Final Project: Follow-the-Leader

1 Introduction

For your final project, you will be designing and building a wheeled vehicle that plays "follow-the-leader". You will be applying many of the concepts that you used in class.

2 Final Deliverable

The final product will be an autonomous, line-following robot that follows a lead robot (created by your instructor). You will program your robot to follow a line and maintain a specified distance behind a lead vehicle. You will also have to follow the leader as it makes turns.

The requirements are as follows:

- Your robot will use reflectance sensors to follow a line – black electrical tape – laid out on the floor.
- Your robot will use an ultrasonic range finder to determine the distance to the lead robot and respond by speeding up or slowing down as needed.
- The lead robot will indicate upcoming turns by signaling with an IR emitter. You will detect the signal with an IR remote demodulator.
- After the lead robot turns, your robot will continue on its current path until it reaches the intersection, after which it will turn in the proper direction.

The requirements may evolve a little if there are still questions, but I have it mostly nailed down, now. I'll try not to surprise you.

3 Details

Figure 1 shows a proposed architecture of the robot. Components will include:

- *Chassis.* The chassis will consist of two pieces of plastic, no more than 5.75" in any direction. They may be square to give more real estate for current and future peripherals. The plastic will be cut on the laser cutter from your design. The pieces will be stacked using stand-offs. The top one will hold your Arduino; the bottom one will hold batteries, motors, reflectance sensors, and casters for maintaining balance. You will have to place a small breadboard

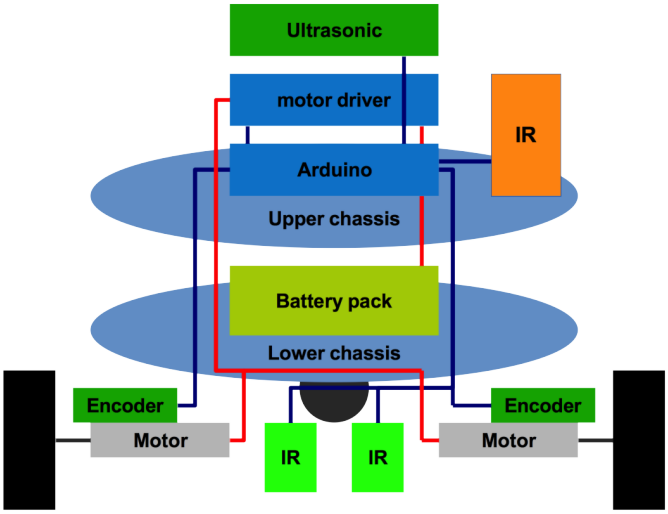

Figure 1: A suggested architecture for your delivery robot. Red lines refer to power connections; blue lines are logic.

for minor circuitry, which can go wherever you can fit it. Same with the ultrasonic and IR sensors. Everything must be secured with standoffs or screws and spacers.

- *Motors.* Each robots will use two micro gear motors from Pololu with wheels and encoders (https://www.pololu.com/product/1218, plus the micro-metal gear motors linked therein). These come as a kit and will be relatively easy to mount. Motors will be controlled using the TB6612 dual motor H-bridge. See:

  `https://www.sparkfun.com/products/9457` or `https://www.pololu.com/product/713`

- *Batteries.* See `https://www.pololu.com/product/2225`. A 2x3 (6-pack) of NiMH batteries will be provided. **It will be important that you don't drain them below their minimum charge, about 7.2V.** You will have to hold the batteries reasonably securely using a 3d printed mount or clever laser cutting. Note that you will want to be able to easily remove the batteries for charging. Whatever holder you make for the batteries should take this into account.

- *Reflectance sensors.* See `https://www.pololu.com/product/2455`. We will use Pololu's reflectance sensors, which incorporate RC-circuits whose response changes based on the shade of the surface it sees. You will need to make the sensors adjustable, since transverse positioning is important. An 'easy' way to do that would be to make a long slot that will hold the connectors.

4 Final trials

The final trial will occur whenever your robot is ready. We'll put your robot a reasonable distance behind the lead robot and let them drive. Your robot will have to complete three laps of the course.

Exact scoring will be determined soon, but will include reliability, a subjective measure of how well it follows the leader, and fit and finish of your robot.

5 Proposed timeline

The following is a good plan for what you should have done and should be doing. Note that your final exercise will be an oral interview, and your robot must be done by the time you meet with me. You have until I leave for Sweden on Thursday, May 11, to complete you robot, which gives you a week or two flex time going into finals.

Date	Suggested tasks	Friday milestone
April 10 - 14	Basic design and layout. Writing out state diagram. Discussing methods. Testing reflectance sensors.	Robot assembled.
April 17 - 21	Driving. Line following. Turning. IR decoding.	Basic line-following worked out.
April 24 - 28	Maintaining distance.	Simultaneously follows line and maintains distance. Turning algorithm complete.
Finals week	Trials. Begging for mercy. Sad attempts at bribery. Ritual sacrifice.	Complete system.

Notes