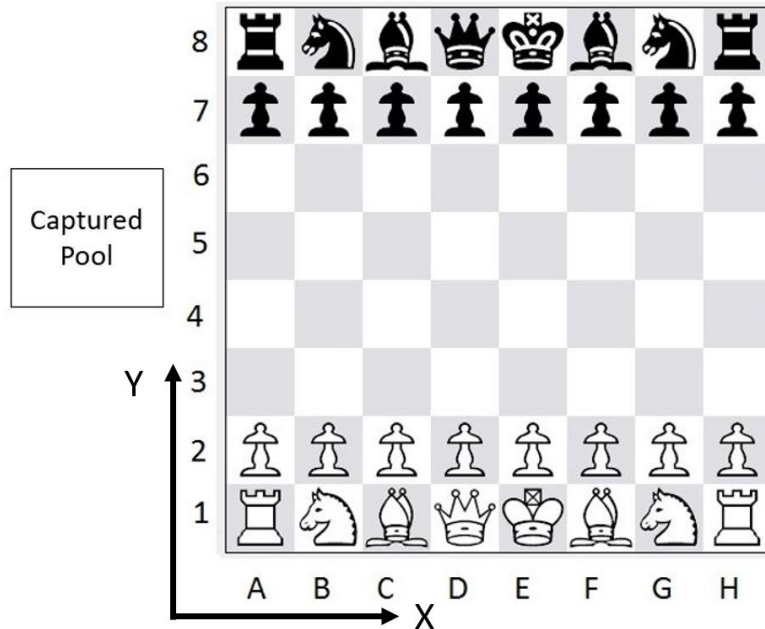

Figure 1: Starting position and coordinates of the squares on the board. The "captured pool" represents an area where the captured pieces are placed outside the board.

2   Tasks to be Executed (up to 18 marks)

Using the coordinate as shown in Figure 1, perform the following moves with your robot. Assume you are playing white. These are translated from chess algebraic notation into "from" and "to" square coordinates.

2.1 Task 1 (up to 11 marks)

Define one "home" position, located anywhere outside the board, where the robot rests when not moving pieces. The robot is expected to start from the home position, to pick up a piece (as shown in the table) and deliver it to the intended square. The robot then returns to the home position, before executing the next move.

Table 1: list of moves to be completed in Task 1

Move number	**From**	**To**
1	e2	e4
2	g1	f3
3	f1	b5
4	b1	c3
5	e1	g1
6	h1	f1
7	e4	d5
8	d5	captured pool
9	c3	d5
10	d5	captured pool
11	b5	c6
12	c2	c3
13	f3	g5
14	d2	d4
15	d1	f3
16	f3	d5
17	c1	captured pool
18	a1	c1
19	d5	captured pool
20	g1	h1
21	f2	f4
22	g5	h3
23	g2	g3
24	c1	d1
25	f1	e1

Task 1 is to demonstrate successful pick-and-place of all the 25 moves listed in Table 1[1].
Marking criteria:

- Completion of all steps correctly in the listed sequence (up to **7 marks**)

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[1]This is taken from the sample game record sheet on a blog https://blog.chesshouse.com/how-to-read-and-write-algebraic-chess-notation/, for the white player.

- Accuracy of positioning: not touching other pieces, placing pieces squarely inside the intended squares (up to **4 marks**)

To carry out Task 1, it is recommended that students utilise the task-space velocity control approach. However, it is possible to carry out Task 1 through joint position control of inverse-kinematic reference trajectory. While it is not the recommended approach, there will be no penalty for using the joint space controller on an inverse-kinematic solution of the reference trajectory.

2.2 Task 2 (up to 7 marks)

In Task 2, it is required for the robot to:

1. pick up a piece and allow the human user to manually push the end-effector (carrying the chess piece) toward the intended location. The robot is to lock the displacement of the end-effector in all directions except in the direction that is allowed for the piece. For example, if a bishop is selected, then the robot would initially move and picked it up by the end-effector, then remains on the spot for the human user to push the end-effector (using his/her hand) and the robot would allow itself to be pushed along (to slide along) the diagonal movement (bishops can only move diagonally), but would not allow the human user (and the end-effector) to move in other directions.

   By levels of difficulties, perform this on:

   - a rook: basic implementation with compliant movements in X and Y directions of the inertial frame of coordinate (up to **4 marks**)
   - a bishop: requires a transformation as the bishop moves in a straight line not aligned with the X or Y axes of the inertial frame of coordinate in addition to the successful completion of compliant motion with the rook (up to **1 mark**)
   - a knight: requires a more complex consideration, keeping track of how far the piece has been moved in one direction and then changing the allowed compliant move, or other possible interface, such as allowing only human to move the piece in XY plane, but snapping into one of the few possible places. (up to **2 marks**)

3 Robot Tidiness and Robustness of Build (up to 2 marks)

This portion of the mark considers the professionalism in the robot. Things held together with duct tape and blue-tack do not score high in this aspect. A confident, non-rattling, smooth accurate movements that are repeatable would indicate a good quality of build and will be rewarded. Neat wiring, soldering and the clean presentation of the robot, with appropriate attention to the safety of the users, would be rewarded. (up to **2 marks**)