INSTRUCTORS

• Paul Wright, ME
• Björn Hartmann, EECS
• Lab Manager:
  Mark Oehlberg (EE, UC Santa Cruz)
• 3D Printing guru:
  Dan Chapman, ME
GOAL OF THIS COURSE

You will learn how to design, prototype, fabricate and program **interactive devices** – physical products that sense user action or input and respond intelligently to it.
EXAMPLES
Nest Thermostat
Nest Thermostat

- PIR sensor (human presence)
- Hall effect sensor (?) for ring rotation + pushbutton
- Color LCD screen
- WiFi+ZigBee radios
- USB port
- Remote management via nest.com

Photos: N. Seidle, Sparkfun Nest Teardown
FitBit
FitBit

- Single pushbutton
- OLED display
- Accelerometer
- ANT radio to connect to base station
- Web-, app-review of data
Wireless Scales

- Weight, body mass
- Wifi
- Stats through web, phone app

FitBit Aria
TREND

Stand-alone electronic devices → Devices with associated apps
Phone/Tablet Accessories

WikiPad Game Controller
Phone Accessories

- Internal DSP
- Connect to phone to configure
- App store for e-pedals

iStomp
Phone Accessories

Scosche RDTX Radiation Monitor
Phone Accessories: Pebble

- Bluetooth to Phone, running Pebble App
- e-Paper display
- 4 pushbuttons
INTERACTIVE TOYS: TOPOBO

Robot construction toolkit
Hayes Raffle,
Amanda Parkes,
Hiroshi Ishii
MIT Media Lab

http://www.topobo.com/videos.html
INTERACTIVE TOYS: TOPOBO

Topobo Technology

- button
- red/green/orange LED
- 40 MHz microcontroller: memory & processing
- power distribution circuitry
- power/communications sockets
- servo motor
INTERACTIVE TOYS: SIFTEO
“...with a vibration motor for each finger, and a lightweight computing device such as an MP3 player or a smartphone. When instrumental music is played (such as piano or saxophone), the tactile glove vibrates the fingers to indicate which fingers play which notes. Thus with MMT, users can hear a song and feel it playing on their hands.”

Mobile Music Touch
Starner, Do, Weinberg et al, Georgia Tech
http://www.gtcmt.gatech.edu/research-projects/mobile-music-touch
Research

CapStones
Chan, Müller, Roudaut, Baudisch
CHI 2012
http://www.hpi.uni-potsdam.de/baudisch/projects/capstones.html
Research

Abracadabra: Harrison and Hudson, UIST 2009
http://www.chrisharrison.net/index.php/Research/Abracadabra
EXAMPLES FROM ME221
COURSE STRUCTURE

• First Half:
  – Many small projects to build up skills (individual, pairs)
  – Rapid pace: One assignment per week

• Second Half:
  – Design project in teams
PROJECT PARAMETERS

• **Must solve a real user need**
• **Must involve some custom electronics**
• **Must involve some custom 3D printed elements**
• **Should be either device+cloud or device+phone (wireless encouraged)**
FINDING USER NEEDS

You will go through a rapid product design process:

• Ideate
• Interview and observe target users
• Develop prototypes
• Obtain feedback from target users
• Iterate
COURSE INFO
HANDS-ON, SKILL-FOCUSED

• Electronics:
  – Breadboarding, Soldering, Circuit board design
  – Sensing and actuation circuits

• Software:
  – Embedded programming
  – Phone + web service programming
  – Wired + wireless networking

• Fabrication:
  – Laser cutting, foil cutting
  – 3D printing
PREREQUISITES

• **CS class:** You must have some programming experience and be able to learn new languages quickly *(we cannot teach you coding from scratch - take CS61a-c for that)*

• Learn lots of new tools and processes in a short amount of time

• Deal with open-ended design projects in groups

• Expect to spend long hours in lab
void displayDigit(byte value, boolean dp) {
  byte shiftData = 0;
  if (value <= 15) {
    shiftData = ledCharSet[value];
  }
  if (dp) {
    shiftData |= B10000000;
  }
  digitalWrite(LATCH, LOW);
  shiftOut(DATA, CLOCK,
           MSBFIRST, ~shiftData);
  digitalWrite(LATCH, HIGH);
}
WORKLOAD

• EECS classes usually have **a high workload** - this class is no exception.
  (Look at CS160, CS260 HKN reviews)
  (First semester grad students: you don’t know what “high” means yet).

• Expect to spend long hours on the weekly assignments.

• Bi-modal distribution: fast start and final sprint

• Hardware != software: Start assignments early. Machines break, parts need to be ordered, lab not open 24h: cannot keep work until last day.
ENROLLMENT

• This course has a **hard limit** of 30 students.
• We’ll make all admissions decisions by Wednesday.
• You **must** submit a petition by Wed 9am – even if you are already enrolled.
ENROLLMENT

• If you lack the programming background: don’t take this course.
• If you can’t commit to significant effort this semester: don’t take this course.
ADMINISTRIVIA

• Course web site: http://hci.berkeley.edu/devicedesign
• All Q&A happens through Piazza: https://piazza.com/#fall2012/cs29484
• Reading response submissions through Google Forms, linked from course web site
• No individual email. (Use individual messaging in Piazza instead; if anyone else in the class can benefit from the answer – ask publicly)
ACCESS TO READINGS

l: cs298

p: cs298Reading
WEEKLY OPTIONAL LABS

• Led by Mark Oehlberg
• Safe use of tools
• Take them if you’re rusty or new to a tool or process; or if you want to use a tool during open lab hours
SAFETY

• Mostly safe machines/tools – but it’s still possible to get hurt (burns, cuts, etc.)
• Your safety is your responsibility: you must sign waiver (and pay lab fee) before using the space.
• You must review safe operating procedures for each tool and sign that you’ve done this.
• Mark’s labs will provide the appropriate training. Web site will also have info.
BASIC SAFETY

• Wear eye protection, even with “safe” hand tools and soldering irons.
• No flip-flops, sandals
• If you use power tools, remove jewelry, loose fitting clothing, tie back hair (anything that can caught)
• Only use tools in intended manner
OPEN LAB HOURS

• Work on your assignments/projects
• We aim for Monday, Wednesday, Friday or MTF, 12pm-5pm.
• Details will be on Google Calendar on the course website.
• Show of hands: who can/cannot make these times?
GRADING

• 40% Homework Assignments
• 40% Class Project
• 10% Reading Responses
• 10% Participation
  (attendance, in class, on Piazza)
LATE POLICY

• Reading responses by 9am on day of class, or no credit
• 10% penalty per day of late submission for homeworks (including weekends)
• No late submission of group project assignments
PERSONAL KIT

Consider getting a personal kit that will allow you to work outside class:

– Design notebook: to keep all your ideas
– Safety: your own safety glasses
– Soldering: iron & solder, flush cutters + pliers
– Cutting: Xacto, cutting mat, metal ruler
FOR WEDNESDAY

• Submit class **petition by 9am**
• Submit **reading response by 9am**
• **Lab Fee**: Bring check over $75 made out to UC Regents
• Sign **Waiver of Liability**
ENTRY SURVEY

CS294-84 Interactive Device Design - Entry Survey - Fall 2012

Everyone in the class, whether you are enrolled or on the waitlist, must submit the following survey by the end of the first week of class meetings. We will use the information to determine which students are admitted to the class. By answering the questions now, before the class starts, you’ll help us with course planning.

* Required

Name *

Preferred email address: *

Degree program at Berkeley *

- EECS PhD
- EECS MS/MEng
- EECS Undergraduate
- ME PhD
- ME MS/MEng
Reading Responses

Q1

\[ R_T = ? \]

Q2

\[ V_{in} = 5V \quad V_{out} = ? \quad \text{GND} \]

Q3

\[ C_1 = 10 \mu F \quad C_2 = 1 \text{mF} \]

\[ C_T = ? \]

Made with Fritzing.org
Check

Aug 29, 2012

PAY TO THE ORDER OF: UC Regents

Seventy five and 00/100

DOLLARS: $ 75.00

FOR: CS294-84 Lab Fee

1936
WAIVER

UNIVERSITY OF CALIFORNIA, Berkeley
CITRIS Invention Lab

Waiver of Liability, Assumption of Risk, and Indemnity Agreement

Waiver: In consideration of permission to use, today and on all future dates, the property, facilities, staff, equipment and services of CITRIS Invention Lab, I, for myself, my heirs, personal representatives or assigns, do hereby release, waive, discharge, and covenant not to sue The Regents of the University of California, its directors, officers, employees, and agents from liability from any and all claims including the negligence of CITRIS Invention Lab resulting in personal injury, accidents or illnesses (including death), and property loss arising from, but not limited to, participation in activities, classes, observation, and use of facilities, premises, or equipment.

Signature of User

Assumption of Risks: This use of University property, facilities, staff, equipment, and/or services carries with it certain inherent risks that cannot be eliminated regardless of the care taken to avoid injuries. CITRIS Invention Lab has facilities for and provides for activities such as hand and power tools and other shop equipment. Some of these involve situations, environments, or activities that may lead to illness, physical injuries, and psychological stress or damage.

The specific risks vary from one activity to another, but the risks range from 1) minor injuries such as scratches, bruises, sprains, and embarrassment 2) major injuries such as joint or back injuries, heart attacks, head injuries, and psychological trauma 3) catastrophic injuries including paralysis and death.

I have read the previous paragraphs and I know, understand, and appreciate these and other risks that are inherent in the activities made possible by CITRIS Invention Lab. I hereby assert that my participation is voluntary and that I knowingly assume all such risks.

Indemnification and Hold Harmless: I also agree to INDEMNIFY AND HOLD The Regents of the University of California HARMLESS from any and all claims, actions, suits, procedures, costs, expenses, damages, and liabilities, including attorney’s fees brought as a result of my involvement at CITRIS Invention Lab and to reimburse them for any such expenses incurred.

Severability: The undersigned further expressly agrees that the foregoing waiver and assumption of risks agreement is intended to be as broad and inclusive as is permitted by the law of the State of California and that if any portion thereof is held invalid, it is agreed that the balance shall, notwithstanding, continue in full legal force and effect.

Acknowledgment of Understanding: I have read this waiver of liability, assumption of risk, and indemnity agreement, fully understand its terms, and understand that I am giving up substantial rights, including my right to sue. I acknowledge that I am signing the agreement freely and voluntarily, and intend by my signature to be a complete and unconditional release of all liability to the greatest extent allowed by law.

Signature of User

Date
FOR WEDNESDAY

Schedule

This is a new class - expect this schedule to change as we progress through the semester.

Week 1

M, Aug 27: Introduction

Assignment: Entry Survey / Course Petition due by 9am on Wednesday Aug 29
Assignment: Reading response due by 9am on Wednesday Aug 29
Assignment: Bring $75 check for lab fee to Wednesday's class, payable to UC Regents
Assignment: Read and sign Waiver of Liability, Assumption of Risk, and Indemnity Agreement and bring to Wednesday's class

W, Aug 29: Electronics and Microcontrollers 101

Reading: Review Material from F. Mims III, Getting Started in Electronics, p. 8, 9, 14, 18-19, 20-21, 28-31, 32-35.
Due: Entry Survey / Course Petition
Due: Reading response
Due: Bring $75 check for lab fee to class, payable to UC Regents
Due: Read and sign Waiver of Liability, Assumption of Risk, and Indemnity Agreement and bring to class

Assignment HW 1 - Microcontroller Kit due Wed, Sep 5

Lab: Soldering Lab time TBD, likely directly after class on Wed
NEXT CLASS

- Review of high-school-level electronics
- Introduction to microcontrollers
- Pick up your microcontroller kit (HW 1)