BWL-MA-FWB8(D)
Digital Innovation Lab

Instructors

- Prof. Dr. Jan Recker (jan.christof.recker@uni-hamburg.de)

- Dr Lucas Goebeler (lucas.goebeler@uni-hamburg.de)

Overview

This course takes the form of a **project-based digital innovation lab**. The main learning objective is to develop a functioning novel *digital innovation prototype* containing both hardware and software components that addresses a chosen *sustainable development challenge*. With this objective, we have two specific foci.

1. Address a Sustainable Development Challenge
We define a sustainable development challenge as a problem of environmental or social but not primarily commercial value. Sustainable development challenges are specified as the *Sustainable Development Goals of the United Nations*, which provide a set of internationally agreed upon goals and an agenda for peace and prosperity. As a concrete project example consider the *Fairphone* – a highly modular smartphone that accounts for conflict-free production resources, worker welfare and e-waste programs – or *WakaWaka* – a solar-powered lamp providing 16 hours of reading light on less than a day of sunlight. What we do not consider as sustainable development are, for example, lean manufacturing approaches that are directed to primarily increase efficiency in production processes and which may include reduction of waste only as a side effect. Another negative example are greenwashed products and practices that make unsubstantiated or even misleading claims about their environmental benefits (e.g., reducing the carbon footprint).

Our goal in this course is to help students understand the nature of the sustainable development challenges that concern current and future generations, and to advance students' understanding of the solution potential of digital technologies to address these grand challenges.

2. Develop a Digital Artifact as a Solution to the Sustainable Development Challenge
Students work together in cross-disciplinary teams to develop a concrete, tangible, digital innovation solution that contains hardware and software components and which addresses the chosen sustainable development challenge. For the hardware components, we will provide a selected hardware technology stack within the Coworking Space of the Digital Innovation Lab (located in room 3096/3097 in VMP 5), which students can choose to work with. The students' task is then to configure the hardware technology stack and develop a corresponding software solution such that a digital innovation can be realized.

For illustration purposes, consider these examples:

- Vertical Hydroponic Farm Arduino Project (Langdon 2015)
- Self-powered water meter for direct feedback to safe water consumption (Tasic et al. 2012)
- Meter devices for smart and energy-efficient school buildings (Pocero et al. 2017)
- Open source low-cost power monitoring system (Oberloier and Pearce 2018)
- Wireless sensor network system for environmental monitoring applications (Ferdoush and Li 2014)
- A datalogger for irrigation water use monitoring to enable crop management (Spinelli and Gottesman 2019)

The following examples are solutions developed by students in previous instances of this course:

- *Hivesound.AI*: An AI-based sound monitoring system for bee hives
- LunarVision: AI-powered smart glasses that provide orientation and navigation to visually impaired individuals.
- *Proteus*: A Platform for Monitoring and Predicting Water Quality and Availability
- *Speak4Me:* A wearable “eye-to-speech" solution to help people who are unable to communicate verbally and cannot use sign language

Learning outcomes

Students learn to…

… understand what digital innovation means and learn about important related concepts.
… acquaint themselves with the potential of emergent digital technologies.
… understand challenges related to developing digital innovations.
… understand challenges of sustainable development
… develop a socio-technical artifact incorporating latest digital technologies.
… organize themselves and work in independent teams.

Contents

The contents of the unit roughly unfold in the following way:

- Introduction to digital innovation
- Grand challenges and wicked problems of a sustainable society
- Working with emergent digital technology stacks
- Ideation and design thinking methodologies
- Project and team management
- Design and implementation of digital innovations
- Prototyping and Testing

Procedures

Students will form teams to complete this unit. In teams, they are free to choose their own sustainable development challenge as a problem setting to be addressed within their digital innovation project. Team formation is scheduled for the kick-off session.

A selection of hardware technologies will be made available in the Digital Innovation Lab at the beginning of the course to start experimentation right away. In advance, students are encouraged to familiarize themselves with some preparation material and fill out a brief survey that can be used for team formation.

During the semester, student teams will be provided with a budget of 500€ that they can use to buy additional hardware components such as sensors, extensions, motors, tools etc. for their projects on an as-needs basis. Orders must be issued through the course instructors.

Over the course of the semester, student teams will continuously work on developing their digital innovation solution. The course will include a range of accompanying help and assistance formats including lectures, tutorials, and interactive workshops. For the workshops, students are provided with resources and materials in advance to prepare for the workshop in a flipped-classroom style.

The final report and solution should be submitted under a free and open-source design solution that meets the requirements of a professional outlet such as *HardwareX* – an open-access journal established to promote free and open-source designing, building and customizing of scientific infrastructure (hardware). Therefore, reports must provide potential end-users with sufficient information to replicate and validate the advances presented. More information on documentation requirements and examples can be found on the journal's website. As a compatible open-source license model, we recommend the *General Public License (GNU).*

Technology Stack

In our Digital Innovation Lab we already have a selected stack of hardware technologies available for students, which they can use to start experimentation and trial straight from the beginning. The following list is illustrative for some of the technologies available; it is not a comprehensive list of technologies that can be used.

- Arduino Hardware Platform / Arduino Education Starter Kits – central part is an open-source microcontroller board, including integrated development environment
    - Official Website: https://www.arduino.cc/
    - Arduino Project Hub: https://create.arduino.cc/projecthub
- Circuit.io – prototyping tool for instant circuit schematics and code for electronic circuit
    - Official Website: https://www.circuito.io
    - Blog: https://www.circuito.io/blog
- Ultimaker 3D printer – create and innovate with the easy and powerful 3D printing solution
    - Official Website: https://ultimaker.com/
    - Blog: https://ultimaker.com/de/learn/blog
- Tobii Eyetracker – wearable and static eyetracker for behavioral research in a wide range of settings
    - Official Website: https://www.tobiipro.com/product-listing/tobii-pro-lab/
    - Blog: https://blog.tobii.com/
- Acer Predator computer – high-performance computer for demanding tasks with processors of the 12th generation
    - Official Website: https://www.acer.com/ac/de/DE/content/predator-series/predatororion3000
- Sony 4K-HDR Camcorder – a compact handheld camcorder for shots in broadcast quality
    - Official Website: https://pro.sony/de_DE/products/handheld-camcorders/pxw-z90
- Furthermore, our technology stack comprises Raspberry Pi 4 microcontrollers, a printer and camera equipment that can be used for the project
- For further inspiration of technologies and tools to use, students can take a look at web sites such as *Stackshare.io*.

Room

MTL Digital Innovation Lab (room 3096/3097 in VMP 5)

Assessment

Overview of Assessments

Assessment	Assessment Weighting	Type of Assessment	Deliverables
1. Problem definition	10%	Group	Presentation
2. Solution concept and prototype	20%	Group	Presentation and prototype
3. Project report and working solution presentation	70%	Group	Finished prototype, report and presentation

Assessment 1: Problem definition
Students formulate their problem description including motivation and relevance. Problem definitions should already address the type of innovation and stakeholders, possibly the realm of technologies involved. Students present their deliverable in an adequate format (e.g., an oral group presentation).

Assessment 2: Solution concept and prototype
Students formulate their solution concept. Reports address the planned digital technology solution to serve as a blueprint. An integral part is the description of the group's development method and project plan. Feasibility tests and prototypes, schematic diagrams, mock-ups, and other useful forms of early design should be included. Students present their deliverable in an adequate format.

Assessment 3: Project report and working solution presentation
Students formulate a detailed report of their project. The working solution is described and adequately presented. The assessment comprises two parts: (1) the project report and (2) the presentation of the working solution.

Introductory Reading Resources

- Fairphone (website): https://www.fairphone.com/en/
- Fridays for Future (website): https://www.fridaysforfuture.org/
- General Public License (GNU) – free, copyleft license for software and other kinds of works: https://www.gnu.org/licenses/gpl-3.0.en.html
- HardwareX Journal (website): https://www.journals.elsevier.com/hardwarex
- Stackshare.io (website): https://stackshare.io/
- United Nations, Sustainable Development Goals Agenda (website): https://sustainabledevelopment.un.org/?menu=1300
- Wakawaka (website): https://waka-waka.com/en/

Schedule

Duration	Date	Content
13:00-16:00	Di, 22.4.2025	Kick-off lecture and exploration of the digital innovation lab
14:00-18:00	Mi, 30.4.2025	Workshop: Systematic Ideation to develop solution ideas
14:00-16:00	Di, 06.5.2025	Check-In Session 1
14:00-18:00	Mi, 21.5.2025	Milestone 1 presentations plus design thinking workshop
14:00-16:00	Mi, 04.6.2025	Check-In Session 2
13:00-16:00	Di, 17.6.2025	Milestone 2 presentations
14:00-16:00	Mi, 25.6.2025	Check-In Session 3
14:00-16:00	Di, 1.7.2025	Check-In Session 4
13:00-16:00	Di, 8.7.2025	Final milestone presentations and course closure

About your instructors

Jan Recker is Alexander-von-Humboldt Fellow, Nucleus Professor for Information Systems and Digital Innovation at the University of Hamburg, and Adjunct Professor at the QUT Business School, Australia. In his research, Jan Recker explores how organizations with the opportunities and challenges of digitalization and artificial intelligence. He has worked with companies such as Apple, SAP, Volkswagen, Deutsche Bahn, Lufthansa, Olympus, Cognigy.AI, Vytal, Woolworths, Clipchamp, Edeka, Bertelsmann, Ultimaker, Auticon, and others. Jan Recker explores how organizations with the opportunities and challenges of digitalization and artificial intelligence. He has worked with companies such as Apple, SAP, Volkswagen, Deutsche Bahn, Lufthansa, Olympus, Cognigy.AI, Vytal, Woolworths, Clipchamp, Edeka, Bertelsmann, Ultimaker, Auticon, and others. He teaches on topics such as digital innovation, technology management, qualitative methods, and scientific research.

Lucas Göbeler completed his PhD degree in the field of Information Systems and is now working as a postdoctoral fellow at the Chair for Information Systems and Digital Innovation. His research focuses on digital innovation in environments typically characterized by their physicality, such as digitalization in sports.