CDA 4621 Lab 1: Kinematics

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I. Introduction

Our task for Lab 1 was to write a program that moves the robot across a trajectory through the use of kinematics. In order to complete this task, we utilized a combination of rotational and forward motions. We were able to construct functions for 3 general motions: forward motion, left turning motion, and right turning motion. During the course of the trajectory, the X-Y-Z coordinates are printed, which will change as adjustments to the robot's trajectory are made.

II. Methods

Throughout the duration of the project, several enlightening challenges were encountered which not only tested our initial assumptions but also contributed to our understanding of robotic systems and their intricacies.

Kinematic Understanding: One of the first challenges was the theoretical understanding and application of kinematics. The task at hand required precise movement, which meant that the calculation of velocities for the left and right servos had to be spot-on. This was a lesson in how critical correct theoretical foundations are to practical applications. In the future, a more extensive review of theoretical kinematics, perhaps with simulations, would be beneficial before diving into coding.

Sensor Limitations: We noticed that the gyroscopic sensor data, while generally reliable, did have moments of fluctuation. These small discrepancies can introduce errors over longer sequences of movement. An improvement could involve integrating multiple sensors and using algorithms to fuse and filter data for more accurate measurements.

Real-world vs. Theoretical Discrepancies: Even with mathematical models to guide the servo's speeds, the robot didn't always behave exactly as predicted. Factors like friction, battery voltage drop, and even tiny imperfections in wheel shape affected movement. This experience emphasized the importance of iterative testing and refinement in robotics. Future endeavors could benefit from integrating feedback mechanisms that adjust movements in real-time based on the robot's current state.

Error Accumulation: Over long sequences, minor errors in movements could accumulate, leading to a noticeable difference from the expected position or orientation. To counteract this, we incorporated periodic re-calibration of the robot's position by utilizing a sleep function. This allowed the robot to complete its trajectory seemlessly.

III. Kinematics Calculation

A. Hardware Setup

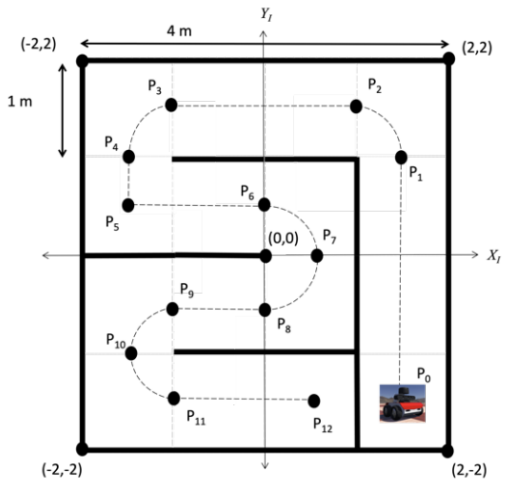

Fig. 1. Path to be followed by the robot.

IV. Conclusion

This project provided invaluable insights into the difference between theoretical models and real-world application. It underscored the need for iterative testing, the importance of feedback mechanisms, and the value of a cohesive team effort.