ECE 110L Spring 2024

IDC Week 2 Laboratory:

Sensing and Transmission

Contents

1 Abstract

Now that you have used the full set of sensors and gotten the basics of line following to work separately, it is time to put those together! The main task for this week will be to integrate line following with your group's sensing task. You will also need to wirelessly send a value indicating the location of your target object to a sentry 'bot, which the TAs will provide. In a future lab, you and your team will need to figure out how to communicate the target object locations to all the bots.

Note that this week the work is concentrated in one part - the IDC Checkpoint. As mentioned last week, the IDC Checkpoint will specifically support the integrated design challenge and will be graded based on your 'bot's ability to complete the task using a particular system or set of systems. Once again, this week's IDC Checkpoint is intended to be accomplished by the groups individually and will require your team to properly implement their own unique systems involving sensors. It is important to note, however, that IDC Checkpoints 3 and 4 will require collaboration with, and completion as, a team as you will design and apply general communication systems. This lab has brief pre and post-laboratory deliverables, but does not contain any deliverables for the experiments or explorations.

2 Objectives

After performing this laboratory exercise, students should be able to build a 'bot that:

- Navigates their IDC track(s) they have been assigned,
- Stops at hash mark(s) along the track,
- Use the appropriate color of an RGB LED to indicate the hash mark,
- Uses the sensor they have been assigned to locate a target object and reject other objects, and
- Communicates the target object's information

3 Pre-Laboratory Exercises

Your 'bot's ability to line follow will be crucial for this assignment, so ensure that you have fully completed IDC Checkpoint 1 before you attempt this portion of the IDC. There are two previous labs from this semester that will help you accomplish this IDC Checkpoint — Lab 1: Controlled Motion and Serial Communication and Lab 4: Sensors and Displays. Once you are comfortable with navigation and controlled motion, have a conversation with your lab partner(s) about the best sensor for the task, how IDC Week 1 Lab went, and anything from prior labs that you are not sure about. Go over your work with the XBee Communication modules from Lab 1. If you have questions that could improve your efficiency for this lab, please post on the lab Ed page and the instructional team will try to answer as soon as possible. Once you feel confident in your group's ability to tackle system integration, write down any notes from your communication with your lab partner(s) and compile them into a paragraph.

Pre-lab Deliverable (1): Write a brief paragraph detailing any ideas or notes that came up in your communication with your partners.

4 Pre-Laboratory Assignment

Your assignment responses should be uploaded to the ECE 110L Laboratory Gradescope site by the assignment deadline.

EACH STUDENT must submit their own INDIVIDUAL assignment responses!

You will respond to the following:

1. Type the Duke Honor Code:
    - *"I have adhered to the Duke Community standard in completing this assignment."*
2. **Pre-lab Deliverable 1:** Brief Paragraph
    - Write a brief paragraph describing your conversation with your partner(s) and any important notes you may have. **This can contain information about your sensor, configuration of the XBee, Navigation, or anything else you find useful for the coming IDC Checkpoint.**

Your assignment responses should be uploaded to the ECE 110L Laboratory Gradescope site by the assignment deadline.

EACH STUDENT must submit their own INDIVIDUAL assignment responses!

5 Experimental Exercise

Get together with your whole lab team to talk about communication. Remember that five 'bots will be, potentially simultaneously, sending information about where their target object is located. As a lab team, try to figure out how each of the 'bots and the sentry can understand what is going on given that it is entirely possible two or more 'bots will be "speaking" at once.

6 Exploration

Build a 'bot that accomplishes your group's navigation, sensing, and communication tasks. The IDC document may be a useful resource as you develop your code or adjusting hardware. During this lab, you will be allowed to test your 'bot on the actual track, but make sure you keep your battery pack plugged in so you have plenty of stored energy for the IDC Checkpoint. It is also encouraged that you use wall power when testing, to keep your batteries fresh for the checkpoint, which will require your 'bot to use the batteries.

7 IDC Checkpoint

For IDC Checkpoint 1, you learned about QTIs and how to use them to follow a path. You also learned how to make your on-board RGB LED turn on the color of your event ring (Black ring is white) when it reached the hashmark. The 'bot remained at the hashmark for about a second before turning off the RGB LED, turning right $90°$, and then driving forward into the circle. You will be adding on to this code for IDC Checkpoint 2.

As noted in the Pre-Laboratory exercise, it is crucial for your group to have completed IDC Check-

point 1 before attempting IDC Checkpoint 2. In accordance with the IDC document, the next step will involve integrating your code for navigation and hashmark indication with sensing, and then with data transmission. Based on your group's specific sense task, you will need develop a system for correctly identifying the state of your group's object inside the circle. To help demonstrate that your bot is utilizing it's sensor to find objects the on-board RGB LED must flash the color of your ring to indicate it's use. Your TA may require further use of the RGB LED to help troubleshoot and clarify it's usage.

IDC Checkpoint (2): Show your TA that your 'bot can navigate as it did for IDC Checkpoint 1 while also using it's sensor to look for the object your group is expected to identify. Once your 'bot has finished navigating and sensing it must also use an XBee module to transmit (send) the correct data (see IDC document). The sentry 'bot will be used to identify the correct values are being transmitted/sent.

IDC Deliverable (1): Integrate your code for navigation with your code for sensing. Save this as a separate file. **Be sure your code is thoroughly commented.** This *does not mean every line needs a comment*, but there should be enough comments to make it clear what your code does.

IDC Deliverable (2): To show your progress, you should now integrate your code for navigation and sensing with your code for transmitting data (see IDC document) to the sentry 'bot. Save this as a separate file. **Be sure your code is thoroughly commented.** This *does not mean every line needs a comment*, but there should be enough comments to make it clear what your code does.

8 Assignment

Your assignment responses should be uploaded to the ECE 110L Laboratory Gradescope site by the assignment deadline.

EACH STUDENT must submit their own INDIVIDUAL assignment responses!

You will respond to the following:

1. Type the Duke Honor Code:
    - *"I have adhered to the Duke Community standard in completing this assignment."*
2. **IDC Deliverable 1: Code for Navigation and Sensing** 7
    - The integrated code for navigating your group's respective path and correctly identifying object states.
    - Be sure your code is thoroughly commented. This does not mean every line needs a comment, but there should be enough comments to make it clear what your code does.
3. **IDC Deliverable 2: Code for Navigation, Sensing, and Transmission** 7
    - The integrated code for navigating your group's path, sensing objects, and transmitting the appropriate data value for your IDC task
    - Be sure your code is thoroughly commented. This does not mean every line needs a comment, but there should be enough comments to make it clear what your code does.