Homework 1 - CSE 276A - Intro to Robotics

Due: Thursday, 17th October 2024, before midnight

Descriptions:

In this assignment, you will implement an open-loop control algorithm (i.e., no feedback loop is used to correct the robot) for navigating a robot through a set of ordered waypoints. Your task is to define a kinematic model for your robot, calibrate the kinematic model parameters, and implement a simple navigation algorithm under open-loop conditions. You are expected to provide your Python code along with a short report summarizing your implementation and its performance.

Instructions:

1. **Waypoint File**:
    - A text file named waypoints.txt is available on the course Canvas website. The file contains individual lines with the structure:
      x_0, y_0, theta_0
      x_1, y_1, theta_1
      ...
      where:
        - x and y are coordinates (in meters),
        - theta is the orientation of the robot in radians,
        - These coordinates are in the world frame.
2. **Github Repository**:
    - You should start from this provided github repo
        - https://github.com/AutonomousVehicleLaboratory/rb5_ros2.git
    - After cloning the repository, checkout to the branch `fa24_cse276a`.
    - This repository contains the base ROS 2 packages you will use for this and the following assignments.
3. **Algorithm Design**:
    - Design an algorithm to traverse the set of waypoints in the provided file.
    - Your algorithm should incorporate a kinematic model for the robot platform.
4. **Implementation**:
    - Implement your algorithm and ensure it runs on ROS Foxy using the rb5/mbot platform. Your code should be designed to execute the waypoint navigation based on the input from the waypoints.txt file.
5. **Execution**:
    - Run the algorithm on the rb5/mbot platform using the provided waypoint file.
6. **Report and Code Submission**:
    - Write a short report (1-3 pages) that includes:

        - A description of your kinematic model and navigation algorithm.
        - An explanation of your calibration strategy for your kinematic model.
        - Comment on the performance of your algorithm (e.g., accuracy of waypoint traversal, error sources, improvements if any).
    - Submit both the report (as a pdf) and the code to Canvas.
7. **Video Demonstration**:
    - Record an example run of your robot executing the algorithm. Upload the video as an unlisted video on YouTube. You may run multiple times and only include the one with best performance.
    - Include the URL to your video demonstration in your report.

Submissions:

- A ZIP file containing your Python code.
- A PDF report with a link to the video demonstration.