

Fish Tank Project Introduction

EAS 199B Portland State University
Mechanical and Materials Engineering


- ### Learning Objectives for these Slides
- After this presentation you should be able to
- ◆ Explain the scope of the fish tank project
 - ▶ What your fish tank will be able to do at the end of the class
 - ▶ Which skills the project will help you develop
 - ◆ Know what items you need to purchase
 - ▶ And where to find the list of items
 - ◆ Know where to find fabrication instructions for the fish tank
 - ◆ Know the basic components required for automated control of the fish tank
 - ◆ Know how the fish tank project will be graded
 - ◆ Know the role of task leaders in completing the project
- LWTL: Fish Tank Project Overview 2

What does a fish need?

A hand-drawn diagram of a fish in a tank. The fish is drawn in red and orange, swimming towards the right. The tank is represented by a simple rectangular frame with a wavy line for the water surface. To the right of the fish, the chemical symbols H^+ , OH^- , Na^+ , and Cl^- are written in black ink, representing ions in the water.

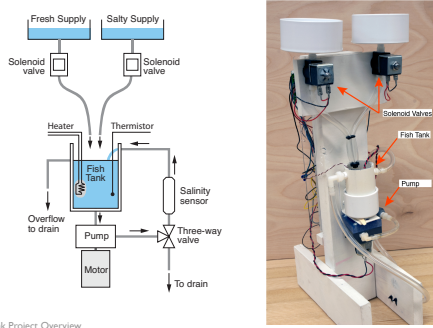
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Fish tank project uses the pump from EAS 199A



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Schematic and photographic views of a completed fish tank



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Fish tank development can be divided into 4 phases that will span all 10 weeks of the term.

1. Preliminary system fabrication
 - ❖ Wooden platform
 - ❖ Salinity sensor and assembly of flow loop
 - ❖ Calibration of salinity sensor
2. Salinity control system
 - ❖ Assembly of supply tanks and solenoid control circuit
 - ❖ Programming the salinity control algorithm
3. Temperature control system
 - ❖ Fabrication of thermistor sensor and heater
 - ❖ Programming of temperature control
4. Integration of salinity and temperature control

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Start with the structure

1. Materials are provided
2. Start next class
3. Have painted by next week
4. See:
 - ◆ <http://web.cecs.pdx.edu/eas199/B/howto>



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Make the fish tank and salinity sensor

1. Materials are provided
2. Make fish tank today
3. Have it painted by next week
4. See:
 - ◆ <http://web.cecs.pdx.edu/eas199/B/howto>



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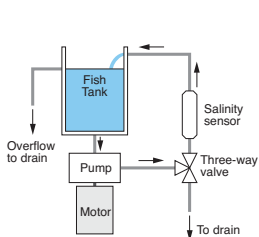
Make the fish tank and salinity sensor

1. Materials are provided
2. Make fish tank today
3. Have it painted by next week
4. See:
 - ◆ <http://web.cecs.pdx.edu/eas199/B/howto>



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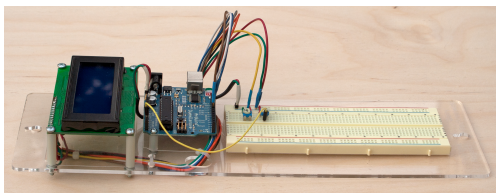
Assemble the flow loop



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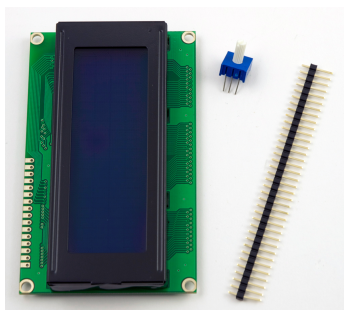
Assemble a wiring harness for the LCD panel



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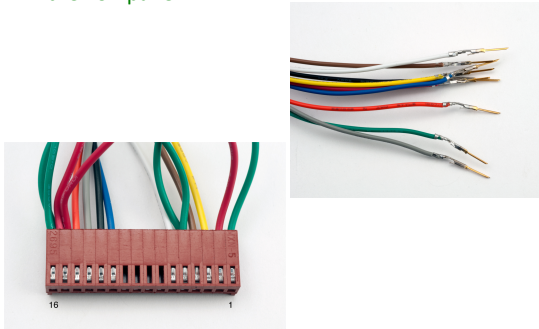
Each student buys an LCD panel from the bookstore



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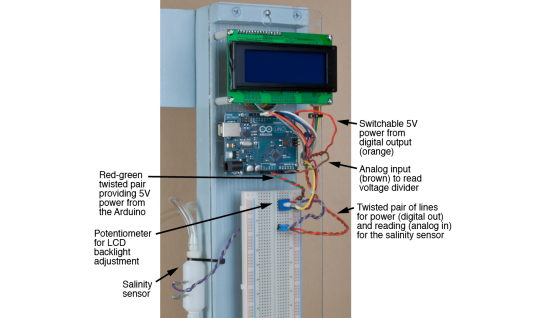
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Each student assembles a wiring harness for the LCD panel



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Use the LCD to display salinity readings



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Student teams will calibrate their salinity sensors

Calibration: (from Wikipedia):

Calibration is a comparison between measurements – one of known magnitude or correctness made or set with one device and another measurement made in as similar a way as possible with a second device.

The device with the known or assigned correctness is called the standard. The second device is the unit under test, test instrument, or any of several other names for the device being calibrated.

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Student teams calibrate their salinity sensors

What does "calibrate" mean?

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Salinity sensor calibration will involve ...

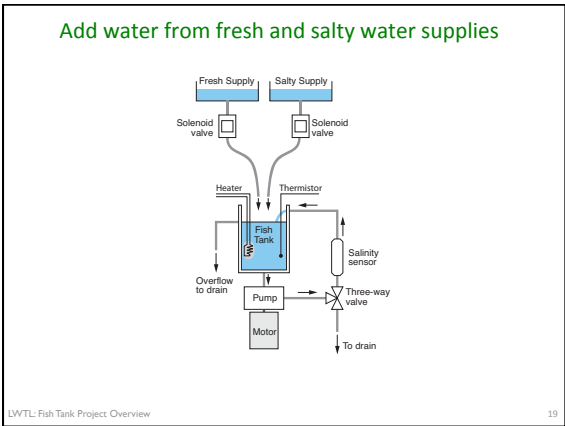
1. Making careful measurements!
2. Analyzing the statistics of the measurements
3. Introduction to MATLAB
4. Curve fit of averaged data
5. Forward and reverse calibration

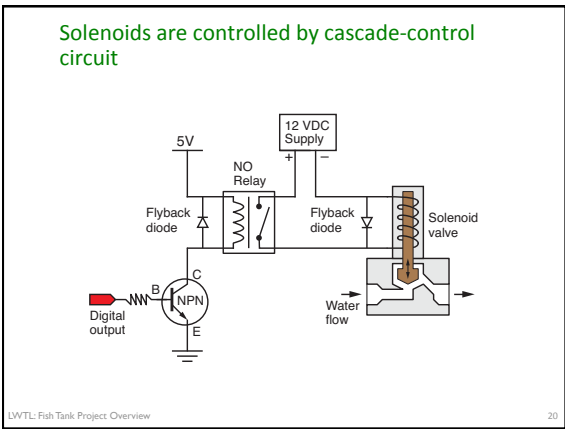
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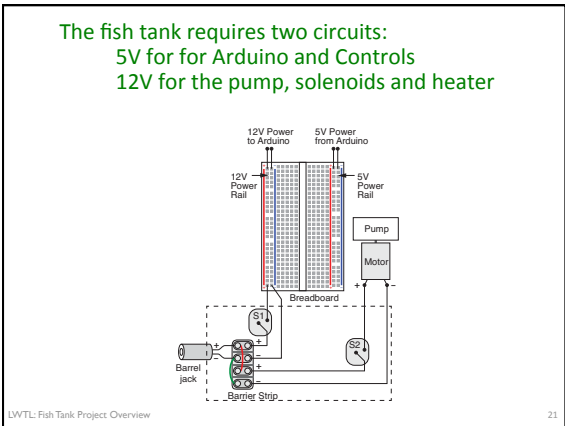
After calibrating the salinity sensor you will be able to determine the salinity of water in the tank

1. Measure salinity
2. If salinity is greater than upper limit:
Add fresh water: open valve, wait, close valve.
3. If salinity is less than lower limit:
Add salty water: open valve, wait, close valve.
4. Wait for the system to mix
5. Return to step 1.

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Control algorithm requires planning and modeling of the system

1. Measure salinity
2. If salinity is greater than upper limit:
Add fresh water: open valve, wait, close valve. **How long?**
3. If salinity is less than lower limit:
Add salty water: open valve, wait, close valve. **How long?**
4. Wait for the system to mix. **How long?**
5. Return to step 1.

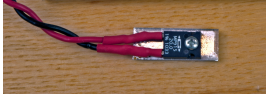
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For temperature control we need to measure temperature and add heat

Thermistor for measuring temperature

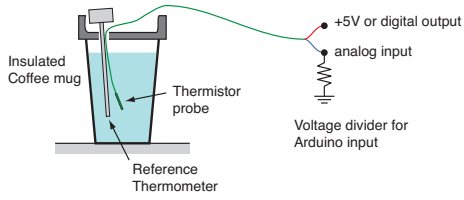


Power resistor as an electric heater



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Calibrate the thermistor



Insulated Coffee mug

Thermistor probe

Reference Thermometer

+5V or digital output

analog input

Voltage divider for Arduino input

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Control algorithm requires planning and modeling of the system

1. Measure temperature
2. If temperature is below than lower limit:
Turn on the heater, wait, turn off the heater. **How long?**
3. Return to step 1.

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Final system has both salinity and temperature control

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Grading scheme for the project

- 5% Fabrication of platform and flow loop
- 5% Assembly of electrical power system
- 10% Calibration of salinity sensor
- 15% Dynamic control of tank salinity
- 10% Calibration of thermistor probe
- 15% Dynamic control of tank temperature
- 20% Final system performance for dynamic, autonomous control of salinity and temperature, and display of system state
- 20% Final presentation

100%

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Rotate task leadership for the fish tank project

1. Fish tank has 8 grading checkpoints
2. Teams of 4 will designate a leader for each checkpoint
 - ◆ Two checkpoints per student
3. Responsibilities of leader are
 - ◆ Communicate with instructor
 - ◆ Make sure project objectives are met (refer to rubrics)
 - ◆ Make sure all members of the team are capable of answering questions about the current phase of the project
4. Pick your leadership assignments early

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Learning objectives

By the end of this course you should be able to

- Explain on/off and proportional feedback
- Write Arduino codes to implement controls
- Describe basic statistics of sensor measurements
- Perform sensor calibration
- Build cascade control circuits using transistors and relays
- Use mass and energy balances to describe system performance

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To-do list for Class Meeting 1

1. Form groups of four
2. Fabricate the fish tank
 - ◆ See <http://web.cecs.pdx.edu/~eas199/B/howto/>
3. Prepare for next class
 - ◆ Read instructions for fabricating the fish tank platform
 - ◆ Start homework
 - ◆ Visit D2L web site
 - ◆ Make a shopping list
 - ▶ <http://web.cecs.pdx.edu/~eas199/B/equipment/>

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