Industry Projects Submission 1
ME 639 - Introduction to Robotics
IIT Gandhinagar

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We attest to abide by the stated collaboration policy: We understand that all sorts of collaboration are allowed, however plagiarism will not be tolerated. If we use material from some other source (or from friends), we will cite them appropriately.

Planys Technologies
Design a control system for a 2 DOF manipulator

Statement of Our Understanding of the Project (in 200-300 words)

We are given a 2-link manipulator. Link 1 rotates about the vertical axis and link 2 rotates about the axis perpendicular to the plane. This manipulator will be attached to the ROV and used for carrying ultrasonic thickness gage which will help in navigation and survey.

We are allowed to assume any end-effector velocity and acceleration required and obtain a control system that can cover the distance in the shortest path underwater. We also need to determine the duration required to cover the path(according to our understanding, though we have a doubt about it). According to the specifications we determine for the velocity, acceleration and motors we have, we need to perform a market survey and suggest suitable actuators for the manipulator. We need to design a control system for the motion of the manipulator accounting for the underwater dynamics.

For the given underwater manipulator we are not accounting for any environmental disturbances like waves, underwater animals or waste materials.

Other Information - The length of link 1 is 150mm and that of link 2 is 300mm. Apart from that a passive gimbal having 2 degrees of freedom is attached at the end of the arm to aid in the finer alignment of the probe to the specimen surface.

Tentative Approach and Tools we May Need to Use (not more than 3-4 sentences)

For the given points to be tested, we will be finding the shortest path for the end-effector position. Assuming the velocity and the acceleration of the end effector position we will find the joint velocities as well as the accelerations. Using the dynamic equations of the manipulator we will get the torques to be applied on the joint motors. A feedback controller will be designed to find the torque values(changing constantly) along the motion.

We will attempt both PI and PD control and implement the best one suitable and will code in Python(preferably, however, Planys Technologies can suggest which platform they want the code of)

Key Assumptions Made in Approaching the Problem (in enumerated list from)

1. Mass of link 1 = 1.5 kg, Mass of link 2 = 1 kg, Mass of probe = 0.5 kg
2. The weight is distributed evenly throughout each link.
3. Maximum depth the manipulator would go into the ocean = 100 m (to determine the maximum forces it might experience)
4. The disturbance due to waves is neglected. Only pressure will be taken into account.

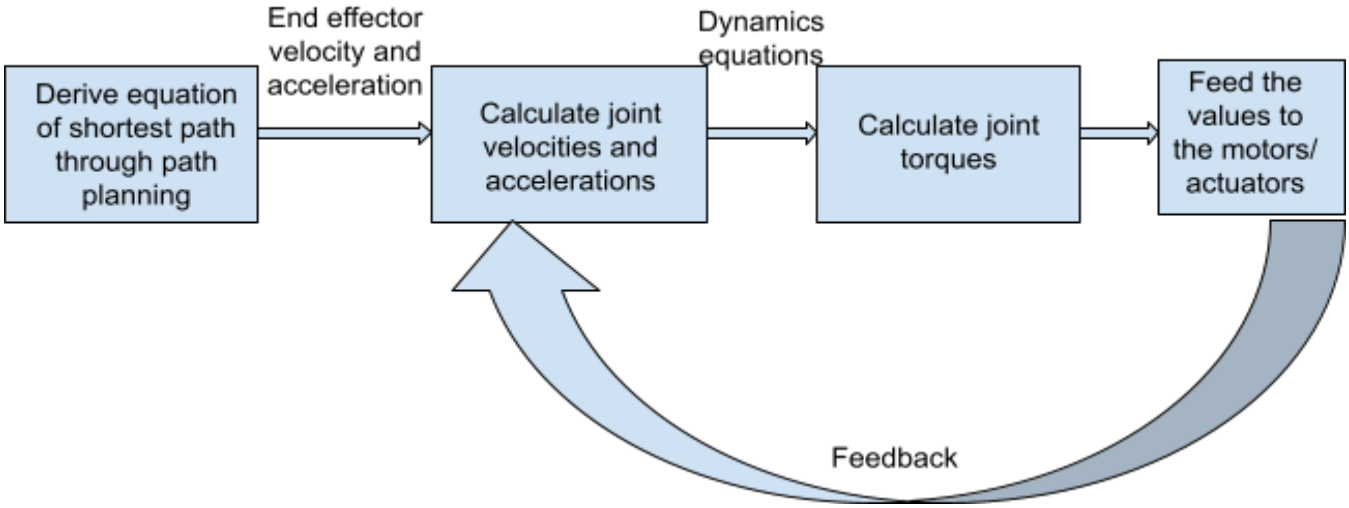
Key Questions to Clarify the Requirement of the Project (in enumerated list form)

1. 'Duration between two readings'.
2. Angle limits of the links.
3. Individual mass of the links and probe.
4. Is the surface to be tested planar?
5. If the surface is not planar then what will be the location of points.

Expected list of Deliverables (check all that apply)

- ☐ A brief explanation of the concept (including type of robot, number of links and joints, and other such details
- ☐ Relevant equations of the robotics solution
- ☐ Codes incorporating the solution
- ☐ Explanation of the solution and the results

A Highly Tentative Sketch of the Problem and Expected Solution



Expected Solutions

1. Shortest Path
2. Constants for PI and PD Control
3. Torque to be given to motor
4. Suitable Actuators
