Universal Robot (UR5)

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ABSTRACT

The goal of the entire exercise is to familiarize oneself with the UR5 robot and its programming environments by performing specific tasks. By moving the robot through specified poses in both Cartesian and joint space, and tracing a virtual cube, the objective is to gain hands-on experience and understanding of the robot's capabilities. This exercise enables users to develop proficiency in controlling the robot's movements, executing precise trajectories, and manipulating objects, ultimately facilitating the utilization of the UR5 robot for various applications that require accuracy and versatility in robotic operations.

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1. INTRODUCTION

In this integrated laboratory exploration, our focus is on the UR5 robot, a versatile robotic system known for its precision and adaptability. The overarching goal of this combined lab endeavor is to conduct a thorough examination of the UR5's capabilities, with a specific emphasis on repeatability and straightness analysis, as well as a comprehensive assessment of its gripper functionality.

Simultaneously, we turn our attention to the adaptability of the gripper, a critical component of the UR5's functionality. Through a series of tasks ranging from pick-and-place operations to intricate maneuvers such as pin insertion and removal, we assess the gripper's versatility and effectiveness in handling diverse scenarios. The gripper's adaptability is further showcased in a practical demonstration, wherein it is employed to insert a battery into a torch, illustrating its broader applicability in real-world scenarios.

By combining these elements within a single lab setting, we aim to offer a comprehensive understanding of the UR5 robot's capabilities, providing valuable insights into both its precision in motion and the efficiency of its gripper functionality. Through this holistic exploration, we seek to equip participants with a nuanced appreciation of the UR5's potential across a spectrum of tasks and applications.

2. METHOD

To control the UR5 robot and perform the desired tasks, the following method was employed. The pose of the robot's tool or end effector, which includes its position and orientation, was described in the robot manual. The programming environment utilized was PolyScope, a visual programming interface specifically designed for the UR5 The process began by accessing the PolyScope Robot User Interface page and selecting "Program Robot." Then, an empty program was created by pressing "Empty Program." Navigating to the "Structure" tab, the "Move" option was chosen. Within the robot program, "MoveJ → Waypoint" was clicked, followed by pressing "Set this waypoint" to specify the Tool Center Point (TCP) as Pose 1. This procedure was repeated for Pose 2 and Pose 3

	X (mm)	Y (mm)	Z (mm)	RX (rad)	RY (rad)	RZ (rad)
Pose 1	-575	-350	300	2.10	1.11	0.63
Pose 2	-240	-445	650	1.57	-1.57	-1.57
Pose 3	400	-400	200	2.79	-0.16	0

To ensure accurate positioning, the free drive function of PolyScope was utilized by manually guiding the robot to the required coordinates. Horizontal lines in the cubes were traced using the "movel" command, which allows for smooth and controlled motion. This process was repeated in a loop to test the repeatability of the robot's movements. To verify the robot's performance, the "Graphics" tab was accessed in PolyScope's move robot interface. By selecting the "Simulation" mode and pressing "Play," the robot's actions were observed to ensure they aligned with expectations. Finally, the "Real Robot" option was chosen in the "Graphics" tab, and the robot performed the task while being monitored.

3. RESULTS AND DISCUSSION

As illustrated in the table, the robot effectively accomplished Task 1 by reaching the three specified destinations. It demonstrated the desired accuracy was capable to move the end effector without any issues. Nonetheless, there were complications with moveJ, as the robot collided with its own linkages and came to a halt. The issue was rectified by adjusting the robot's home position and moving it more efficiently. In the case of moveL, both the actual and the simulated robot avoided self-collision as they adhered to the pre-set routes. Task 1 served as a valuable learning tool for us students, providing insights into operating the teach pendant and understanding the basics of UR5 robot programming. https://youtube.com/shorts/WuZaSwZJDT8?feature=share

4. CONCLUSION

The goals of this lab were successfully achieved, with the UR5 robot demonstrating its capabilities by navigating through all the necessary waypoints. The task of tracing the cube in Cartesian space was also carried out effectively. Additionally, the exercise served to familiarize us with the UR5 interface.

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REFERENCES

The main references :
[1] https://academy.universal-robots.com/video-tutorials/
[2] https://academy.universal-robots.com/free-e-learning/
[3] https://academy.universal-robots.com/https://www.usna.edu/Users
[4] /weaprcon/kutzer/_files/documents/User%20Manual,%20UR5.pdf

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Holmes Joseph, currently a Masters student at Arizona State University, brings a rich background in project development, specifically in the realms of Embedded Software and Hardware, have honed skills in multiple communication protocols and have a track record of successfully integrating a variety of sensors and actuators into microcontroller environments. And the proficiency extends to the field of Machine Learning and its applications, particularly in Robotics and Data Science. A passion for Artificial Intelligence is evident and fuels their aspiration to be a part of the rapidly expanding Robotics industry. And I also foresee this industry as a major driver of change in the future. Through diverse experiences, cultivated a high level of adaptability, allowing to navigate and excel in various work environments. Email:hjoseph6@asu.edu