Middlesex University Dubai

PDE4431 Robot Manipulator

Coursework 2 – due date 12-January-2025

Aim

The aim of this assignment is to assess your understanding of the principles of robotic manipulators and your ability to simulate real robots (Epson VT6) using RoboDK (Simulation Tool). Hence, there are two tasks for this assignment.

Your task is to design a virtual robot cell in RoboDK software, simulate the industrial robot arm to perform the required task that needs to be transferred to real robot for action. The manipulator to be used is EPSON VT6 that needs to be simulated in RoboDK. All the standard items to be used in Robot cell will be provided including base, table robot pedestal and gripper.

The step-by-step guidance to perform this coursework is as follows:

- First step, students need to understand the functionality of each part of a robot system and assemble them to formulate a system design in simulation world.
- Second step, students will be formulating the target points in the simulation world considering the real EPSON Manipulator in Lab. Target points can be taught manually or programmatically using Python programming languages in simulation tools. The computed targets then need to be programmed for performing the required task.
- The third step is to generate a robot program using the right post processor (provided in the simulation tool) to execute the task on a real robot and perform the action on the real robot.
- The fourth step is to perform forward kinematics calculation to find the target coordinate point using DH parameters based on arbitrary joint angles (J1-J6). The validity of the calculation should be compared with the simulation result. Students are allowed to use any existing codes, libraries, and/or generative AI to get the result as long as proper referencing is included.

The schematic diagram for the path and 3D models related to the task will be provided in below (CAD provided in MSTeams folder).

The virtual cell so called as Ice-cream vending station, that has an infeed pallet (2 x 3 matrix, marked “A” in the *figure 1*) , ice-cream filling station (marked “B” in the drawing) and an Outfeed pallet arranged in hexagonal pattern(marked “C” in the drawing).

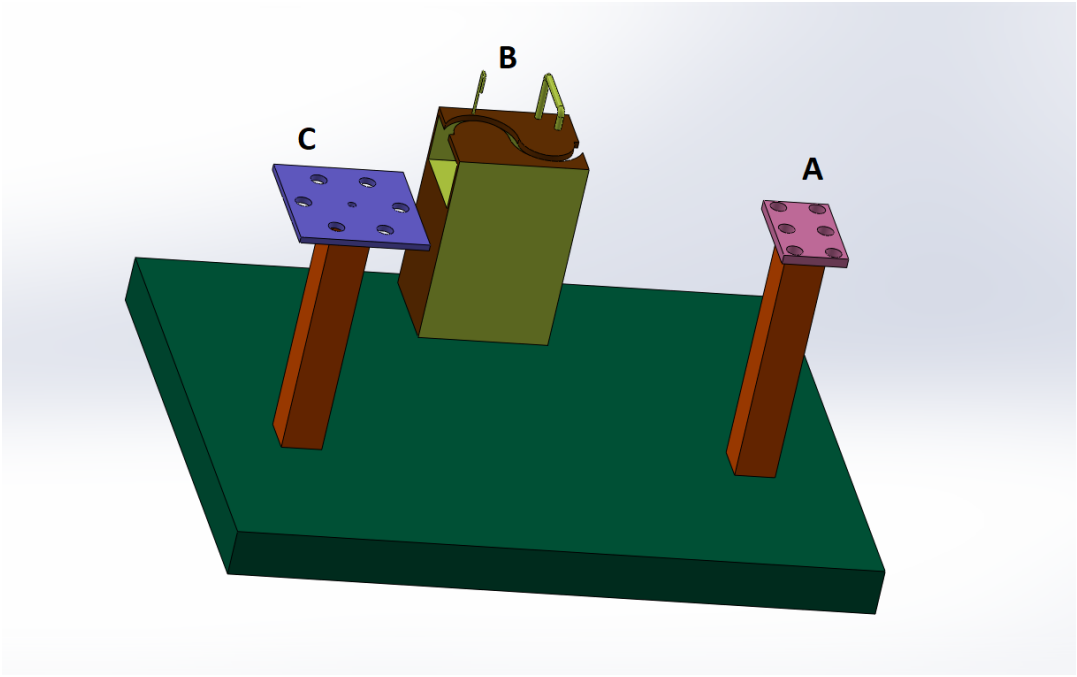

Figure 1: Station layout

The image below refers to the object named as ice-cream cone that needs to be handled by robot. The task of the industrial manipulator is to pick one cone each time and then move to the vending machine travel through the specific path and stop at the position of the vending nozzle to fill the cone. Moving the vending machine robot needs to manipulate the path in reaching the output dispensing tray and place the cone in the empty slot. Six cones need to be arranged at input pallet and handled by the robot during the complete cycle.

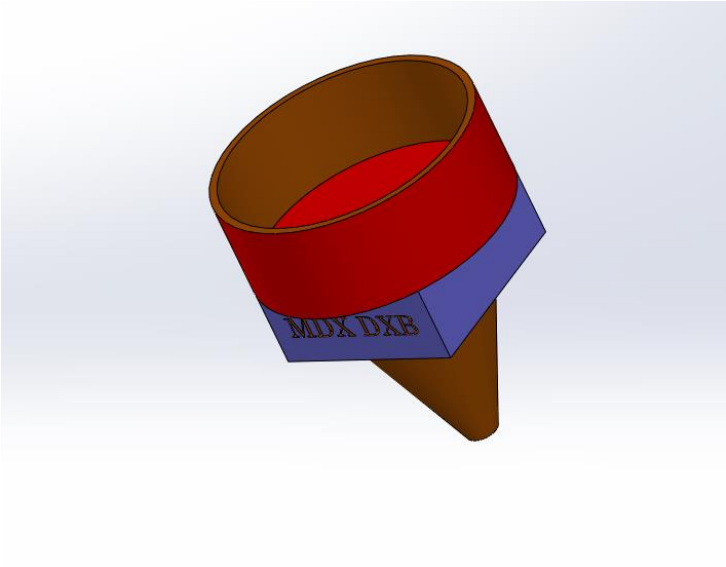

Figure 2: Cone Part

Guidelines

Students need to import the layout provided in *.STEP format into the RoboDK work cell.

The robot used in the operation is EPSON VT6(same model that is available in lab).

Pedestal height and position to place robot at the right coordinate needs to be formulated by student. Three different height pedestals are provided as *.STEP file within the coursework CAD Library Folder. Any other pedestal choice too can be used but needs to match with requirement.

Robot EOAT needs to be selected appropriately to handle the cone part at designated area. Please note that all areas of the part are not idle for gripping. Three tool choices are provided at RoboDK tool file as well as *.STEP from which best one needs to be selected. Any other tool from external libraries too can be used.

All the related CAD drawings with dimensions are provided in the coursework CAD Library for your reference.

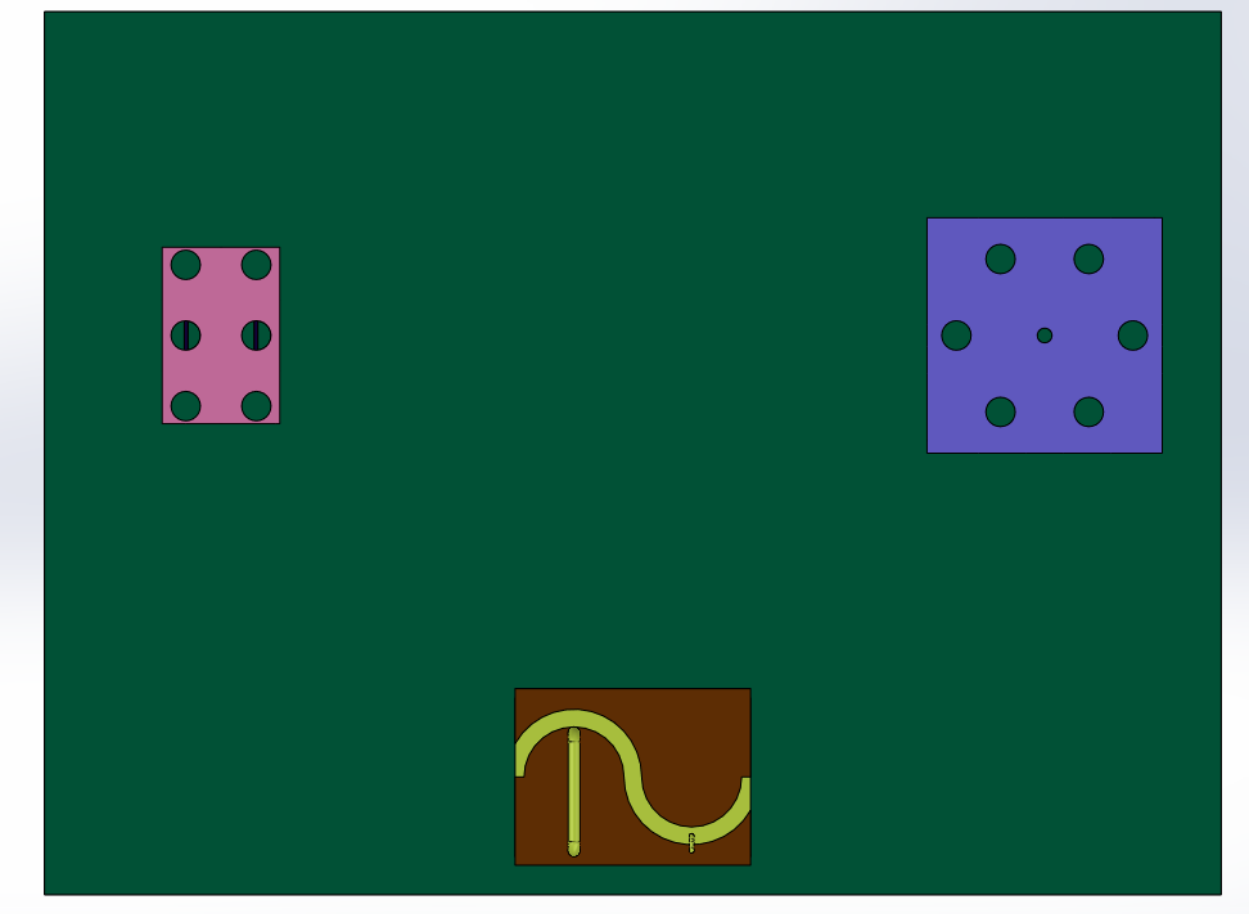

Figure 3: Top View of the work cell layout

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Deliverable:

1. Video of the simulation with narration (uploaded to YouTube, max 3 minutes, link to be included in the report)
2. Python code from the RoboDK simulation on Github (link to be included in the report).
3. One page report contains:
   - Screenshot picture of the simulation
   - Forward kinematics calculations, and comparison with the simulation result
   - Link to YouTube video and Github

Rubric

1-4 (Distinction):

- The simulation carried in appropriate and most suitable target were taught/computed and implemented in a real robot.
- The simulation demonstrates the whole animation sequence required to carry out the task in 3D space.
- Your program demonstrates more advanced features such as python programming and computation functions.
- The forward kinematics calculation result matches or has minimum error as compared to the simulation result.
- Your program demonstrates your independent study by implementing something relevant not taught in class.
- A very detailed video presentation explaining all the aspects and implementation without exceeding time limit

5-9 (Merit):

- The simulation carried and suitable target were taught/computed and implemented in a real robot.
- The simulation demonstrates the animation sequence required to carry out the task in 3D space.
- The video is clear with appropriate comments.
- The forward kinematics calculation result matches or has acceptable error as compared to the simulation result.

9-16 (Pass):

- The simulation task is executed in real robot.
- No forward kinematics calculations.

- All the required positions are taught/computed, and programs are executed successfully on a real robot.
- The video is unclear or lacks comments.

Fail:

- With resubmission opportunity: Files submitted but the simulation does not demonstrate the robot carrying out the task.
- Without resubmission opportunity: No work submitted.