PC/CP 320
Project Overview

Terry Sturtevant

Wilfrid Laurier University

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There are 3 projects this term. Integration project brings together several things you've done in lab. Exploration project allows you to investigate something that has been mentioned, but you haven't used in the lab. Enclosure project allows you to design and create a casing for a device with the Raspberry Pi. You'll do the integration project and one other.
Outline

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Why two projects?
The integration project only involves previously-seen material. The challenge is adapting the code to incorporate all of them.
The exploration project introduces something you've never used. The challenge is learning how to use it.
The enclosure project introduces you to prototyping in the Maker Lab. The challenge is learning how to design and create.

Trying to combine them would make it too easy to get overwhelmed.
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Integration project
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- Distance sensor (IR or ultrasonic)
- Operator interface
- Motor (DC, servo, or stepper)
- Raspberry Pi
- Multivalued Input
- User output (complex)
Integration project

Note that the “?” may include more than just signals, such as a D/A or A/D converter.
Exploration project
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The code is to demonstrate "proof-of-concept".
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Diagram:

- Operator interface
- Raspberry Pi
- Unfamiliar device
Enclosure Project
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  Avoid glue, solder, etc.
- Design it so that it’s easy to adapt.
  e.g. Future users may want to add other components.
Schedule

There are 4 weeks, (8 lab periods), exclusively for the projects. Two weeks are exclusively for the integration project. Two weeks are mostly for the exploration or enclosure project. If you're doing the enclosure project you'll have to start much earlier, or you may not finish.
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Schedule (continued)

Two weeks, (i.e. 4 lab periods), are exclusively for the integration project.

Lab 1A; Demonstrate 1 input or output device working. A motor is easy since those are recent.

Lab 1B; Demonstrate previous device and one other. Decide on 3rd device to be used.

Lab 2A; Demonstrate previous devices and one other. Decide on 4th device to be used.

Lab 2B; Demonstrate all devices together. They may not yet interact; they just need to all be connected and functional at the same time.
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Lab 3A; Choose device to explore and learn about it.

There are lots of resources online.

Lab 3B; Demonstrate the completed integration project.

This includes operator interaction.

Lab 4A; Demonstrate basic functionality of the device.

Show it doing something.

Lab 4B; Demonstrate the completed exploration project.

Show it doing something that wasn't in any of the resources you found.

Be sure to highlight what you came up with on your own.
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**Be sure to highlight what you came up with on your own.**
Schedule (enclosure)

There are 2 weeks, (i.e. 4 lab periods), mostly for the enclosure project. Because the Maker Lab is busy at the end of term, you will need to get most of this done ahead of time.

Lab 3B; Demonstrate the completed integration project. This includes operator interaction. Include enclosure prototype. There may still be refinements needed.

Lab 4B; Demonstrate the completed enclosure project. Show how to assemble it and how it is in operation. Be sure to highlight your creative ideas.
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Project Substitution Option

You have the option of combining the projects as follows:

An unfamiliar input device can replace one input device for the integration project.

An unfamiliar output device can replace one output device for the integration project.

If you make this your 4th device, you can determine feasibility during the first 3 lab periods. This means that you are basically doing the projects in parallel.

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PC/CP 320 Project Overview
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Ramifications

For the exploration project, you make a reduced test program for the unfamiliar device. (In fact, it may be similar to what you use for early testing of the device.) It may use functionality you created for the integration project. If you can show it working on time as the fourth device, the integration demonstration can be delayed.
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Component Options

Motor Options
- servo, stepper, or PMDC with shaft encoder

Distance Sensor Options
- ultrasonic or infrared

Multivalued Input Options
- more than just a switch; allows a range of values

User Output Options
- more complex than an ON/OFF LED; displays a range of values

Following are some examples of options for the various system components.

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PC/CP 320 Project Overview
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Following are some examples of options for the various system components.
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Servo motor
- uses PWM output from the Pi

Stepper motor
- uses 4 digital outputs from the Pi

DC motor
- needs MOSFET for control
- Also needs shaft encoder inputs to monitor speed and position (combination project possibility)
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*(combination project possibility)*
Distance Sensor Options

- Ultrasonic sensor - digital TRIGGER (output) and ECHO (input) pulses with the Pi. It's a 5V device, so ECHO pulses must be adjusted for Pi.
- Infrared sensor - analog output must feed into ADC to interface with the Pi.
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Multivalued Input Options

Analog sensor—such as photoresistor or photodiode, Hall sensor, resistive or capacitive soil moisture sensor, heart rate monitor (combination project possibilities)

Analog output must feed into ADC to interface with the Pi. Some will need voltage dividers or need analog voltage amplification or attenuation.

If you are using an analog sensor, it makes sense to use the ultrasonic distance sensor so your two input devices are more independent.
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Multivalued Input Options (continued)

- DS18B20 1-wire temperature sensor (combination project possibility)
- DHT11 temperature/humidity sensor (combination project possibility)
- Keypad (combination project possibility)
- Capacitive Hex Keypad (combination project possibility)
- RFID reader (combination project possibility)
- TM1638 Keypad/display (combination project possibility)
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- TM1638 Keypad/display - \( (combination\ project\ possibility) \)
## User Output Options (complex)

- **PWM LED**
  - Varying brightness can convey information

- **Analog voltage**
  - Varying voltage can convey information

- **Analog output**
  - Requires DAC to interface with the Pi

- **MAX7219 displays**
  - Combination project possibility
  - Includes 8x8 dot matrix, 8 digit 7 segment display
  - 128x32 OLED display
    - Combination project possibility

- **I²C TM1637 display**
  - Combination project possibility

- **TM1638 Keypad/display**
  - Combination project possibility

- **LED string options**
  - Combination project possibility
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Different modes - operation of system changes based on operator input
Change sensitivity - range of response controlled by operator
These are in addition to simply monitoring the status of the system.
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