MOBILITY part 2

Introduction from part 1

You will create a mobile base to circle three times around a wall in the middle of the playing field situated in the GMlab. There will be a large gap between the wall and the obstacle - approximately 2'. During the final project the gap will be smaller. There will be two trials spaced one week apart. In one trial you will drive the robot via wifi and the internet from your home. In the second trial the robot will run autonomously.

TRIAL RULES:

1. Complete 3 circuits around the obstacle in the middle of the 12' x 5' field. 2% of grade will be on performance (time to completion) during demonstration.
2. You will have two types of runs at different times about one week apart, one driven manually through wifi and another autonomous.
3. No intentional bumping or obstructing other drivers during a heat, or your mobile base may be manually reset by the TAs
4. The vehicle must be smaller than 12" x 12" x 12".
5. You must use the Beston Battery as a power source.
6. You must use the ESP32 for wireless connectivity.

You should consider which motor choice will give you the best overall performance before making your choice. Given the lag time for internet control, you will likely get better performance if the vehicle doesn't move faster than a few inches per second. Breadboards on mobile bases for circuits are allowed for the project, but soldering the circuit is **very highly recommended**. Soldering the circuit will make the mobile base more robust, and your wires are less likely to fall out/disconnect during the race.

Any additional components not found in the ministore/RPL can be purchased independently, or you may use any parts you may have previously acquired. We will have races in heats (each student assigned to one TA/Coach will be in one heat).

4.2 ESP32 and WiFi

We will be using the Arduino Integrated Development Environment (IDE) to program the ESP32 Pico to give you experience in an alternative well-established development environment. Pick up a second ESP32 Pico from a TA (or use the oscillosorta - realizing that you can reprogram it back later). Then follow the steps on the getting started link below. Note that the NodeMCU that the website refers to is an ESP32 but with different pinout. All other functionality is the same (mostly...).

http://medesign.seas.upenn.edu/index.php/Guides/ESP32

Digital Input/Output `(digitalRead(); digitalWrite();)`
4.2.1 Use ESP32 GPIO pins, a switch, an LED and resistors to read the state of a switch and light an off board LED when the button is pressed. **Submit your code.**

Analog Input/Output `(analogRead(); ledcWrite();)`
4.2.2 Add a potentiometer in a voltage divider circuit to be read as an analog signal and control the 50% duty cycle blinking speed of an LED using the ledc commands based on the reading. The LED should switch from off to 100% duty cycle depending on pot position, at a frequency you choose ranging from 0.1Hz to 10Hz. **If you don't do the next step, then submit your code that uses ledc for this, a drawing of your circuit, and a video link showing the LED change brightness as you turn the pot.**

WiFi `(TCP)`
4.2.3 Building on 4.2.2, add code that will create a website that will display the frequency and duty cycle using your individually assigned IP address. **Submit your code for this, a drawing of your circuit, and a video link showing your LED as you turn the pot and the webpage displaying at the same time.**

PWM and motor control `(LEDC)`
4.2.4 Generate PWM from the ESP32 using the LEDC timer functions and control the speed and direction of a motor (through a motor driver from 4.1) with a potentiometer (from 4.2.2). **Submit code on canvas. Demonstrate the motor changing speed and direction, with variable speeds in both directions. Show a TA for check off. Or if you prefer, you may submit a video, but in the video show your face before demonstrating.**

Wifi at home
4.2.5a Drive the mobile base you create at home using your home WiFi. (Please notify the staff if you don't have home WiFi). You may use the supplied MEAM510 javascript code, or create your own UDP or TCP web-based interface. Note that for the next parts HTML (TCP) is the only option through the internet, so it may be more useful to use TCP. **Get a check off from a TA or submit a video of you driving your mobile base in your home via wifi. Submit code on Canvas if different from the next step (otherwise indicate that it is the same).**

Wifi Through the internet
4.2.5b Bring your mobile base to your TA/Coach in the GMlab. Arrange for a time when they are at the GM lab for you to test-drive your mobile base from home through the internet. Show that you can command your mobile base to go straight and turn when you want. **Get a check off from a TA of you driving your mobile base from home through the internet while the mobile base is in the GM Lab. Submit code on Canvas.**

Mobile Base Race

4.2.6a Arrange for a time when you and your TA/Coach's other teams can drive at the same time. Race 3 times around the center object in the GM lab. Between activities 4.2.5 and 4.2.6 you may want to tweak your mobile base for better traction on the wood panel, for more controllability and/or for speed. **Submission will be your time performance in the race compared to the whole class, which will count as 2% of this lab grade.**

Report

4.2.6b Submit report on mobile base design and performance. Include:

1) Description of mobile base approach (photographs) [max 1 page]
2) Discussion of performance and list of improvements [max 1 page]
3) Final version of code used on mobile base
4) Bill of materials
5) Circuit diagrams