Project 1: Build the Robot

Due: 02/16/2023 @ 1:30 P.M.

Welcome to your first project. The goal of this project is to build a differential drive mobile robot. The robot is expected to be remotely controllable using ROS. You'll start building your robot with some basic materials:

- Raspberry Pi
- Raspberry Pi Pico
- high-torque DC motors
- high power motor driver board
- LiPO batteries
- 30x30 aluminum extrusions
- skateboard wheels
- caster wheels
- acrylic sheets & wood boards
- nuts & bolts

Your project will be evaluated from the following three aspects: prototype building, feature analyzing and documentation. Please try your best to meet the requirements as stated below.

1 (60%) Functional Prototype

Build a prototype of the differential drive robot. Assemble the hardware and prepare the software. The robot is expected to be controlled remotely under the ROS framework. You'll need to set up a functional prototype for the future projects.
Requirements:

- (5%) Make a functional and steady robot base. Make sure you have plenty room for all the add-ons (RPi, motor driver, batteries, etc.)
- (5%) Wire up electrical and electronic devices. Check if every device is functional.
- (5%) Set up software. This may include:
  - Flash Ubuntu 22.04 on Raspberry Pi.
  - Install ROS Humble on both RPi and laptop.
  - Configure Pi Pico properly.
  - Download essential libraries.
- (15%) Introduce safety features to your robot.
- (10%) Implement motor driving strategies. Verify the robot can correctly understand the commands and behaves as expected.
- (20%) Integrate ROS on your robot. Drive the robot using *geometry_msgs/Twist* topic. Verify the robot is controllable via *teleop_twist_keyboard* package.

2 Analyzed Features

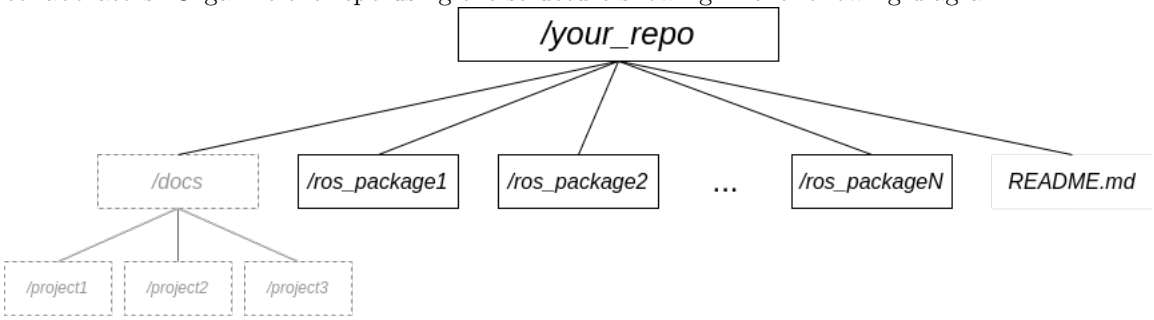
You need to carry out a series of experiments to know your robot better. Please try to identify a few key features of your robot as listed below. You are welcome to analyze more features.
Requirements:

- Robot weight.
- Base dimensions (include the add-ons).
- Max speed (linear, angular).
- Payload capacity.
- Battery (minimum) life span

3 (40%) Documentation

A project is meaningless if no one knows how to use it. A well documented project can help people to either develop variations or continue the development after a long break. Please use a *README.md* and a technical report to document this project. Save all the projects related resources in a Github repository, so that you can manage versions of your project "easily".
Requirements:

- Create a public Github repository, and add all the team members and the instructor (linzhanguca) as collaborators. Organize the repo using the structure showing in the following diagram.



- (10%) In your Github repository, you need to have a **README.md** to give the basic instructions on using your robot. You may want to publish the most important technical detail in the **README.md** as well.
- (30%) Write a technical report. This report is expected to include
  - (2%) An overview section to introduce your robot with the most highlighted functions and features.
  - (15%) A specification section to describe all the detailed features, including those listed in **2 Analyzed Features**. You may want to attach the hardware configuration (all the dimensions including screw holes), part list and wiring diagram here.
  - (15%) An experiment(analyzes) section to describe the methods of how you evaluate the interested but not straightforward features and facts. Please reveal the results of your experiments and/or analyzes.
  - (3%) A summary and discussion section to close up the report and share any interesting findings.