

Assignment 6 – ECE4560

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1. 5 hours
2. Completed the survey.

3a) $g_a = \begin{bmatrix} 1 & 0 & 0 & 5 \\ 0 & 0 & -1 & 6 \\ 0 & 1 & 0 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$g_c = \begin{bmatrix} 0 & 0 & -1 & 4 \\ 0 & 1 & 0 & 3 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$g_m = \begin{bmatrix} 0 & -\sqrt{2}/2 & -\sqrt{2}/2 & 6 \\ 0 & \sqrt{2}/2 & -\sqrt{2}/2 & 3 \\ 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

3b) $\Delta y = d_3 - d_2 = 6 - 3 = 3$
 $\Delta x = d_4 - d_1 = 5 - 4 = 1$
 $\Delta z = d_5 = 3$

$p_{cm}^1 = [-1, 3, 3]^T$

3c) $R_z(\pi/2) = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ -1 & 0 & 0 \end{bmatrix}$

$\Delta x = -3$
 $\Delta y = 1$
 $\Delta p = [-3, 1, 0]^T$

$g = \begin{bmatrix} 0 & 0 & 1 & -3 \\ 0 & 1 & 0 & 1 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$R_{QUADCOPTER} = R_x(\pi/2) \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta - \sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix} \bigg|_{\theta=\pi/2}$

$R_{CHASSIS} = R_z(\pi/2) = \begin{bmatrix} \cos\theta & 0 & \sin\theta \\ 0 & 1 & 0 \\ -\sin\theta & 0 & \cos\theta \end{bmatrix} \bigg|_{\theta=\pi/2}$

$R_{MZ} = R_{CHASSIS}$

$R_{mx} = R_x(\pi/4) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta - \sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix} \bigg|_{\theta=\pi/4}$

$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & \sqrt{2}/2 & -\sqrt{2}/2 \\ 0 & \sqrt{2}/2 & \sqrt{2}/2 \end{bmatrix}$

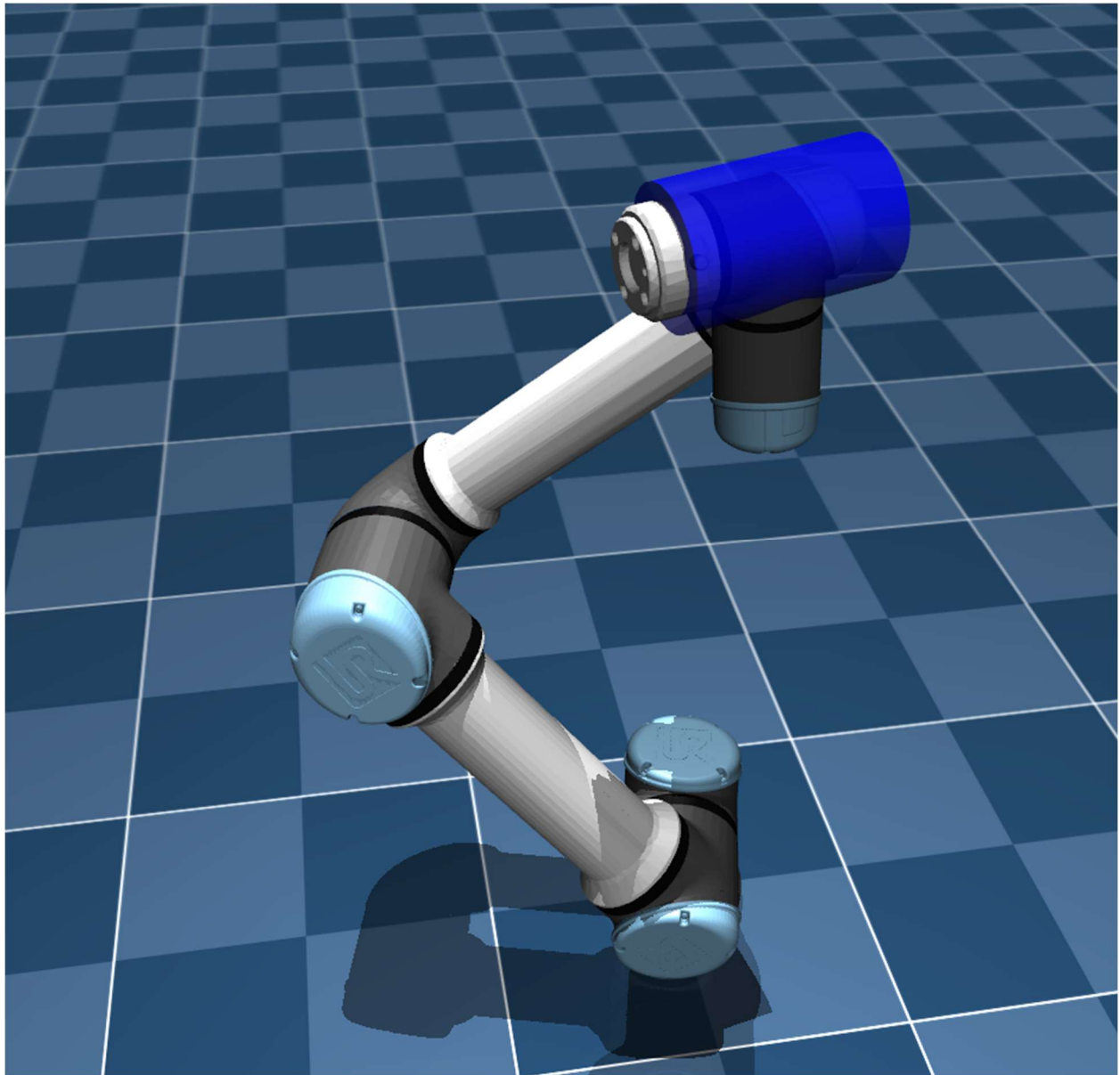
4.

```

# Obtain all Rotation Matrices
R1 = rot_z(theta1) # This rotation is in
R2 = rot_y(theta2)
R3 = rot_y(theta3)
R4 = rot_y(theta4)
R5 = rot_z(-theta5)
R6 = rot_y(theta6)

# Obtain all Displacement Vectors
d1 = np.array([[0], [0], [0.163]]) # Thi
d2 = np.array([[0], [0.138], [0]])
d3 = np.array([[0.425], [-0.131], [0]])
d4 = np.array([[0.392], [0], [0]])
d5 = np.array([[0], [0.127], [0]])
d6 = np.array([[0], [0], [-0.1]])
# dt = np.array([[0], [0.1], [0]])

```



5. Rodrigo went to perform the checkoff for our group.

Finishing the robotic arm code was relatively straightforward, all we had to do was write the `get_xx()` functions to gain the transformation matrices based on the robot definition of each frame for each DOF.