**Lab 1**

This lab I have learnt the Homogenous Transformations for the 6 DOF myCobot. During this lab, I have learnt the rotation matrix of frame by frame and Projections and There by calculated the homopgenous Transformations. After having my Homogenous Transformations, I verified four cases by imputing the angles.

1. Theta(1 to 6) = [0,0,0,0,0,0]

Coordinates [px, py, pz]: [45.5,-62.7, 413]

1. Theta(1 to 6) = [0,90,0,0,0,0]

Coordinates: [-282.8, -65.2, 168.9]

1. Theta(1 to 6) = [0,0,90,0,0,0]

Coordinates: [-170, -64.2, 288.1]

1. Theta(1 to 6) = [0,0,0,90,0,0]

coordinates: [-77, -64.1, 382..0]

I could be able to get these verified and all the coordinates shown above are achieved with +-5 points.

Then, For verification purpose I have used the below mentioned joint angles for which I have obtained the mentioned position and orientation as mentioned below.

* Joint 1: 0
* Joint 2:90
* Joint 3:-60
* Joint 4:0
* Joint 5:0
* Joint 6:20

Position and orientation of your calculations:

[-160.3, -63.5, 296.9, -55.8, 16.96, -78.59]

Now, I have programmed my robot with the above joint angles and checked the results and they are matching and thus showcased this result.

Python Code For Cross Checking is “ Cross\_Check\_Homogenous\_Transformations.py”

MATLAB Code: File Names “Kinematics\_Cobot.m”

**Lab 1.2 CIM**

In this exercise, I have learnt the way how we can get coordinates continuously for each of the alphabets and get coordinates step by step and use them as the feed to the myCobot so that it follows these coordinates and achieves the goal of writing the word “CIM”

1. For me, the best way of writing the letters CIM is to start from Point A and then move on step by step (Grid by grid) on the graph paper and collect many points not just the A, B, C, ……, K. I have taken almost 30 points so that the task can be achieved. After Each Letter I collected the co-ordinates somewhere in the space. I tried running this at different speeds as well.
2. Relative Co-ordinates are for improving the flexibility, adaptability, and precision in different robotic applications. These are required for real time adjustments, as these changes needs to be adapted quickly for such changes. These Relative coordinates are also used for Localizations a robot, as these sensors are used to update their relative positions with respect to reference points. By using the relative coordinates, the robots can break down these motions into smaller steps and this is how, I completed my task of “CIM”.
3. The Motor Speed can really influence the robot’s accuracy. However, there are other factors which combines with this Motor speed comes into play.
4. By greatly increasing the mass of the pen, can have an impact on various factors like
5. Take for example, if pen mass is high, controlling can be more challenging and might lead to inaccuracies.
6. The motor of the Robot also should handle the extra load. If they cannot move this high mass Pen, it might lead to inaccuracy.
7. Last but not the least, if the mass of the pen increases, then we need to make sure the robot can handle the task effectively and perform with high accuracy and precision.
8. Accuracy is something which is confined to quality of a single action. It is all about how close the robot achieves its goal in a single attempt. Whereas, repeatability is concerned with something consistent about the ability of a robot to reproduce the same results consistently in multiple attempts.
9. Point ‘I’ in this activity can be calculated using the Pythagoras Theorem.

Note: Attached is the Python Script I used for solving this task with the name” **lab\_1.2\_CIM.py**”.

The URL to this video is https://www.youtube.com/watch?v=gLwGGHL\_FYA

Serial Number of myCobot: **ER28001202200416**

**Lab 1.3**

In this exercise, I have learnt the way how we can get coordinates continuously for each of the points and get coordinates at different places and use them as the feed to the myCobot so that it follows these coordinates and achieves the goal of pick and place operation.

1. At the first place, I have decided to go with the 8 places and got the coordinates of those 8 places. At first, I have got the home position which is at the space.
2. And then taken the coordinates of the above Pickup point and at the pick-up point coordinates.
3. After the gripper gets adjusted, and collects the cube or block. Then I navigated myCobot to above pickup point.
4. And then move to the drop place, and then take coordinates of the at the drop place coordinates.
5. And then, the gripper extends and releases the block.
6. The myCobot goes again to the above drop point again.
7. And then moves on to the Home Coordinates.

I didn’t get this running at the first time, as I collected the coordinates which are not absolutely perfect. So retried getting the coordinates again, once I attained these coordinates, I made it work. A small change which I have done is that I made home position set to the calibrated position of all joint angles as 0.

1. The suction cup is connected with the necessary connections to make it active. When the myCobot is just at the pickup point activate the suction using pump\_on() function, So that it can hold the block. And the suction cup needs to be on till the block is at the drop point. Once the Cobot is at drop point, release the suction using pump\_off() function.

2. First and foremost, the gripping system of the robot should be flexible enough to accommodate objects of various sizes and forms. The object's size and weight are important. The hardware and actuators of the robot should be able to handle the weight and size of the object. The robot might be unable to pick up the object if it is too heavy or huge. So, if we replace the wooden cube with other object, we need to tweak the gripper value, but at the same time, I made sure the gripper can handle those objects which are somewhat delicate as I wanted to be smoot with myCobot.

Note: Attached is the Python Script I used for solving this task with the name” **1.3\_Pick\_And\_Place.py**”.

The URL to this video is https://www.youtube.com/watch?v=sSMpuU6msOI

Serial Number of myCobot: **ER28001202200470**

**Lab 1.4**

I used the same strategy for this to be demonstrated. I have taken the 8 points to complete this operation. But in case of gripper, I used suction cup to take the object from source to destination. I have used the same logic except for two functions which are created for suction on and suction off.

From the previous exercise, I have taken just functions named pump\_on() and pump\_off() which controls the suction. The same operation of pick and place is performed with the suction cup now. I have taught only the 8 points as is done in before exercise.

Note: Attached is the Python Script I used for solving this task with the name” **1.4\_Pick\_Place\_Suction.py**”.

The URL to this video is https://www.youtube.com/shorts/rCKXWnUIBwY

Serial Number of myCobot: **ER28001202200470**