Physical Computing

... in the broadest sense, means building active and interactive physical systems by the use of software and hardware that can sense and respond to the analog world.
Physical Computing

Devices and Systems
• Electronic
• Mechanical
• Active
• Interactive

Applications
• Visual Art
• Theater
• Performance
• New Media
What you will Learn

Practical Toolbox

- Basic electronics
- Basic electronic construction techniques
- Basic programming
  - Traditional, sequential, text-based
  - Ideal for standalone, embedded applications
  - Using the Arduino and a simplified C programming language
- Use of sensors and transducers
  - Electronics $\leftrightarrow$ physical world
- Introduction to MaxMSP
  - Graphical programming language ("virtual patch bay")
  - Running on a PC
  - Higher level media control
- New ways of interfacing to & interacting with computers/electronic media
What you will Learn

• Survey of electronic art
• Approach to Critical Design
• Work creatively in the medium of electronics
• Electronic systems and devices as an aesthetic/expressive medium
Course Format

• Hands-on
• Laboratory-based
• Syllabus/Schedule Flexible
  Depends upon your abilities, expectations, ideas
# Projects & Grading

**Grading**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance and participation</td>
<td>25%</td>
</tr>
<tr>
<td>Several short technical assignments</td>
<td>10%</td>
</tr>
<tr>
<td>Several short written assignments</td>
<td>10%</td>
</tr>
<tr>
<td>Project 1: The Object that Responds…</td>
<td>10%</td>
</tr>
<tr>
<td>Final Project Proposal/Prototype</td>
<td>10%</td>
</tr>
<tr>
<td>Project 2: Sensor Integration</td>
<td>10%</td>
</tr>
<tr>
<td>Final Project</td>
<td>25%</td>
</tr>
</tbody>
</table>

**Projects**

- Also flexible
- Active → Interactive → Expand/integrate
- Demonstrate technical proficiency
- Conceptual evolution
Materials & Texts

• **Getting Started with Arduino** by Massimo Banzi

• **Physical Computing: Sensing and Controlling the Physical World with Computers,**
  by Tom Igoe and Dan O’Sullivan. Thompson Course Technology. ISBN 1-59200-346-X.
  *Available online* through the TU library.

• **What's a Microcontroller?** by Andy Lindsay
  *Available online*: http://www.parallax.com/dl/docs/books/edu/wamv2_1.pdf

• Arduino Kit  http://www.adafruit.com/index.php?main_page=product_info&cPath=17&products_id=68
• Miscellaneous electronics
• Recommended: tool kit
What is a Computer

A programmable machine.

The two principal characteristics of a computer are:

• It responds to a set of instructions in a well-defined manner.
• It can execute a prerecorded list of instructions (a program).
What is a Computer

In general, computers incorporate the following hardware components:

• **memory**: Enables a computer to store data and programs.
• **input device(s)**: Usually a keyboard and mouse, the conduit through which data and instructions enter a computer.
• **output device(s)**: A display screen, printer, or other device that lets you see what the computer has accomplished.
• **central processing unit (CPU)**: The heart of the computer, this is the component that actually executes instructions.
How the computer sees us

The traditional “computer” interacts with the physical world in a very limited manner.
New Interface Paradigms

keyboard
Sensors

Computer

Transducers

monitor
What is a Microcontroller

• A (little) computer
  • memory
  • provisions for input
  • provisions for output
  • central processing unit (CPU)
• The Arduino
• Embedded
• Stand-alone
• Ubiquitous
• Ideal platform for interactive design
Physical Computing Architectures

sensor → microcontroller → transducer

sensor(s) → microcontroller(s) → computer → transducer(s)
Physical Computing Architectures

- sensor(s)
- transducer(s)
- microcontroller(s)
- computer
  - audio
  - video
Examples and Demo

- Survey of my work
  - Active
  - Interactive/embedded
  - Installation/environmental
- Mixed Body
“Evolution of Desire”
custom analog electronics
Handheld interactive device based on BasicStamp platform
“Supplemental Shrubbery Sound Source”
Assignment

Assignment for Thursday Jan 28th:

• Order Arduino Kit!  http://www.adafruit.com/index.php?main_page=product_info&cPath=17&products_id=68
• Complete survey
• Read *Physical Computing*, introduction and chapters 1-3
  (note info relating to specific microcontrollers and BASIC)
• Read soldering tutorial pp. 41-45 of *Physical Computing*.
• Review online soldering information available at:
  http://www.aaroncake.net/electronics/solder.htm
  http://itp.nyu.edu/physcomp/Tutorials/SolderingAPerfBoard

There is also a rather extensive video on soldering available at:
http://blog.makezine.com/archive/2007/01/soldering_tutor_1.html
Basic Electronic Toolkit for under $40

- Xacto knife
- Solder
- Solder sucker or desoldering braid [http://www.mpja.com/prodinfo.asp?number=0041+TL]
- Assorted screw drivers

Also useful:
- Hot melt glue gun
- miscellaneous pliers