Report for Foundations of Robotics (RBE500)_Group Assignment Part 2:

Report By:
Swapneel Dhananjay Wagholikar (WPI ID: 257598983)
Shounak Sheshadri Naik (WPI ID: 728556739)
Nikunj Reddy Polasani (WPI ID: 901004192)

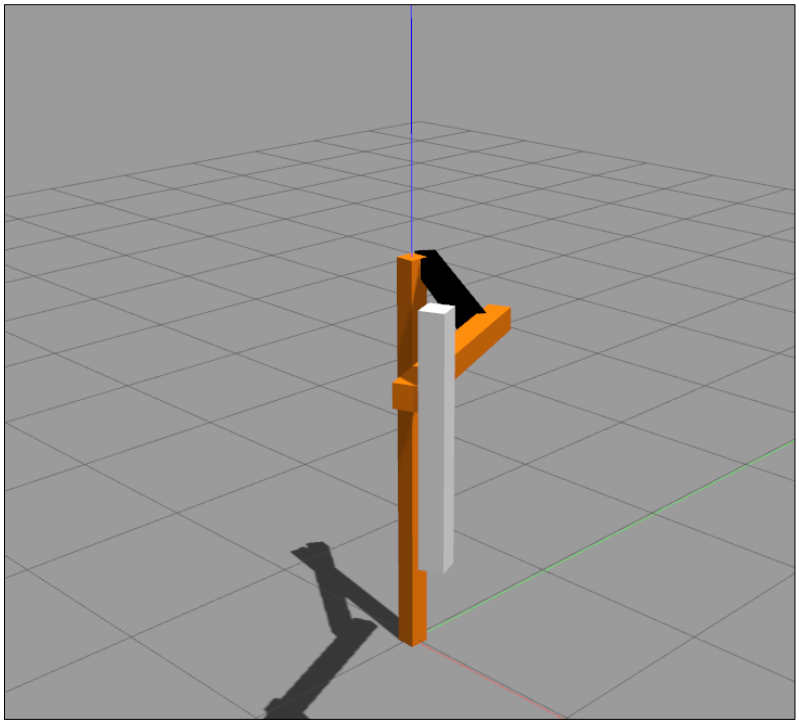
Part 1:

This assignment is built on our already built robot from last group assignment. To execute the requirements in this assignment, one additional node is created which subscribes to joint states values, get reference values from service, and calculates the efforts.

In service_callback function, reference value for joints is requested from terminal first and then these values are returned from this function as response.

In listener_callback function, execution is done to read the joint states i.e. q1,q2,q3 and v1,v2,v3 from gazebo and efforts for each joint are calculated by using formula. K_p and K_d values are also assigned in this function. [effort=(-K_p*e)-(K_d*e_dot)].
This effort is published in the listener_callback function to the topic '/forward_effort_controller/commands'. Gazebo listens to these commands and moves the bot accordingly.

While running this node, the robot is spawned. (snap attached)



After giving the reference values and joint efforts, we can see the robot moved and oscillated in gazebo first before reaching the stability.

Also, in rrbot_world.launch file from gazebo launch, we activated the robot effort controller to get the desired results.

Part 2:

As we observed in the first part, the robot was oscillating in gazebo before reaching the desired position. To reduce this overshoot, we tried different k_p and k_d values for each joint by trial and error and found the optimal values which reduced the overshoot and reached the stability.

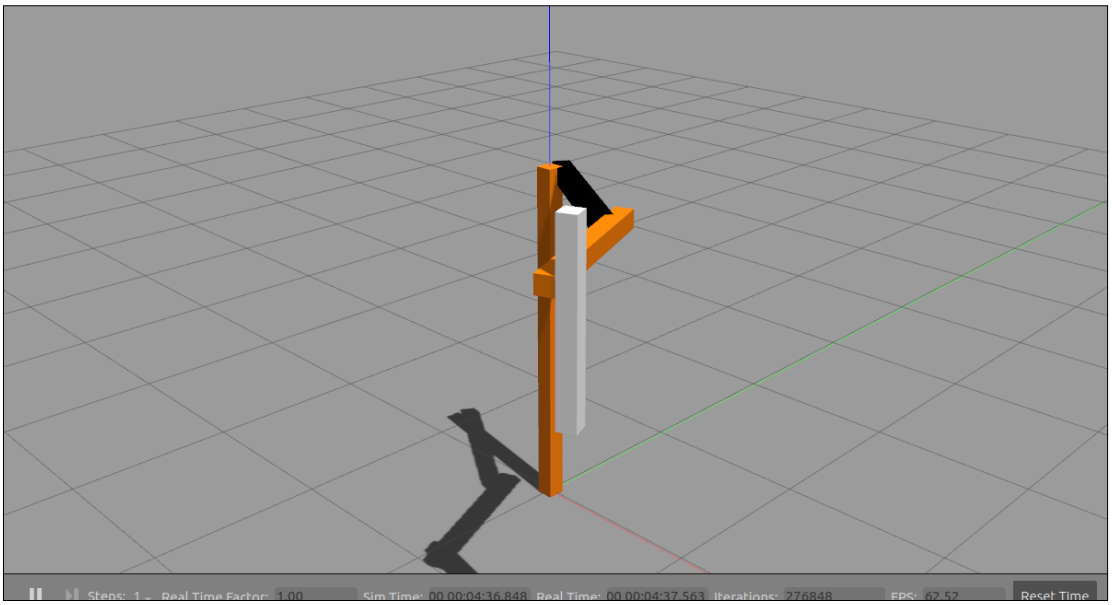
Our final K_p and K_d values for all 3 joints are
K_p = [9.5, 5.2, 100]
K_d = [7.8, 6.9, 80]

Part 3:

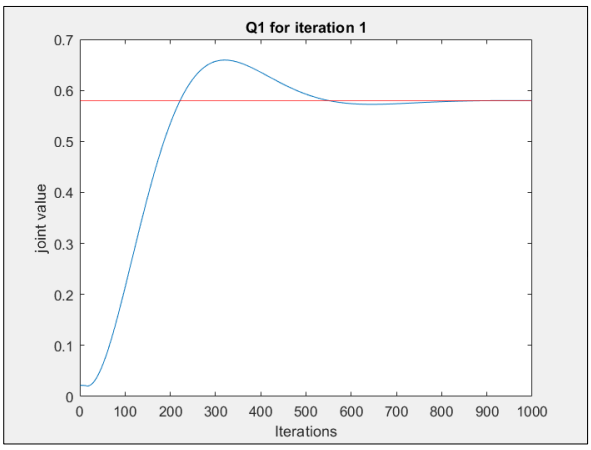
In this part of the assignment, we have recorded reference positions and current positions of the joints in a text file and plotted a graph using MATLAB. (graph and gazebo snaps attached)

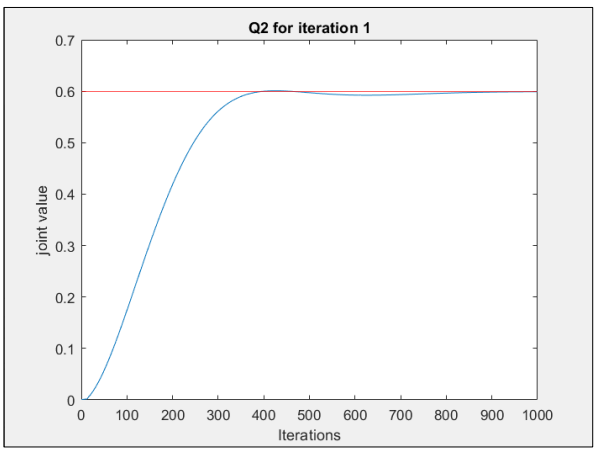
Limits were changed so that the robot could freely move about the specified reference values.

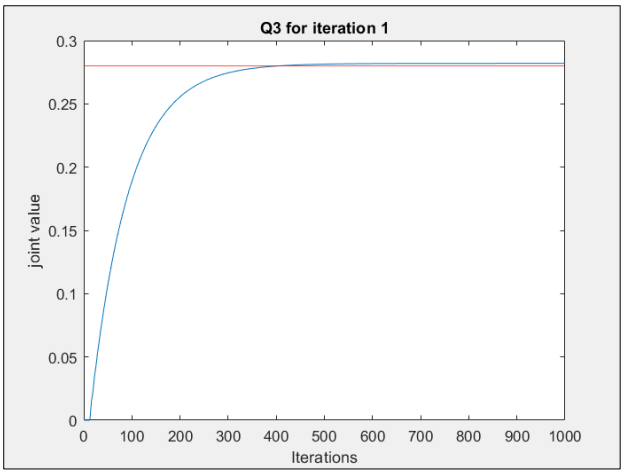
1st set of joint positions: [q1=0.5799, q2=0.6, q3=0.2799]
Gazebo Snap:



Graphs for 1st set of joint positions:

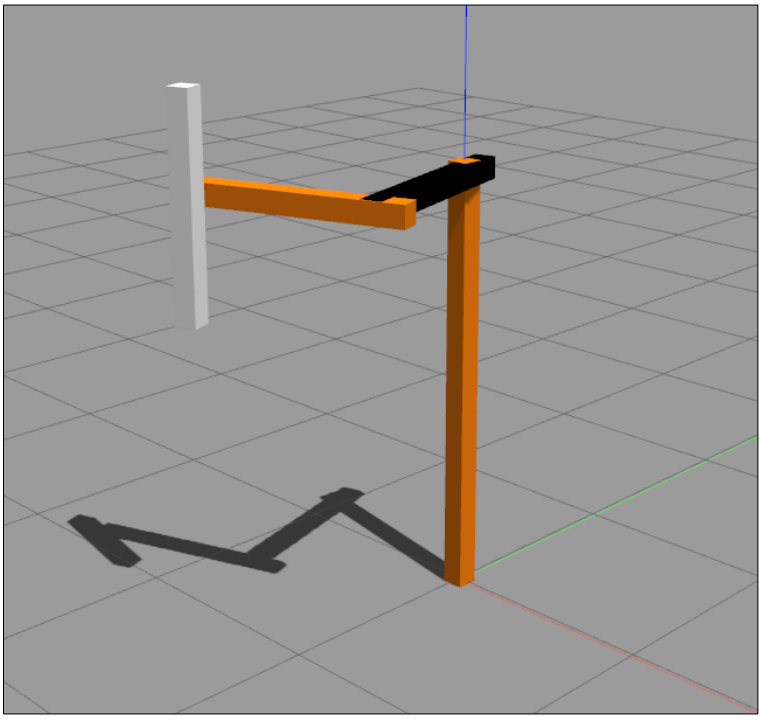




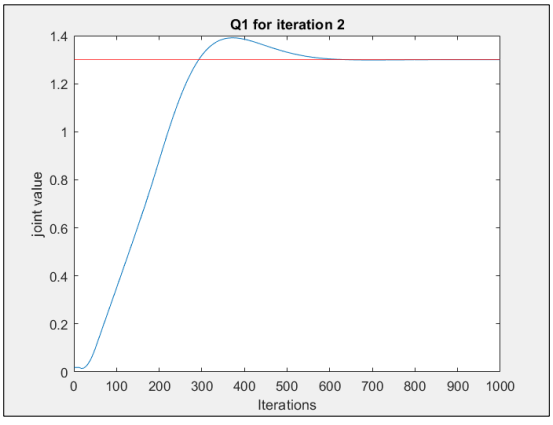


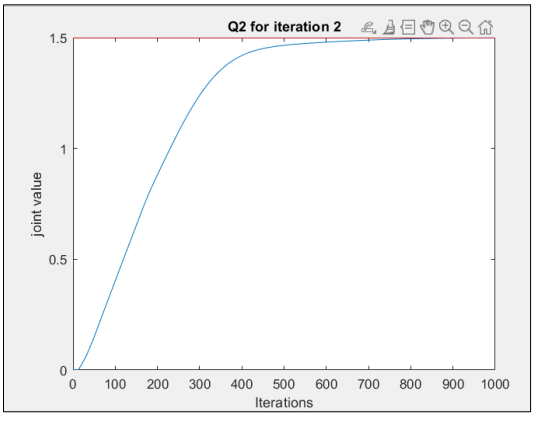
2nd set of joint positions: [q1=1.2999, q2=1.5, q3=-0.4]

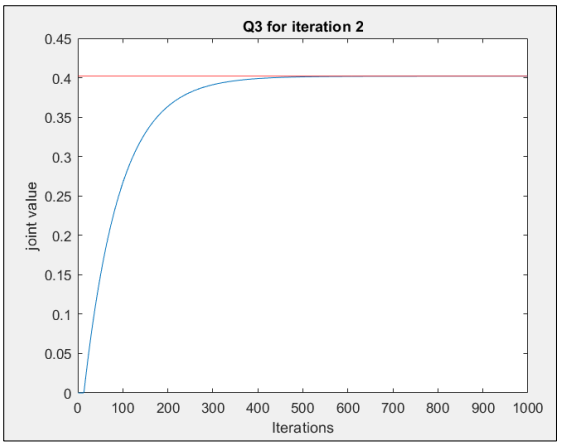
Gazebo Snap:



Graphs for 2nd set of joint positions:

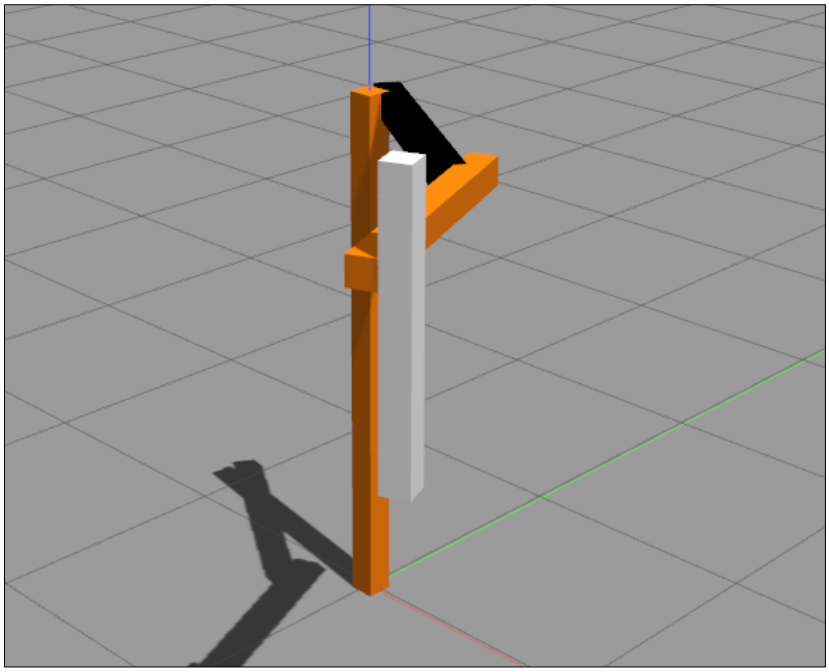




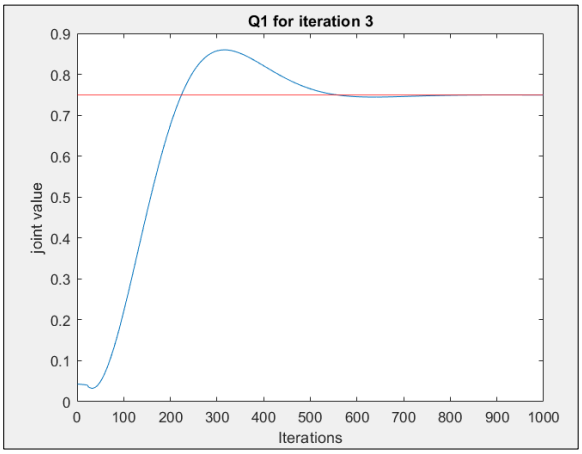


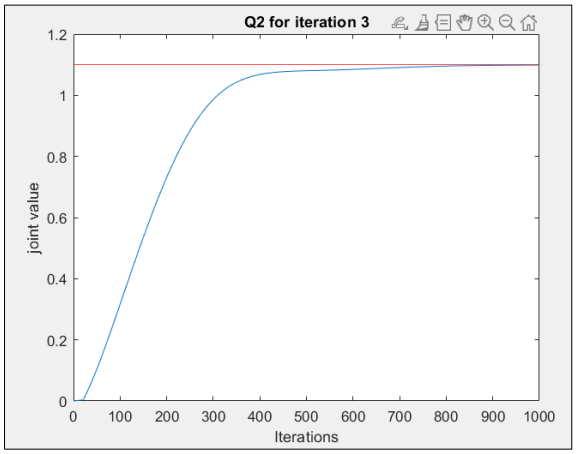
3rd set of joint positions: [q1=0.75, q2=1.1, q3=-0.102]

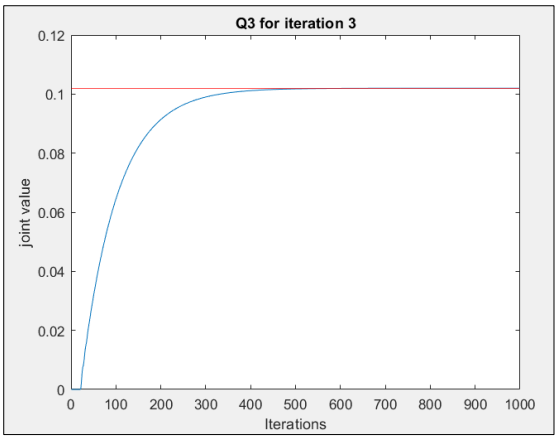
Gazebo Snap:



Graphs for 3rd set of joint positions:






Q3 for iteration 3
0.12
0.1
0.08
0.06
0.04
0.02
0
joint value
0
100
200
300
400
500
600
700
800
900
1000
Iterations