

Robosail Workshop 3

Objectives Students will:

- Practice using the RoboSail frame of reference for sensor data.
- Continue learning how to program on Arduinos.
- Write code to control Sail servo from Windvane and test it out on water.
- Improve automatic sail trim code with “heel” Information from the accelerometer

Materials:

- Sensor and Actuator definitions
- Arduino Tutorial 2
- Plastic Boats
- On-the-Water Challenges (may not use today)

Part I Practice specifying positions of rudder, sail, windvane (20 min)

1. Use plastic sailboats to get clear on the frame of reference for sensors and actuators
 - a. Define frame of reference
 - i. Wind vane reads 0° to $+180^\circ$ for wind on Port side (positive = port)
 - ii. Wind vane reads 0° to -180° for wind on Starboard side
 - iii. Rudder rotating CCW is positive (looking from above) and range is $+60^\circ$ to -60°
 - iv. Sail is 0° to 90° where 0° is full in and 90° is full out. Side doesn't matter
 - b. Practice degree definitions
 - i. Call out various positions for Windvane, Rudder, Sail
 - ii. Kids move parts of boat to appropriate places
 - c. Practice Sailing definitions
 - i. Do exercises in workbook or at <http://www.robosail.org/model-boat-exercises.html>
 - ii. Kids switch for each exercise, can repeat exercises

Part II Arduino Exercise 2: Serial I/O (40 min)

Summary: Practice getting input from user and displaying on screen

1. Follow Arduino tutorial 2 to learn how to read in numbers from the computer monitor and how to display program values to the screen
 - a. Review how to open Serial Monitor
 - b. Show examples of integers and floats and chars.
 - i. Explain how each is used.
 - ii. Note that we will only use ints and floats.
 - c. Discuss how reading in and displaying are useful in debugging
 - i. Can pause a program while waiting for input from screen
 - ii. Can print out calculated program values to check

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Part III Generate and Program algorithm for Automatic sail control (30 min)

1. Plan Autonomous Sail with Manual Rudder (like having a friend control the mainsheet while you steer the boat – they keep an eye on the tell-tales and adjust accordingly)
 - a. Figure out the algorithm using the Plastic Boats
 - b. Draw/write an algorithm making sure to consider these cases:
 - i. $\text{windAngle} < 45$
 - ii. $\text{windAngle} > 45$ and $\text{windAngle} < 135$
 - iii. $\text{windAngle} > 135$

Part IV Generate and Program algorithm for Automatic sail control (90 min)

2. Create code for Autonomous Sail with Manual Rudder
 - a. Use BoatCodeStarter program as a starting point for new code. Save it in a new program called AutoSail.
 - i. Enter the calibration values for Transmitter and WindSensor
 - ii. Look for the place that your code goes and the variables you will set
 - iii. Print values to Serial monitor to confirm or debug.
 - b. Test indoors with someone moving windvane
 - c. Test outdoors on the water.
3. Discuss and compare algorithms as a group
 - a. Draw each on a graph on whiteboard. Member of each group explains how it works
 - b. Students look for similarities/difference
 - c. Discuss/show code used for each.
 - d. Can share on google docs and have group leader display to screen