

Media Interface Technology

Dan Overholt - dano@create.ucsb.edu
class mailing list – sensors@mat.ucsb.edu
TR 4:00-6:50 4431 South Hall

1. Overview

This course explores the use of sensor technologies for interactive environments/installations and responsive artwork/performance systems. Students will get an in-depth analysis of current technologies, and acquire experience that will allow them to research and develop custom sensor systems in their own work. It will introduce the principles and operation of many sensor techniques and discuss applications in gestural human-computer interfaces, new musical instruments, the visual and spatial arts, engineering, science, and other areas of interest. It covers the design of computer interface systems including analog/digital electronics and human factors/interaction styles. This is an applied theory course with laboratories and student projects which can potentially continue as independent research in following terms. Topics include:

- HCI design and microcontroller programming
- Analog-to-digital conversion and RF wireless systems
- Sensor applications and signal conditioning electronics
- Ergonomics, haptics, and emerging interface technologies
- Pressure, position, optical, inertial, capacitive, and ultrasonic sensing techniques
- Communication protocols, signal processing, feature extraction, and mapping schemes
- Output modalities will include interactive visuals, music/sound, and motion control

2. Objectives

The goal of this course is the application of sensor technology to areas such as new audiovisual interfaces, music/sound manipulation and spatialization systems, interactive installations/virtual environments, 2D/3D video and graphics interfaces and other innovative devices for interacting with and manipulating computer systems. It is expected that the course will lead to a completed prototype of some sort as a final project. A student who successfully completes this course will have experienced taking an original interface through a full cycle of design, prototype, evaluation and testing. The system demonstrated at the end of the term should explore the relation between a physical interaction and some kind of media, and is to be accompanied with a written report / web site describing the intent and an evaluation of the interface.

3. Research Questions

Technological breakthroughs in computation have impacted both art and engineering, opening up possibilities for expression far beyond those of previous generations. This has especially affected the way we think and produce, but in many cases has relegated user interaction to simple start/stop or point/click paradigms. The lack of connectivity between the real world and the digital world severely limits the amount of user interaction that is possible—this course therefore focuses on extending computer systems with novel real-time interfaces. It seeks to provide students with conceptual frameworks for thinking and technical skills for the production of new interactive systems.

- How to generate artistic expression from sensor interfaces?
- How to enhance the interactive experience with sensor-mediated content?
- How to control structure from free-form expression?

4. Environments

Media Interface Technology is intensely interdisciplinary: students from MAT, Arts, Music, CCS, Computer Science, and Engineering departments with interests in interaction design and new interface technologies are encouraged to take this course. Real-time computing environments such as Max/MSP/Jitter, Pd, SuperCollider, Processing, Lingo, Java, GameX, CSL, and C/C++ are useful tools for designing content for interactive systems—students should have experience in one of these or an equivalent.

5. Prerequisites

Instructor approval required; given the interdisciplinary nature of the class, students should have some programming skill and be prepared to absorb new information in a variety of areas. In addition, it would be good to have some experience in the following—if you do not have any of these but are interested, check with the instructor as it might be ok.

- introductory physics/electronics
- software design/programming experience
- basic mechanical experience/working with electronics tools (soldering, etc)
- familiarity with one of the real-time computing environments mentioned before
- basic object making or sculpture techniques/fabrication experience

Finally, bring your creative and artistic side. While a technical background is essential to build interfaces, some of the best ideas and intuitions come from the hours you spend with old-fashioned hand tools, musical instruments, drawing/painting/sculpting implements, and anything else where you've found the physical medium allows you some control over content that a keyboard and mouse doesn't.

6. Sensor Toolkit

For a \$30 lab fee, all necessary components are provided to build a microcontroller circuit board with a USB interface that will be used to connect a variety of sensors to the computer. Although some basic sensors will be included, students may wish to use additional sensors (accelerometers, bend sensors, air pressure, etc) that will need to be acquired individually (free samples or purchase online/Marvac/Radioshack). All other procurement of materials (eg. box or other object to house sensors, etc) is left to the imagination of the student/inventor.

7. Materials

Required — John Catsoulis: *Designing Embedded Hardware* (O'Reilly)

Additional — Dan Overholt: *Instructor handouts*

Supplementary — Horowitz & Hill: *The Art of Electronics* (Cambridge University Press)

8. Evaluation

This is a highly participatory and project-oriented course. Distribution of credit / grading policy:

20% Class Participation | 30% Homework / Exams | 50% Project

Class time will be made available for progress checks and consultation with the instructor. The project will be in place of a formal final exam—it will be evaluated as follows:

- 1/4 progress milestones
- 1/4 scope, execution and originality
- 1/4 quality of final presentation/demo
- 1/4 written report / web documentation

9. Syllabus (subject to change)

<p>Week 1</p> <p>Electronics 1 – Principles of Media Interface Technology</p> <p>Lecture/Lab: Intro, Overview / Get Lab kit with Components</p> <p>Readings: Instructor handouts, Designing Embedded Hardware, Ch. 1</p>
<p>Week 2</p> <p>Electronics 2 – Sensors and Signal Conditioning</p> <p>Lecture/Lab: Basic Electronics / Soldering and Hacking Skills</p> <p>Readings: Instructor handouts, Designing Embedded Hardware, Ch. 2-3</p>
<p>Week 3</p> <p>Electronics 3 – Digital and Analog I/O circuits</p> <p>Lecture/Lab: Sensing Methods / Construction of USB Microcontroller</p> <p>Readings: Instructor handouts, Designing Embedded Hardware, Ch. 4</p>
<p>Week 4</p> <p>Microcontrollers 1 - Connecting to the Computer</p> <p>Lecture/Lab: Signal Conditioning / Construction of USB Microcontroller</p> <p>Readings: Instructor handouts, Designing Embedded Hardware, Ch. 5-6</p>
<p>Week 5</p> <p>Microcontrollers 2 – Customizing the Embedded Design</p> <p>Lecture/Lab: Programming the PIC / Hooking up your Sensors</p> <p>Readings: Instructor handouts, Designing Embedded Hardware, Ch. 7-8</p>
<p>Week 6</p> <p>Projects 1 – Project Concepts and Initial Designs</p> <p>Lecture/Lab: Interaction Design / Project Ideas</p> <p>Readings: Instructor handouts, Designing Embedded Hardware, Ch. 11-12</p>
<p>Week 7</p> <p>Computer Interface – Using Sensor Data in your Application</p> <p>Lecture/Lab: USB HID Device Drivers / USB Device Enumeration</p> <p>Readings: Instructor handouts, Designing Embedded Hardware, Ch. 9-10</p>
<p>Week 8</p> <p>Projects 2 – Project Prototypes Due</p> <p>Lecture/Lab: Haptics and Ergonomics / Work on Projects</p> <p>Readings: Instructor handouts, Web sites</p>
<p>Week 9</p> <p>Projects 3 – Project Evaluation and Testing</p> <p>Lecture/Lab: Real-time Computing / Work on Projects</p> <p>Readings: Instructor handouts, Web sites</p>
<p>Week 10</p> <p>Projects 4 – Project Presentations</p> <p>Lecture/Lab: Wrap-Up and Turn in Report / Presentations, Demos</p> <p>Readings: Instructor handouts, Web sites</p>