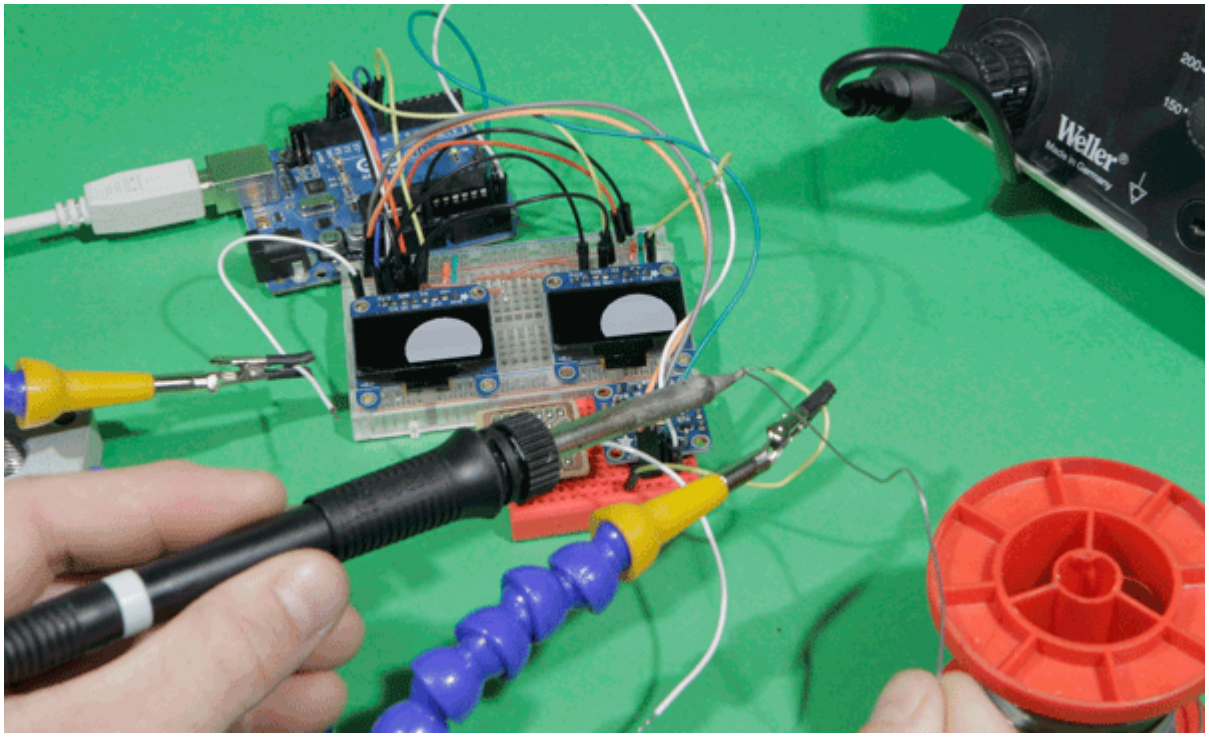
Physical Computing HS25



Overview

Lecturers: Johannes Reck & Duy Bui

In this course, we will look at Physical Computing as a method of Interaction Design. Our definition of Physical Computing refers to the use of hardware and code to make interactive objects that can respond to events in the real world. These events may be from the environment (temperature, radiation, etc.) or user interactions (touch, speech, etc.). These devices might respond with direct physical feedback and action or by performing actions in a digital environment. Physical Computing also describes the creative problem-solving process using technological and functional prototypes.

Course Goals

The students learn how to handle hardware and code to prototype their design outcomes. Students develop an understanding of the characteristics of physical interactions and demonstrate them through functional prototypes. From a technical perspective, students learn the basics of electronics, microcontroller programming (Arduino), and working with digital and analogue sensors, actuators and displays.

Course Structure

The course takes place in two blocks: Physical Computing Basics in the first week and the Main Project in the last two weeks. In the first block, students will work mostly individually through the introductory

topics, while the main project is in groups of four.

Grades will be based on group presentations, class participation, exercises, final outcomes and documentation. An attendance of min. 80% is required to pass the course.

Unless otherwise indicated, the course is from 9:00 to 17:00, Monday to Friday.

Individual Work (weeks 1 to 2) 30%

Workbook documentation of all exercises and minor projects from weeks 1 and 2:

- Make a photo of each assignment, and sketch a schematic when appropriate.
- Write a short comment or note for each exercise.

Group Work (weeks 2 to 3) 70%

1. Final Prototype of Object
2. Final Presentation
3. Standard IAD Documentation (see handbook on wiki):
    - Text file including the project title, names of students and mentors, a short description(250 - 400 characters), and a project description (>1000 characters), in a file to be labelled “Texts”
    - Approx. 10 representative images of the project (to be stored in a file labelled “Images”)
    - At least one short video (~2min) of the project (to be stored in a file labelled “Video”). Mp4 full HD, see wiki for more details on format.
    - Two to three short social media teaser videos (20-30 seconds) in portrait format.
    - A PDF documentation (to be stored in a file labelled “Documentation”)
    - Additional raw data, e.g., presentation, prototypes, or codes (to be stored in the respective file).

Final Presentation notes

- 5 minutes for presentation, and 5 minutes for feedback and discussion
- Show the process that brought you to this outcome
- Live demonstration of your project

Documentation

Documentation includes separate submissions: the individual workbook (all individual exercises) and the group documentation.
Upload your files to
smb:fileredu.ad.zhdk.ch/DDE/BDE_VIAD/01_ABGABEN/25_HS/Sem1_Physical_Computing

Project Budget & Reimbursement

150CHF per group.

Fill out the Reimbursement Form and send together with your receipts and payment confirmation to johannes.reck@zhdk.ch to sign. After you receive back the signed form, send everything to bettina.hannwacker@zhdk.ch for payment processing.

Material Returns

Grades will not be awarded until you return your complete project box, the prototypes have been disassembled, and the parts returned!

Schedule

Week 1 – Basics				
5.1. Mo	1	J(&D)	Input	Kick-Off, Electronics Basics, Arduino Intro, IDE, Digital Output
6.1. Di 10:00 – 15:00	2	D	Input	Digital Input, Analog Input, Analog Sensors
7.1. Mi 09:30 – 17:00	3	J	Input	Digital Interfaces (I2C/SPI), Distance Sensor, IMU, Electrical Components
8.1. Do	4	J	Input	Sensors, NeoPixels & Libraries, Servo, Filtering
9.1. Fr 10:00 – 15:00	5	D	Input	Soldering, Voltage Regulators, Transistors
Week 2 – Advanced + Start Group Project				
12.1. Mo 10:00 – 12:00, 13:30 – 15:00	6	J	Input	Research Methods, **AI-Tools Session** Afternoon: Soldering
13.1. Di 10:15 – 12:00	7	D→J	Input→Project	D & J: **Projekt-Kickoff + Assignment**
14.1. Mi	8	–	Project Work	Concept Work
15.1. Do 10:00 – 12:00	9	J&D	Project Work	Mentoring 1
16.1. Fr 10:15 – 12:00	10	J&D	Project Work	**Concept Presentation**, group work in the afternoon
Week 3 – Production				
19.1. Mo	11	–	Project Work	Group work
20.1. Di 13:00 – 14:00 (Mentoring) 14:00 – 14:30 (3D Print Input)	12	J&D	Project Work	Mentoring + Atelier Walk-through Johannes available until 17:00 for tech support
21.1. Mi 09:00 – 12:00 Duy 11:00 – 17:00 Johannes	13	J&D	Project Work	Tech Support in Lab: Duy approx. 09:00-12:00 / Johannes approx. 11:00 - 17:00
22.1. Do 09:00 – 12:00 Duy 13:30 – 18:00 Johannes	14	J&D	Project Work	Tech Support in Lab: Duy approx 09:00-12:00 / Johannes approx. 13:30 - 18:00
23.1. Fr 09:15 – 11:00	15	J&D	Final Presentation	**Final Presentation**, individual project documentation in the afternoon

Groups

Group 1: Vanessa, Pranjal, Kimi, Yulha
Figma Board

Group 2: Fabio, Dominik, Kateryna, Luana
Figma Board

Group 3: Akira, Lou, Finnja
Figma Board

Group 4: Olena, Carolina, Andrin
Figma Board

Main Topic: Guerilla Devices - Moments of Encounter

In this module, we focus on a specific kind of interactive object: the **Guerilla Device**. These are small, autonomous, and often unexpected interventions – objects that insert themselves into everyday situations and create moments of encounter.

We're interested in devices that:

- **Reveal the invisible** – making hidden data, forces, or behaviours perceivable
- **Disrupt routines** – interrupting the flow of everyday life with surprise or curiosity
- **Invite participation** – turning passive observers into active participants
- **Provoke reflection** – raising questions about technology, behaviour, or environment

Think of the work of collectives like **Graffiti Research Lab** (laser tagging, LED throwies), **Daily tous les jours** (musical swings, collective urban experiences), or artists like **Natalie Jeremijenko** (environmental sensing as activism). These projects share a common quality: they use simple technology to create powerful moments of human connection or reflection.

Your devices don't need to be complex. A single sensor, a well-chosen response, and a thoughtful placement can be enough to shift how someone experiences a moment.

What You'll Learn

Technical Skills:

- Electronics fundamentals and Arduino programming
- Selecting, connecting, and interpreting sensors
- Signal processing and debugging
- Prototyping for robustness and autonomy

Design Skills:

- Framing interaction as dialogue (input → processing → output)
- Designing for context: where, when, and for whom
- Iterative testing with real users
- Research competency: datasheets, libraries, AI tools

Critical Perspective:

- Understanding Physical Computing's roots and relevance
- Reflecting on what it means to design objects that act in the world

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What You'll Build

In groups, you will design and build a functioning **Guerilla Device** – an autonomous interactive object that creates a moment of encounter. You will test it with real people and document the interactions on video.

References & Resources

Books:

- Tom Igoe & Dan O'Sullivan – *Physical Computing: Sensing and Controlling the Physical World with Computers*
- Tom Igoe – *Making Things Talk*
- Paul Dourish – *Where the Action Is: The Foundations of Embodied Interaction*
- Anthony Dunne – *Hertzian Tales: Electronic Products, Aesthetic Experience, and Critical Design*
- Dunne & Raby – *Speculative Everything*
- Sensing Place - Mediating the Urban Landscape - Christoph Merian Verlag
- Smooth City - Against Urban Perfection, Towards Collective Alternatives - Valiz Verlag

Key Concepts:

- Tangible User Interfaces (Hiroshi Ishii, MIT Media Lab)
- Embodied Interaction (Paul Dourish)
- Critical Design (Dunne & Raby)
- Ubiquitous Computing (Mark Weiser)

Projects & Practitioners:

- Graffiti Research Lab – *LED Throwies, Laser Tag*
- Daily tous les jours – *21 Balançoires (Musical Swings)*
- Natalie Jeremijenko – *Environmental Health Clinic*
- Random International – *Rain Room*
- Chris O'Shea – *Hand from Above*
- Usman Haque – *Open Burble, Pachube*

Institutions:

- MIT Media Lab – Tangible Media Group
- NYU ITP (Interactive Telecommunications Program)
- Copenhagen Institute of Interaction Design (CIID)

Initial Setup

We'll use the development environment from Arduino to program our microcontrollers during the course.

1. Visit the Arduino homepage and download the correct version for your operating system:

Miro Board

Miro

Files

Slides

physical_computing_input_1_-_jlr.pdf

physical_computing_hs25_digital-analog_input.pdf

input_2.pdf

servopwm.pdf

physical_computing_-_servo_overview.pdf

Copilot Setup

vscode_copilot_guide.pdf

copilot_instructions_physical_computing.pdf

3D-Printing

3d-printing_pchs25.pdf

3d-printing-cheat-sheet_pchs25.pdf

Project Kick-Off

physical_computing_hs25_project_kick-off.pdf

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