CSC 4700 s2: Special Topics in Computer Science

“Programming Embedded Interfaces”

Credit Hours: 3 hours

Prerequisites: CSC 3102 or permission of department.

Prerequisites by Topics:
Some prior programming experience is expected.
Some C experience is valuable.
Python or Java experience is useful, but not required.

Catalog Course Description:
May be taken for a max of 9 cr. Hrs. when topics vary. Total hrs earned in CSC 2700 and 4700 should not exceed 9 hrs. Specialized areas of current interest in computer science.

Students will examine the concepts and practice, and work hands-on with programming embedded interfaces to sensors, actuators, displays, networks, and people. In the process, they will gain experience both in directly programming embedded devices (in C); and high-level networked control of multiple embedded devices (in Python or Java). Students will also gain familiarity with example hardware and application domains relevant to embedded interfaces.

This is a project-oriented class. Working in small teams, students will learn to build working systems using embedded processors and interfaces (no prior electronics experience is necessary); to program these interfaces; to connect these devices with physical sensors, actuators, and displays; and to use these in real applications.

Course Outcomes:
1. Be familiar with the composition, design, and implementation of embedded systems,
2. Be familiar with both medium level and high level languages appropriate for embedded systems development techniques (e.g., C and Python),
3. Be familiar with reading and understanding processor and component datasheets
4. Be familiar with driving use contexts, including human-computer interaction, environmental sensing and actuation, etc.,
5. Be familiar with the basics of interfacing hardware and software,
6. Be familiar with working on a team to create and apply embedded systems,
7. Be exposed to history of embedded interfaces
Texts and Other Course Materials
The class builds on roughly a dozen required and recommended online readings. The text “Physical Computing” (O’Sullivan and Igoe) is recommended, but not required.

Major Topics
- Introduction to the PIC microcontroller,
- Embedded programming in C,
- Embedded control and applications in Python and Java,
- Reading datasheets for microcontrollers and enabling components,
- Embedded communication (wired and wireless, including I^2C, RS232, USB, Bluetooth),
- Human-computer interaction,
- Introduction to sensors, actuators, and displays,
- Environmental sensing and actuation,
- Issues related to energy and power,
- Related design and fabrication technologies.

Assignments/Projects/Laboratory Projects/Homework
Three projects:
1) Basic embedded programming in C
2) Basic embedded control in Python or Java
3) Final project applying (1) and (2) to a topic of student interest

Homeworks:
1) Questions on contextual readings
2) Questions on basic electronics
3) Review in preparation for midterm
4) C and Python application examples
5) Review in preparation for final

Curriculum Category Content (estimated in semester hours)

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<th>Area</th>
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<td>Data Structures</td>
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Relationship to Criterion 3 Outcomes
Math and Fundamentals:
   Bitwise operations in binary and hexademedical
   Base conversions

Data Structures:
   Bitfields for state representation and messaging
   Class libraries for embedded communications, sensing, control, and display
   Class libraries for streaming Internet content (e.g., RSS)

Algorithms and Software:
   Watchdog timers
   Interrupt handlers
   Embedded control loops
   Event-based programmings
   Internet to embedded system interlinkages

Computer Organization and Architecture:
   Datasheet fundamentals
   PIC processor fundamentals
   Embedded communication networks and protocols

Concepts of Programming Languages:
   Embedded programming in C
   Embedded control in Python and Java

Social and Ethical Issues:
   Embedded systems in applied use contexts, including human-computer interaction
   and environmental sensing systems.
   Discussions of resource and societal implications of varying levels of power consumption

Oral Communication (presentations)
   Every student is required to make _3 oral presentation(s), typically of 10 minutes
duration.

Written Communication:
   Every student is required to make extended (multi-paragraph) English responses in both
homeworks and midterm + final examinations.

Course Coordinator: Dr. Brygg Ullmer
Last Modified: June 18, 2007