

Spatial UX

a user experience course for spatial interactions

Fall 2023 Thurs 11a-1p
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Background

Spatial UX is the user experience guide to the physical world beyond the screen. From gesture, speech, audio, projection mapping, smart homes, and even interactions on the web, Spatial UX will guide you through how to think about user experiences in the real world. You will learn to create designs based on the context of location, proximity, scale, and social contexts. The course provides a conceptual framework for thinking about user experience spatially, but also provides the technical how-to, to make these experiences quickly realized with a suite of low code tools.

This course will expose you to the latest techniques and technologies for designing experiences beyond the screen (such as large language models for speech and live camera image recognition, gesture recognition, and Unity spatial mapping). Even more importantly it will provide a quick start to prototyping spatial user experiences in the real world stringing together hardware and softwares that don't typically talk to one another.

This is a must for anyone who's serious about making embodied interactions in our real world beyond phone and computer screens.

Computing is fundamentally physical. Electrons move through circuits, servers require infrastructure and power, and even digital applications on the internet impact movement, behavior and changes in our physical world. While we typically think of today's technologies as 2-D, this course will push you to develop interactions in the physical world, drawing on the physical nature of our world: 3 dimensions, the senses, materiality, physical affordances and even in-person social dynamics.

In this course, you will investigate the spatial and tangible potential of digital connectivity. We'll design interactions beyond the screen using social experiences and spatial interfaces. We'll critically consider the impacts and externalities of these technologies. What cultural defaults are encoded in our designs? Who are they designed for and who do they, typically

unintentionally, exclude? You will gain hands-on experience with hardware and software, and will gain comfort with designing the network architecture necessary to integrate and coordinate eclectic technologies which may not typically speak to one another. You will interrogate methods from **physical computing** and **user experience**; use hardware (sensors, microprocessors, computer vision cameras, smart home products), software (OpenAI, ChatGPT, IFTTT and Processing).

The Future of Spatial UX

Since the first personal computer in the 70's, technology and user experience design has been reshaping the lives of individuals and even the behavior of societies. Today you'd be hard pressed to meet a technology user that didn't experience its ailments: screen fatigue, digital overload, reality disconnection, loneliness.

- Why does user experience design still require “toothpick navigation” picking dropdown menus from little buttons on a screen?
- Why do we create computer interfaces that represent things in the physical world, vs just interacting directly with that world?
- Why do we design user experiences devoid of context about where you are at, who you are with, and what activity someone might be doing?

We're at a particularly interesting time for user experience design. Interactions have the increasing potential to be spatially contextual and embodied in the environment using the spatial, tangible, and impromptu potential of web connectivity. The recent emergence of low-code tools and LLMs are making it easier than ever to string together, design, and prototype these physical technologies.

ChatGPT (typically constrained within single interfaces like a chat app) can now be used to create rich coordinated experiences across multiple applications and with the physical world (smart home cameras, door locks, etc.). Meaning UX needs to go beyond the screen to understand the spaces and environments in which such coordinated experiences take place and to ensure they're indeed coordinated.

Other emerging technologies such as Apple's VisionPro point to greater focus on digital interactions that take place in the context of the physical world. The field of user experience now must evolve to the physical and spatial context of the world which architects have learned to grapple with over centuries.

Spatial UX aims to heighten our connection to the physical world and each other by designing digital interactions beyond the screen: with social experiences and spatial interfaces, designing interactions that engage the five senses and all three dimensions.

Social ~~User~~ Experiences
Spatial ~~User~~ Interfaces

But emerging technologies like ChatGPT and VisionPro don't always paint a clear picture of where the future will *actually* go, or more importantly where it *should* go. Thus we'll aim to ground our speculation with both criticality and computing fundamentals. By iterating with these emerging technologies, you'll start to develop your own opinions on what physical computing should look like 20 years from now.

Course Expectations

1. **Be brave!**

This class is for you, not for me. Be courageous in addressing the problems you care most about, rather than trying to fulfill the assignment. This course requires a tolerance for ambiguity, a tolerance for assignments that have more than one possible answer and a willingness to go outside of your comfort zone. Addressing the uncertainty and ambiguous problems is as key to this class as it is to design and entrepreneurship in emerging fields like spatial ux.

2. **You'll get out what you put into it**

Learning in this course requires engaging with the material, trying things that haven't been tried, adjusting, and trying again. The more you put in, the more you will get out of this course.

3. **Computers for work and not distraction**

I will sometimes ask for you to completely put away computers and phones. Participation in discussions and in-class activities is critical to your learning and the dynamics of the class.

Course Goals

Push forward the field of Spatial UX.

Understand user experience as it exists today and the emerging technologies that allow for spatial experiences. Recognize yourself as active participants in defining where that future of technology heads and be critical of the status quo.

↑ Develop technical capabilities.

Understand and explore techniques embedding and programming sensors and actuators (smart home products) in the built environment. Combine disparate methods and tools in innovative ways to create new interventions in the physical world. While you won't exit this as fluent software engineers, you should have a good sense of how to hack together prototypes that allow you to read and write in the world and know where to access resources (e.g. StackOverflow, Google, GPT, pseudo-coding) to break down a technical problem and think through various methods to solve it. Activities will include workshops, tutorials, live help sessions, lectures, technical prototyping, and demos.

↑ Take a user-centric perspective

Consistently start with intentions and ideas rather than tools or methods. Identify issues to address, articulate problems to solve, develop hypotheses to test, identify assumptions to validate, and engage audiences to serve.

Assignments

All journals should be added to your own journal [slide deck in this folder](#).
(sign in with columbia email)

	Chapter 1 Technical Foundation
WEEKLY JOURNAL	<u>tutorials + response</u> weekly You will employ the survey of physical computing methods through tutorials, and then apply them to a specific use case individually. Each application should be documented through video or gif. Highlight how this application is better than an online interaction and how it is worse.

	Chapter 2 Conceptual Explorations
WEEKLY JOURNAL	<u>reading + responses</u> weekly You will keep record of your weekly tutorials and reading responses in a slide deck. For the first half of the semester this will be ideas related to readings. After reading, capture at least “1 good idea” you had per each reading. These could be short bulleted sentences or longer form writing. Responses should not be reading summaries, rather your own ideas! These are sketch ideas, so don’t aim for perfect but ensure your reader (me) can understand them. The goal is to actively be thinking and critical while reading.
PROJECTS	Project DUE Final Review <u>Spatial Interface</u> This is a three part project geared at leveraging the affordances of what our material world and digital interactions do well, learning to borrow capabilities from each, and leave behind the short-comings of each medium. Part 1 - Critique a digital UX Part 2 - Design a spatial interface Part 3 - Design a generalizable tangible control at 3 scales or a “place-chameleon” Part 4 - Unintended Externalities Develop a vision video, arguing for actions that combat future externalities of trends in UX and Spatial UX

USE CASES IN PHYSICAL COMPUTING

1. **Home Automation:** Smart devices for comfort and security
2. **Personal Health Monitoring:** Wearables and biometric sensors
3. **Assistive Technologies:** Devices for accessibility and disability
4. **Elder Care:** Technologies for aging in place
5. **Education:** Interactive educational tools and toys
6. **Workplace Productivity:** Automation in office, hybrid, and remote work
7. **Industrial Automation:** Robotic systems in manufacturing
8. **Environmental Monitoring:** IoT for climate and pollution tracking
9. **Smart Cities:** Infrastructure monitoring and optimization
10. **Retail and Hospitality:** Customer experience enhancement in physical spaces
11. **Environmental Wellness:** Calm computing and methods to improve environments
12. **Public Installations/Art:** Interactive displays for community engagement

GUEST LECTURES

Sep 14	Lauren Bedal , Google, Design Lead & Choreographer HCI R&D Spatial & Embodied Interfaces
Sep 21	Leticia Izquierdo , MIT City Science
Oct 12	Charlie Miller , Brookfield, Digital Real Estate Leader
Oct 19	Taylor Urbshott , Meta, World Building
Oct 26	Eric Baczuk , Google, Project Starline
Nov 2	Radhakrishnan T R & Vishal Vaidhayanathan LLMs for Space, Spatial Grammars

Course Schedule

Chapter 1

Technical Foundation

Week Date	Class	Homework <i>All Journals due prior to following class</i>
1 7-Sep	Network Architecture Cybernetics: goals, sensors and actuators Affordances of digital and physical systems Cultural “Defaults” Low Code: working with microservices like IFTTT, end user programming	Journal: INTRO (added to your journal slide deck) 1. P5 - Getting Started 2. Programming with ChatGPT
2 14-Sep	Physical Interfaces *** Lauren Bedal, Google, Design Lead & Choreographer, HCI R&D Spatial & Embodied Interfaces *** What is an interface? Hardware Overview: <ul style="list-style-type: none">• Sight: Cameras, Motion Sensors, Image Sensors, Light, Projectors, AR/VR Displays.• Hearing: Microphones, Sound Sensors, Speakers, Buzzers• Touch: Tactile Sensors, Accelerometers, Gyroscopes, GPS, Occupancy Sensors, Thermometers, Infrared Sensors, Motors, Levers, Vibration, Heating/Cooling	Journal: APIs & Microservices 1. IFTTT - Getting Started 2. Webhooks: Connecting IFTTT and Processing
3 21-Sep	Distance	Journal: Speech 1. Speech: Voiceflow + ChatGPT
4 28-Sep	technical sound demo Intent based UX	Journal: Sounds Project 1: Spatial Interface <i>Part 1 - Critique a digital UX</i>
5 5-Oct	MIDTERM Grading of Good Ideas Journal (technical tutorials) Presentation start to Spatial Interface (pairs)	Project 1: Spatial Interface <i>Part 1 - Critique a digital UX</i> <u>DIAGRAMMING WORKSHOP</u>

Chapter 2

Conceptual Explorations

Week Date	Class	
6 12-Oct	<p>AI + UX = Real World Computing</p> <p>***</p> <p>Charlie Miller, Brookfield, Digital Real Estate Company, Real Estate Tech & Innovation Leader</p> <p>***</p> <p>The Future of UX and how AI enables real world interactions...continued</p> <p>Intro Spatial Interface Project, PART 2 Design a spatial interface</p>	<p><u>Project 1: Spatial Interface</u></p> <p><i>Part 2 - Design a spatial interface</i></p> <p>Journal:</p> <ul style="list-style-type: none"> • Computer for the 21st Century, Mark Weiser [link] • Norman, Design of Everyday Things, ch. 1 [link] • Spatial Computing, Simon Greenwald p10-19 [link] • A Brief Rant on the Future of Interaction Design, Bret Victor [link]
7 19-Oct	<p>***</p> <p>Taylor Urbshott, Meta, World Building</p> <p>***</p> <p>Unpacking & Defining Defaults</p> <p>Politics & Bias</p> <p>Race, gender, class and culture in technologies</p> <p>Optimization & personal assistants</p> <p>Discussion unpacking “defaults”</p>	<p><u>Project 1: Spatial Interface</u></p> <p><i>Part 2 - Design a spatial interface</i></p> <p>Journal:</p> <ul style="list-style-type: none"> • Timo Arnall on the fallacy of invisible interfaces, [link] • Hidden Interfaces for Ambient Computing, Alex Olwal [link] • Performative Materiality and Theoretical Approaches to Interface, Johanna Drucker [link]
8 26-Oct	<p>Materiality</p> <p>***</p> <p>Eric Baczuk, Google, Project Starline</p> <p>***</p> <p>Leveraging the physicality of the real world</p> <p>Bodily capabilities: ergonomics and gesture</p>	<p><u>Project 1: Spatial Interface</u></p> <p><i>Part 2 - Design a spatial interface continued (technical execution)</i></p> <p><u>Technical Execution of your project</u></p> <p><u>Please follow my technical guidance for your group</u></p>

9 2-Nov	WORKING DAY *** Radhakrishnan T R & Vishal Vaidhayanathan, LLMs for Space, Spatial Grammars *** *** Leticia Izquierdo, MIT City Science ***	Project 1: Spatial Interface <i>Part 2 - Design a spatial interface continued (technical execution)</i>
10 9-Nov [Remote]	WORKING DAY GROUP - Technical Desk crits ZOOM LINK SIGN UP	Project 1: Spatial Interface <i>Part 2 - Design a spatial interface continued (technical execution)</i>
11 16-Nov	WORKING DAY Present: Final Design Proposal	DRAFT VIDEO / PRESENTATION
23-Nov	NO CLASS THANKSGIVING	NO CLASS THANKSGIVING
12 30-Nov [Remote]	WORKING DAY GROUP - FINAL Desk crits	
13 4-Dec	FINAL REVIEW	

Additional:

- “How long can you work to make a routine task more efficient?”, XKCD, [\[link\]](#)
- Atomic Habits summary (by James Clear) min 8-11 [\[link\]](#)
- Beyond Telepresence, Violet Whitney [\[link\]](#)
- Mission Control: A History of the Urban Dashboard, Shannon Mattern, [\[link\]](#)
- “How long can you work to make a routine task more efficient?”, XKCD, [\[link\]](#)
- Atomic Habits summary (by James Clear) min 8-11 [\[link\]](#)
- Beyond Telepresence, Violet Whitney [\[link\]](#)
- Mission Control: A History of the Urban Dashboard, Shannon Mattern, [\[link\]](#)

Grading

- **Experimentation:**
 - This class involves experimentation, and students should be prepared for hardware failures, software bugs, and more. Assessment will be based on student experimentation, investment in process in addition to the final product.
- **Punctuality:**
 - Work is to be completed at the beginning of class on the due date. Late work may receive a reduced grade.
- **Groups:**
 - Grades for groupwork are assigned to the group. On rare occasions, individual grades may be awarded for exceptional or deficient performance within a group. All group members must participate equally in group presentations.
- **Attendance:**
 - It is important that you attend every class. Regular attendance is necessary to understand the material and successfully complete the assignments.
 - An absence is “excused” if you are sick and submit a doctor’s note, or have a serious issue that causes you to miss class, such as a family emergency. All other absences are “unexcused.” Students may have up to two unexcused absences per semester. Students with three or more unexcused absences will have their final grade reduced, and may fail the course.
 - If you know in advance that you will be absent for any reason, email the instructors to make arrangements to complete make-up work.

Policies and Academic Integrity

- If you require an accommodation for a disability, please let the instructor know as soon as possible. Some aspects of the course may be modified to facilitate your participation and progress.
- All students are held to the academic policies of the University.
- In this course we will work in a collaborative and open manner freely sharing information, ideas and resources. However, assignments and presentations that are indicated as individual efforts must adhere to a high standard of academic integrity. In any case, in any context, representing another’s work as your own is dishonest.
- Students who miss deadlines due to valid extenuating circumstances may submit the required work at a later date, as agreed upon with the instructor. University regulations limit such circumstances to serious personal illness and death in the immediate family. Unexcused late projects will not be accepted. Incomplete projects will be evaluated in relation to their degree of completion, and a student will be allowed to present such work only with instructor approval. Lectures and demonstrations cannot be repeated. There is no excuse for late submittals, late attendance at reviews or pin ups, due to

printer or computer problems. You have to organize your output ahead of time or find other resources outside the college to complete your work on time. Late work will be accepted only at the discretion of the instructors and is subject to a 5% grade deduction for every 24 hours past the deadline.

Reading & Resources

Spatial UX

- Designing Next Gen User Interfaces, Michelle Cortese [\[link\]](#)
- Ecommerce Omni-channels
- “Spatial Interfaces”, John Palmer, [\[link\]](#)

Ubiquitous Computing

- Computer for the 21st Century, Mark Weiser [\[link\]](#)
- Ambient Commons, Malcolm McCullough [\[link\]](#)
- Beyond Telepresence, Violet Whitney [\[link\]](#)
- Everything around you can become a computer, Ivan Poupyrev [\[link\]](#)
- [Humane Ted Talk](#) + [Al Pin](#)

Interfaces

- A Brief Rant on the Future of Interaction Design, Bret Victor [\[link\]](#)
- Timo Arnall on the fallacy of invisible interfaces, [\[link\]](#)
- Hidden Interfaces for Ambient Computing, Alex Olwal [\[link\]](#)
- Mission Control: A History of the Urban Dashboard, Shannon Mattern, [\[link\]](#)
- The City As Interface, Martijn de Waal [\[link\]](#)
- Performative Materiality and Theoretical Approaches to Interface, Johanna Drucker [\[link\]](#)

Ethics

- “Critical Race Theory for HCI”, Ihudiya Finda Ogbonnaya-Ogburu, Angela D.R. Smith, Alexandra To, Kentaro Toyama, [\[link\]](#)
- Things that Beep: A Brief History of Product Sound Design, Shannon Mattern, [\[link\]](#)
- “From Redlining to Digital” 0 min - 18 mins, Chris Gillard [\[link\]](#)

Optimization

- The Power of Defaults, Julian Lehr [\[link\]](#)
- “How long can you work to make a routine task more efficient?”, XKCD, [\[link\]](#)

- Deceptive Designs [\[link\]](#)

Computing

- Samuel Greengard, *The Internet of Things* (MIT Press, 2015)
- Malcolm McCollough, *Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing* (MIT Press, 2005)
- Dan O’Sullivan and Tom Igoe, *Physical Computing: Sensing and Controlling the Physical World with Computers* (Thompson Publishing, 2004).
- Casey Reas and Ben Fry, *Processing: A Programming Handbook for Visual Designers* (MIT Press, 2014)

Architecture and Urban Design

- Stewart Brand, *How Buildings Learn: What Happens After They’re Built* (Penguin Books, 1994).
- Kazys Varnelis, *Networked Publics* (MIT Press, 2012)
- Keller Easterling, [The Internet in 4D](#)
- William H Whyte, *The Social Life of Small Urban Spaces* (The Conservation Foundation, 1980).

Design

- Norman, *Design of Everyday Things*, ch. 1
- Atomic Habits summary (by James Clear) min 8-11 [\[link\]](#)
- Anthony Dunne and Fiona Raby, *Speculative Everything: Design, Fiction and Social Dreaming* (MIT Press, 2013)
- Yvonne Rogers, Helen Sharp, and Jenny Preece, *Interaction Design: Beyond Human-Computer Interaction* (Wiley, 2011)
- Donald Norman, *The Design of Everyday Things* (Basic Books, 2002)
- Bill Moggridge, *Designing Interactions* (MIT Press, 2007)
- Sara Hendren, *What Can a Body Do? How We Meet the Built World* (Riverhead Books, 2020)

Sensory Phenomena, Building Science

- James Gibson, “Affordances,” in *The Ecological Approach to Visual Perception* (Routledge, 2014)
- Barbara Erwine, *Creating Sensory Spaces: The Architecture of the Invisible* (Routledge, 2016)
- Lisa Heschong, *Thermal Delight in Architecture* (MIT Press, 1979)
- Daniel Barber, *Modern Architecture and Climate: Design Before Air Conditioning* (Princeton Architectural Press, 2020)

*A note on the diversity of authors:

*Given the historical context of earlier eras, it's important to acknowledge that the landscape of authors within this field has not always been diverse, and many voices from marginalized communities, particularly people of color and women, were excluded from contributing to the discourse. As a result, many foundational texts lack diversity.**

Tutorials & Technical Resources

- Hardware and Software Purchasing
- P5 - Getting Started
- IFTTT
- Webhooks - Connecting IFTTT and Processing
- Sounds, Speech, and Macros
- Computer Vision
- Markers and Tracking
- Projection Mapping and Displays with GPT
- Zapier and Physical Things with GPT