Cornell University | Human Centered Design | Syllabus

DEA 5210: Interaction Design | course site
- **Tuesday and Thursday, 1:25-4:25pm**
- **HEB 2L32 "Assembly Room" next to the shop**
- **4 credits - letter grade only**

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NOTE: The most current and complete documentation for this course is found online at
https://arl.human.cornell.edu/DEA5210%20IxD%20studio.htm
This pdf is for basic information; some aspects (e.g., assignment topics) may not be current.

COURSE DESCRIPTION The built environment made interactive and adaptive by embedded computation has great promise to support and augment us at work, school, and home, as we roam, play, interconnect, and age. Students will iteratively design, prototype, and evaluate artful, meticulous, physical objects and environments responsive to specific challenges of an increasingly digital society.

PREREQUISITES | ENROLLMENT
- *All students require professor's permission.*
- **Preference is given to** student-majors in HCD, IS, and MAE, and students enrolled in the Robotics Minor. Students from other majors are welcomed as space permits.
- Enrollment is limited to **twelve students** to make full use of the D2FS, the digital and manual fabrication shop and staff located across the corridor from our teaching space.
- This course is for 4 credits, for letter grade only. There is no final exam.

LEARNING OUTCOMES----------

Interaction Design Studio aims to cultivate new vocabularies of design and new, complex realms of understanding towards realizing artifacts and systems responsive to people and the planet. Three learning outcomes are expected of this course.

Outcome 1: To grapple with under-constrained, "wicked" problems and opportunities of living today and in the future.

Outcome 2: To identify design opportunities that may prove responsive to these problems and opportunities.

Outcome 3: To design and prototype interactive devices - physical prototypes at full scale - responsive to these problems and opportunities.

STUDIO CULTURE----------
DEA 5210 is not a formal course in mechatronics but instead a design studio. In a design studio, class time is dedicated to:

(a) students working in class and outside class on assigned projects with guidance from the instructors.

(b) students presenting periodic status reports on and demos of their developing projects.

(c) students offering their design critiques of developing projects accomplished by other students. Students with no coding or electronics experience have done well in this course. The Grove hardware kit components make "physical computing" accessible to the novice who is willing to "roll up the sleeves" and work at it.

This course is foremost focused on "thinking big" and "thinking different" about designing interactive and adaptive systems that enable and augment people. It expects that you - with the best information you can acquire, and with your most intensive and exploratory effort - develop compelling, meticulously conceived and crafted interactive, physical things responsive to challenges and opportunities of living. Given this ambition, I ask that you to take responsibility for your education by attending class, participating, and submitting and presenting assignments that advance thinking in the field.

CLASS ORGANIZATION

A key objective for this Interaction Design (IxD) Studio course is to have every student in the class design not only their project *but every project in the class*. *How?* By benefiting from various inputs:

- *Once per week*, you will present a brief update on your developing project, noting what you did in the past week, and why you did it. You can upload slides to our shared folder, ahead of class, and/or show us a developing artifact.
- *Once per week*, you will select a peer who will be your critique partner for the class session. Confer with your partner at least once during that class.
- You will benefit from informal exchanges with peers.
- You will deliver formal presentations at designated milestones throughout the semester.
- You will advance your project through "desk crits" with the professor and TAs.
- You will consult with D2FS staff on fabricating your project.
- You will review and respond to critique and grades.
  —and perhaps most critically—
- You will offer design critiques of developing projects accomplished by other students, for which you will be graded as part of your participation grade (see below).

INTERACTIVE ARTIFACTS / EXAMPLES

• Student examples on this page, left-column.
• A classic example: musicBottles (Hiroshi Isshi, Tangible Media Lab, MIT).
• The lovebox, a simple, meaningful, whimsical product.
• ixD examples from the ACM "Demo Hour" *of Interactions*.
• You might also find inspiration in projects presented in MAKE and Instructables.

READINGS

There are no assigned readings for this course, but the readings listed below lay an intellectual foundation for what we do in this studio.
• Paul Dourish. Embodied Interaction. MIT Press, 2001.
• Steve Dow. Wizard of Oz Interfaces [WOZ].
• Jen Golbeck. Back off, man. I'm a scientist.'Using Fiction to Teach Beginners HCI.
• E. Grönvall, et al. Causing commotion with a shape-changing bench.
• Kristina Höök. Affective Interaction.

• Hiroshi Ishii. Tangible Bits and Radical Atoms: Beyond Tangible Bits.
• Bruce Mau. An Incomplete Manifesto for Growth.
• John McCarthy and Peter Wright. Technology as Experience. MIT Press, 2004.
• William J. Mitchell. Computers for Living In, from *e-topia*. MIT Press, 1999.
• Nicholas Negroponte. Soft Architecture Machines. MIT Press, 1970.
• Richard Picard. Affective Computing. MIT Press, 1997.
• Terry Winograd. From Computing Machinery to Interaction Design.

M A T E R I A L S N E E D E D -

You will be provided the following in class:

- 1 Grove Beginner Kit for Arduino ($23.88 from Mouser).
- 1 Grove Servo ($6.90 from Mouser).
- 1 Grove Ultrasonic Sensor ($4.30 from Mouser).
- 1 Grove Gesture Sensor ($10.99 from Mouser).
- 1 Grove RGB LED Stick (15-WS2813 Mini; $5.40 from Mouser).
- 1 Grove Switch ($3.20 from Mouser).
- 1 USB Battery Pack - 2200 mAh Capacity - 5V 1A Output ($14.95 from Adafruit).
- Panels (pre-cut) to make an enclosure for your assignment-1. If you need a different size enclosure, you can work with D2FS on laser-cutting panels to-size from digital files you generate using CaseMaker.

You will need in class:

- Your laptop. You need your laptop in class, every class session. If your laptop is not equipped with a port to plug in a USB-A cable (that comes with the Grove Kit), then you need a USB-C hub (here's one) that plugs into your laptop's port and provides a USB-A port. Newer Mac laptops need this USB-C hub, as Macs no longer have USB-A ports on them.

You may also need:

- 1 sketchbook like this one or a comparable one found in our bookstore.
- Fabrication materials for early, rapid prototyping. These include: cardboard from shipping boxes, plastic from fruit and vegetable containers, and craft materials needed to construct your prototypes. Many of these materials you have already, at no-cost; other materials are available from the Cornell Bookstore, Michael's at the Ithaca Mall, and online at Utrecht, Blick, and Amazon.
- Fabrication materials (as needed) for high-fidelity prototyping:

  • Coroplast corrugated plastic is easy to work with and low-cost. I like the colorless, translucent finish found on eBay via Duco Plastics.
  • Honeycomb cardboard is inexpensive and rigid enough to build furniture from it.
  • Acrylic sheets and other plastics are available online from TAP Plastics (cut to your size with reasonable precision) and from ePlastics (cut to size, less expensive than TAP, but less control over cutting dimensions and multiple cuts).
  • Cut2Size Metals.
  • Aluminum Composite Material (ACM) as in the red entry of HEB as well as my LIT ROOM project; available locally (in Syracuse) from Polymershapes, contact Kevin Passerell.

- Additional Grove components available from Mouser electronics with competitive pricing and quick shipping. Grove components are also available from Amazon (often at a higher price), from DigiKey, from other vendors listed on this page, below, and from its manufacturer, Seeed Studio, which ships from its US warehouse.
- An inexpensive book on human-centered design methods: *The Pocket Universal Methods of Design: 100 Ways to Research Complex Problems,...* available from the Cornell Bookstore and from Amazon. Do not purchase the similarly titled, *The Pocket Universal Principles of Design: 150 Essential....*
- If you don't have access to video editing software: try Open Shop, a free video editing app for windows https://www.openshot.org/. And if you don't have Adobe suite, try Canva (free 30-day trial) and Paint.net.

SCHEDULE BY WEEK----------

NOTE: We will also do D2FS shop training to learn how to use the basic power tools safely. *Please come to this training session with close-toe shoes (no sandals)* and something to tie-back long hair if you have long hair!

Week 01.22 | Course Intro | Assignment-1 Intro; Project Framing & User Research

Week 01.29 | Ideation; Conceptual Design

Week 02.05 | Detail Design; Evaluation

Week 02.12 | Assignment-2 Intro; Conceptual and Detail Design

Week 02.19 | Detail Design; Evaluation

Week 02.26 | DEMOS and SCREENINGS | *Cornell Break Tuesday*

Week 03.04 | Assignment-3 Intro; Individual proposals; Form Teams

Week 03.11 | Storyboard; Prototype Development as a GIF or ? (Team Effort hereon)

Week 03.18 | Prototype Development > early DEMO and Scenario

Week 03.25 | Prototype Development > Role Playing *with a Think Aloud*

Week 04.01 | *Cornell Break*

Week 04.08 | Prototype & Video Iteration > hardware system DEMO

Week 04.15 | Prototype & Video Iteration > Think Aloud > DEMO

Week 04.22 | Prototype & Video Iteration > UX Survey / SUS (how to score) > DEMO

Week 04.29 | Prototype & video iteration > DEMO; Course and Peer Evaluation

Final Class 05.06 | DEMOS and SCREENINGS | *last class Tuesday*

DEADLINE: tbd
Upload all requirements to our shared folder for grading *by date/time announced each semester by Cornell U. Registrar as offered* here.

A S S I G N M E N T S -

There are three assignments for this course.

The first two assignments, undertaken by each student, are intended to be fast-paced. The third assignment is undertaken by teams of 2-4 students and provides a longer, deeper development of the design. Team composition for the second assignment will be formed by the instructor(s) based partly on proposals pitched in class by class members.

Assignment-1 | Sensory Design for Children with ASD
(30% of your course grade; individual effort; grade based on quality of the prototype)

Sensory design activates touch, sound, smell, taste, and the wisdom of the body. Sensory design supports everyone's opportunity to receive information, explore the world, and experience joy, wonder, and social connections, regardless of our sensory abilities [1].

For Assignment-1, use the Grove kit and modules provided to develop an interactive, physical device at a small physical scale that responds to the needs of children with Autism Spectrum Disorder (ASD), taking into account their sensorial characteristics. Use any Grove input and output provided; embed these modules and the provided rechargeable battery within the corrugated plastic enclosure provided, which you may perforate, cut into, add on to, inscribe on, paint, or otherwise manipulate.
To prepare for this design challenge, review here slides about ASD on how the sensorial characteristics of children with ASD differ from their typically-developing peers. From the same slides, choose 1-2 needs from those considered and 1 sensorial profile (i.e., *hypersensitivity* or *hyposensitivity*). Then, following the (numbered) design phases that follow, use any methods and tools listed under each of the headings to develop a device responsive to the need(s) and profile you selected.

Project Framing & User Research
• 5 "Why"s
• Golden Circle
• Scenario
• Storyboard
• Empathy Map

Ideation
• Mind mapping
• Brainwriting diagram
• Mood Boards
• "What if …"
• Animated GIF

Conceptual & Detail Design
• Morphological Chart

• Think-Aloud
• Delphi Method
• Use-case diagram
Evaluation
• Usability Study - SUS
• Virtues and Flaws

The kind of artifact we are striving for is small in scale, playful, attractive, interactive in simple ways, and meaningful/purposeful. The brief specification above is sufficient for achieving a compelling design, fully meeting expectations for this course. Likewise, you do not have to generate code on your own: you can select one of the codes provided under the heading below, "Arduino Codes You Can Copy & Paste." (An effective way to tailor your code to your wants without coding experience is to use ChatGPT as described below.) However, you may also pursue the following options as time constraints and your abilities permit:

- You may use an Arduino board and breadboard in place of the Grove system.
- You may integrate a hacked device (e.g., a toy, a camera), any technological approach (e.g., machine learning, computer vision, AR), and any other hardware modules – Grove or otherwise Arduino-compatible.
- You may create a different enclosure for your design than that provided (For this, you may benefit from using CaseMaker to generate digital files and working with the staff of D2FS to fabricate from them.)

Assignment-2 | Sensory Design for Children with ASD
(30% of your course grade; individual effort; grade based on quality of the prototype)

For Assignment-2, you will repeat Assignment-1 but this time apply the AuSENS method and tools specifically developed to support the activity of sensorial designing for children with autism. The AuSENS method and tools considers the specific sensorial profiles: *hypersensitivity* and *hyposensitivity*. A [link] to the AuSENS materials will be shared only at the start of Assignment-2 to avoid interference with your work for Assigment-1.

For Assignment-2, you will maintain the work you did for the first two design phases of Assignment-1 (i.e., 1. *Project Framing & User Research*; 2. *Ideation*), but this time, you will *Conceptual & Detail Design* and conduct the *Evaluation* applying the AuSENS method and tools.

Assignment-3 | Sensory Design for the International Space Station
(30% of the course grade; group effort; grade based on a video and written report)

Inspired by the work of the first two assignments, for this third and last assignment, design an interactive device at a small physical scale responsive to the challenges of those inhabiting the International Space Station. You do not have to limit yourselves to the broader sensorial challenges in space (described, e.g., by NASA and by the Canadian Space Agency for smell, sight, taste, hearing, touch); your device might instead respond to a specific activity in space made challenging by such sensory issues, such as accomplishing a practical task, or interacting effectively with those sharing the spacecraft or with loved ones on Earth, or detecting situations that might jeopardize objectives or otherwise cause harm or damage aboard the spacecraft. For more insight into the sensory challenges of living on the International Space Station, you're encouraged to read Samantha Harvey's recent novel,

Orbital. For Assignment-3, you are permitted to use any methods, tools, and means to arrive at the final working prototype.

G R A D I N G / G R A D I N G R U B R I C -

Please review carefully the *POLICIES* found in the narrower column on the left-side of this page. These policies are not negotiable except under grave circumstances.

Throughout this course—an intimate and intensive "conversation" across students and the professor—students will have ample opportunity to receive feedback on their work. Here is my grading rubric for the two major assignments.

The list that follows names and describes the graded components for this course. Each component is worth so many points, as shown in red type. The sum of all of these components equals the final grade of 100 points. The numerical scale for grading is as follows: A+ (98–100), A (93–97), A- (90–92), B+ (88–89), B (83–87), B- (80–82), C+ (78–79), C (73–77), C- (70–72), D+ (68–69), D (65–67), D- (below 65).

(10 points) Attendance, Participation.

- An attendance sheet must be signed by you in the first ten minutes of class for you to be counted as present. If you expect to be later than 10 minutes on a given day, or if you will be absent, email both the professor and the TAs ahead of the class session with the cause for your late arrival or absence; these will be considered as a valid excuse or not. To assess participation during class, names may be pulled "from a hat" to identify student critics who will then peer-review the developing work accomplished by other students; the quality of the student critique will form part of the 10 point assessment.

(30 points) Assignment-1 [rubric]

- **PROTOTYPE at 1:1 scale** (full-sized), made interactive by way of sensors and actuators to create combinations of movement, lighting, displays, and/or sound.

(30 points) Assignment-2 [rubric]

- **PROTOTYPE at 1:1 scale** (full-sized), made interactive by way of sensors and actuators to create combinations of movement, lighting, displays, and/or sound.

(30 points) Assignment-3 [rubric]

- **PROTOTYPE at 1:1 scale** (full-sized), made interactive by way of sensors and actuators to create combinations of movement, lighting, displays, and/or sound.
- **VIDEO** [my guide] communicates a full, cohesive story of your designed, interactive artifact, answering *why*, *for whom*, *where,* and *for what purpose.* Upload to our shared folder an MP4 file reduced to < 30MB using, e.g., Handbrake (see my video guide). In your Documentation, include a URL link to your video uploaded to Vimeo or YouTube. The video will otherwise adhere to the requirements for a Video Showcase submission to the ACM conference, CHI, a benchmark for design research. (Videos from a previous Video Showcase.)
  Video tip: For your video, you may want to add a remote environment (e.g., the interior of the International Space Station) as the physical context; however, such an environment may not be readily accessible to you. An easy strategy for adding this physical context is as follows: video record your working prototype (with "actors" or scale figures of people if your prototype is to-scale) in front of a white wall; then, in Zoom, add your background context photo (i.e.,, a photo of the ...) as a "virtual background" and "record" your screen.
- **DOCUMENTATION of your design**, in the form of a written report (pdf), that includes every aspect listed in my grading rubric. Upload your documentation to our shared drive as a print quality pdf

document. These examples from previous classes are model reports (1, 2, 3, 4) but they may not contain every requirement in my linked grading rubric. My grading rubric offers the most current expectation for documenting your design.

COURSE POLICIES

No exceptions but for the gravest circumstances, documented.

P1. Come to class. You might discover something.

Unlike a large lecture course, this course is about:

- case study videos
- discussions of previous student examples
- critiques by the professor, TA, and student-peers of developing student work
- answers to student questions
- guest visits

When you miss a class, you miss these rich classroom experiences and fail to share your work and your voice to benefit yourself and your peers. Come to class, undistracted: you might be surprised to discover something important here. In design, we work together.

(If you need help with academic advising or mental health, please make use of the resources available on campus as described in this guide to Cornell Mental Health Resources.)

P2. Follow instructions for the assignments.

Follow instructions carefully for all assignments. Failure to abide by the instructions for any assignment will lower your grade for that assignment.

P3. Get the file format right.

Your submitted work must be submitted in the format stated on the course page for each assignment. Digital files and URLs (e.g., links to videos) must be accessible, without us requesting access-privileges. *Google Docs are never acceptable.* 3 points (of the 100 points total for the semester grade) will be deducted from *each assignment* that does not comply.

P4. Extensions will be granted, but only for grave circumstances.

If you need an extension for any assignment, email both the instructor and the TA (if there is one) *ahead* of the due date and make a case for your extension, attaching evidence when available. Extensions may be granted for illness, injury, or family emergency requiring your travel. No extension will be granted because work is due for other classes, or because you are traveling for a non-emergency. Don't even ask.

P5. If you want a high grade, match or better the quality of the best previous work.

The course page for this course offers student examples of "best work" from previous semesters. Your work will be evaluated relative to these "best work" examples when available. If you disagree with a grade for any work in this course, make a case for reconsideration in an email both to the instructor and the TA (if there is one). *Why does your work merit a better grade?* Do not ask for reconsideration during, before, or after a class session; your request must be submitted in writing by email. And if you ask for reconsideration of a grade for an assignment, you grant the instructor and the TA permission to reconsider your grade for any part of that assignment, which may result in a better grade, no change of grade, or lowering of the grade.