

Design Thinking and Advanced Prototyping – Spring 2023

Course outline, version 11.1.2023, Salu Ylirisku

Synopsis

ELEC-C9821 Design Thinking and Advanced Prototyping course is a bachelor's level course primarily intended for the 2nd year DSD (Digital Systems and Design) major students. The course format is a team project, weekly exercises and lectures.

The course deepens the students' understandings of electronic prototyping, which they have gained in the Design Thinking and Electronic Prototyping course. The intent is to create technically more sophisticated and internet-connected prototypes in a hands-on and iterative manner. Special focus will be given to the user-centred definition of requirements during the prototyping phase, and expressive communication of useful electronic design concepts.

During the 2023 spring the recommended way to take the course is a 8 ECTS wide project (5 credits from the DTAP and 3 credits via elective part). The project will continue from the beginning of the Period III until the end of Period V.

Schedule

Week / Dates	Lecture + workshop	Exercise	Project	Deliverables
02 / 9.-13.1.	Intro + teaming up	Circuit schema design (EDA)	Theme exploration	Mind map + Team Agreement
03 / 16.-20.1.	Users and technology	PCB layout design	User focus, tech exploration	User study plan
04 / 23.-27.1.	Interpreting and ideating	PCB carving	User study & interpretation	User study report
05 / 30.1.-3.2.	Reflective prototyping	PCB etching	Interpretation & ideation	List of early ideas
06 / 6.-10.2.	Idea framing & screening	PCB soldering	Concept design	Design Concept Draft
07 / 13.-17.2.	Concept presentations	PCB testing	Proto V1 definition	Proto V1 goals & reqs + Learning Diary – 1/3
08 / 20.-24.2.	SKIING HOLIDAY / EXAM WEEK – No DTAP teaching or exercises this week			
09 / 27.2.-3.3.	Technical arguments	Specialisation exercise #1	Proto V1 building	Proto V1 images
10 / 6.-10.3.	Financial arguments	Specialisation exercise #2	Proto V1 testing	Proto V1 test photos
11 / 13.-17.3.	UX and Visual Design	Specialisation exercise #3	Proto V2 definition	Proto V2 goals & reqs
12 / 20.-24.3.	UX and Web GUI Design	Specialisation exercise #4	Proto V2 building	Proto V2 images
13 / 27.-31.3.	UX and Physical Design	Specialisation exercise #5	Proto V2 building	Proto V2 images
14 / 3.-7.4.	Effective Concept Presenting (+final session reqs)	Specialisation exercise #6	Proto V2 testing	Proto V2 test photos + Learning Diary – 2/3
15 / 10.-14.4.	EASTER WEEK – No DTAP teaching or exercises this week			
16 / 17.-21.4.	EXAM WEEK – No DTAP teaching or exercises this week			
17 / 24.-28.4.	Team tutoring / custom topic	-	Proto V3 definition	Proto V3 goals & reqs
18 / 1.-5.5.	Team tutoring / custom topic	-	Proto V3 building	Proto V3 images
19 / 8.-12.5.	Team tutoring / custom topic	-	Proto V3 building	Proto V3 images
20 / 15.-19.5.	Team tutoring / custom topic	-	Proto V3 building	Proto V3 images
21 / 22.-26.5.	Team tutoring / custom topic	-	Proto V3 testing / preparing	Proto V3 test photos
22 / 29.5.-2.6.	Final Presentations (31.5.)	-	Reporting	Design Concept Poster
			Reporting	Final report + repo + Learning Diary – 3/3

Weekly Schedules

Lectures & workshops on Wednesdays 09-12

Exercises: Mondays 14-16, Tuesdays 10-12, Fridays 14-16

Learning Goals

Design Thinking

The course deepens students' design thinking project skills and teamwork skills. The course is project-based, i.e., learning happens through practical activities in the project and through written reflection. The project is designed as a user-centred, open-ended, and complex team activity over the duration of whole spring term in order to support the learning of explorative and active sense-making skills.

Advanced Prototyping

Students are expected to be already familiar with electronic prototyping with Arduino kit. In this course the focus of prototyping is on IoT products which typically include cloud services, apps, graphical user interfaces, versatile networking, and a small form factor.

Prototyping

Prototyping is done in several iterations through the course. Each iteration begins with the definition of the learning goals with each prototype version. The learning goals must then govern the key requirements for each prototype. Each prototype must be tested so that the lessons learned with it can be analysed.

8 ECTS version

- Prototyping (3 well-documented iterations with at least 1 custom circuit board included + demo)

5 ECTS version

- Prototyping (2 well-documented iterations with commercial off the shelf components + demo)

Reflexive Learning Diary

Reflexive Learning Diary is a form of diary-keeping, where you explicitly address yourself as a learner as well, for example, in terms of how your new experience relates to something you have experienced earlier, or how you feel that you are learning. Personal reflection is required, which means that you are not simply listing activities, but thinking and arguing what is the significance of these.

Keeping Up the Rhythm

The recommended way to keep a learning diary is to make it your weekly habit. The course supports handing in a weekly diary entry to keep up the pace. However, only periodical diaries will be evaluated, i.e., those that are delivered in the end of each period during the course. In the 8 ECTS version in total 3 diaries are evaluated, and in the 5 ECTS version in total 2 diaries.

Showing You Have Done It

The diary will be used to follow how you have completed the exercises during the course. So, remember to include those in the diaries during periods III and IV.

Being Visual

Images, such as photographs and visualizations, are essential in the diary. In each of the diaries, at least one image must be utilised, and it must be properly addressed in the body text. This means that you need to give a number and title for each image, and then utilise this in the body text, e.g. (see Figure 1).

Reading and Citing

The diary must be written in English, and each of the three articles in the course readings must be properly cited and reflected in the body text. The citations must be made either in the IEEE or APA academic citation format. The minimal length of the reading reflection per diary is 400 words. The V8

Diary Length

The required length for the diary is 400-600 words per active course week. This means that each periodical diary should be between 2400-3600 words.

Poster

Each team is expected to print and submit a poster A1 size by the final presentation day. The poster must communicate the essential facts about the design concept in a persuasive and visually appealing manner. It must contain the name of the concept, its purpose, overall form and key functionalities. The poster must have an image of the design idea and show a possible overall product architecture.

Final Presentation

The final presentations are given on the Wednesday the 31st of May 2023 between 09-15 in the Atrium Learning Hub. In the final presentations each team will have in total 15 minutes time, and they must cover the following aspects in the presentation:

- 1) The design concept with its justifications (desirability, feasibility, and viability)
- 2) The process, which means to illustrate the key activities that led into this design concept
- 3) Demo (or video) of the prototype in action

Project Documentation

Each team will get a wiki page for sharing the team's project outcome in a structured format.

Evaluation

The course is evaluated in the 6-point scale, 0-5. Active participation is required, and max. 2 lecture/workshop sessions can be missed without additional assignments.

Literature

Lepekhin, A., Borremans, A., Ilin, I., & Jantunen, S. (2019). A Systematic Mapping Study on Internet of Things Challenges. 2019 IEEE/ACM 1st International Workshop on Software Engineering Research & Practices for the Internet of Things (SERP4IoT), 9–16. <https://doi.org/10.1109/SERP4IoT.2019.00009>

Rowland, C. (2018). UX and Service Design for Connected Products (Insight Report June 2018). IoT UK. <https://iotuk.org.uk/wp-content/uploads/2018/06/UX-and-Service-Design-IoTUK.pdf>

Laurenti, R., Sinha, R., Singh, J., & Frostell, B. (2015). Some pervasive challenges to sustainability by design of electronic products – a conceptual discussion. *Journal of Cleaner Production*, 108, 281–288. <https://doi.org/10.1016/j.jclepro.2015.08.041>