**Research Proposal – SRIP**

Many stationary tasks performed by humans are accomplished using our hands. Similarly, there is a high demand and scope for manipulators and robotic arms in today's world. Many of today's industrial tasks, such as packaging, manufacturing flow-chains, and tedious, unsafe, and repetitive tasks, are performed by manipulators, specifically robotic arms. The scope of these manipulators is not only focused on industrial lines; a very simple example would be the tasks done in our kitchens and laboratories, where hazardous chemicals and corrosive acids are handled very frequently. However, in these areas, the development of manipulators is not very impressive due to the intricate nature of the tasks, which require complex force control and position control compared to the simpler industrial tasks.

In this research internship, I have been given a project that represents a small step in the direction of building and controlling manipulators to perform intricate tasks. Here, I need to use force control and/or position control to make OpenManipulatorX (a very popular robotic arm used for educational purposes) close the cap of a bottle or a marker. To achieve this, I will be using the concepts of configuration space, manipulator Jacobian, force control, forward kinematics, and inverse kinematics. Additionally, I will be utilizing computer vision with the help of OpenCV to determine the position (x, y) of the bottle or pen's cap in the configuration space. In order to operate the OpenManipulatorX, I need to learn all of these concepts along with gaining fluent knowledge of Python and the ROS framework. ROS is a flexible and powerful open-source framework designed for robotics software development, which I need to master to complete the project.

Once the task is accomplished, I need to analyze the trends observed from the end-effector force and position versus time graph. If the trends show the expected output, we can conclude that our manipulator is functioning perfectly. This research project will significantly contribute to the robotics community by paving the way for future developments in building manipulators capable of performing intricate tasks, such as the one demonstrated in my project.

This research internship not only aims to solve a specific problem but also aspires to advance the field of robotics. By successfully implementing force and position control in the OpenManipulatorX, we can demonstrate the potential for robotic arms to handle complex and delicate tasks. This will ultimately lead to more sophisticated and versatile robotic systems, capable of operating in a variety of environments and applications, thereby revolutionizing industries and improving safety and efficiency in numerous fields.

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