OSLO METROPOLITAN UNIVERSITY
STORBYUNIVERSITETET

RELINK PROJECT

Title: EPS Final Report

Type: EPS Report

Course: EPS
Document version: 1.0
Status: Release
Date: 27-May-2024
Authors:

Eve Bernhard; Melle van Dijk; Daan Heetkamp; Jasper van Meel; Janette Pakarinen

Titlepage

Institute for Information Technology
Post address: Postboks 4 St. Olavs plass, 0130 Oslo
Visiting address: Holbergs plass, Oslo
Phone: 22 45 32 00

Project Number:
5

Availability:
PUBLIC

MAIN PROJECT TITLE:

Contesting AI in smart home devices

Date:
27-May-2024

Number Of Pages/Appendixes:
45

PROJECT TEAM MEMBERS:
Eve Bernhard
Melle van Dijk
Daan Heetkamp
Jasper van Meel
Janette Pakarinen

INTERNAL SUPERVISOR(S)

Tengel Aas Sandtrø
Thomas Russell Muir
Henry Mainsah

Writing and checking

Role	Name	Place	Date
Authors	Eve Bernhard Melle van Dijk Daan Heetkamp Jasper van Meel Janette Pakarinen	Pilestredet 32, Oslo	27-May-2024

Version history

Version	Date	Author(s)	Changes/remarks
0.1	14-Mar-2024	HeDa	First Layout and Input
0.2	04-Apr-2024	All	Added team roles
0.3	20-May-2024	All	Added more chapters + workshop
0.4	22-May-2024	All	Created the final draft
0.5	23-May-2024	All	Added changes from Tom and Daan
0.6	24-May-2024	All	Resolved all review issues and add last text.
1.0	27-May-2024	All	Last fixes. Released.

Review status

Version	Date	Reviewer(s)	**Verdict** (Rejected / Accepted / Accepted after update)
0.4	23-May-2024	HeDa	Rejected
0.5	24-May-2024	HeDa/MeJa	Rejected
0.6	27-May-2024	All	Accepted after update

Abstract

This document describes the final report of the EPS RELINK Project 2024.

The goal of our research is to empower end users by teaching them about the double-edged sword that are smart home devices. While convenient, they are a risk to privacy that is often underestimated or even overlooked. We want to change that by educating people about these dangers so that they think twice before taking a device into their homes and connecting it to the internet. Note that we do not want to scare people away from smart home devices – they do have very real benefits. We want to make sure that when people make decisions, they see the whole picture and have the knowledge and resources to make an educated decision on their own.

We investigated and created two methods for raising awareness: an educational website people can consult to learn more about smart home devices, and resources for a workshop consisting of two activities to illustrate why privacy in smart home devices matters. The website contains an online course to teach people the basics of smart homes, at the end of every chapter there is a short quiz to gauge how much you remembered. The aim of the workshop is to educate people about the potential dangers associated with smart home devices and could for example be used in the context of a high school.

Table of Content

Table of Figures

Table of Tables

Abbreviations

Table 1 - Abbreviations

Word of abbreviation	Meaning
SHDs	Smart Home Devices
IoT	Internet of Things
MGS	Mission Goals Scope
EPS	European Project Semester
MVP	Minimum Viable Product
IT	Information Technology
AI	Artificial Intelligence
EU/EEA	European Union / European Economic Area
GDPR	General Data Protection Regulation
UN	United Nations

1 Introduction

Technology is moving at breakneck speed: while our parents barely used or learned to use computers in their education, we are growing up in a digitalized world where everything is connected all the time. Life without the internet has become unthinkable – and sometimes even impossible. This can be considered both a blessing and a curse: the wealth of technical gadgets and devices around us give us a lot of convenience in our jobs and everyday lives, but this convenience does not come for free.

Smart home devices are becoming increasingly prevalent, and users are promised a lot of benefits, e.g. more efficient, convenient & safer homes. Setting the temperature for when you get home, letting a visitor in when you got delayed by public transport, checking if you have any butter left when you are in the grocery store: these scenarios – though unthinkable a few decades ago – might sound familiar to you. What the average user does not know, is that these 'advantages' often come at a cost, something you were probably not told when buying these devices: your data.

Our homes usually give us a sense of safety, and most of us are fortunate enough that we can take this safety for granted. However, in recent years, smart home devices have complicated this concept of 'safety': can your home still be considered a safe haven if your every step is being tracked by half a dozen companies across the globe? Bringing devices of which the inner workings are not transparent into our homes is a threat to our privacy, one of which many users are unfortunately still unaware of – and that is something we set out to change.

This project is related to an ongoing research project, RELINK, which is based at Consumption Research Norway, Oslo Metropolitan University. RELINK is a base research project that encapsulates different smaller research projects. It aims to develop frameworks, tools, and scenarios that can address current and future risk and safety issues related Internet of Things (IoT) in connected homes and households.

Our group has focused on the data transparency of smart home devices and creating documentation about the dangers and risks. The final solution consists of three parts, which have all been incorporated into a single website:

- Educational chapters for students or young parents to learn more about smart home devices
- Teaching material, including an example presentation & some homework ideas
- Two activities that can be used during a workshop or lesson

We also investigated how our project fits into the 17 UN Sustainable Development Goals. The field of IT has a considerable impact on the climate, which is why it is important that we research & develop with these sustainability goals in mind. This analysis can be found in Attachment 2.

We would like to express our gratitude to our supervisor, Henry Mainsah, and our teachers, Tengel Aas Sandtrø & Thomas Russell Muir. Without their efforts, this project could not have reached its full potential. We would also like to extend a heartfelt thank you to all the people who helped us during this project, mainly the respondents of our survey, the participants of the workshop & the guys over at Dominos.

2 Project Management

The management of the project is shown in this chapter. This will include project roles, strategies, methodologies, and MGS.

2.1 Project roles

This project happened in two of stages: a research and a development stage - this is an important distinction to make. As the project was still in the research stage, there was no intrinsic need for managing roles, as research had to be done by everyone. In the development stage, these roles were of higher importance.

2.1.1 Research stage

For the research stage, no real roles were assigned. Because everybody in the group was from a different culture, there was also a significant difference in the process of completing a project. Some would have liked a leader while others liked a more open culture. The choice had been made to create an open project culture in the beginning.

The only “roles” that were set in the research stage were:

1. Every week there will be a new meeting leader. This person will create a planning for the meetings and make sure everything is discussed and everyone has their opportunity to talk.
2. Every week there will be a new note taker. This person will write down all the important things discussed in the meeting.

As the research stage is a period where new ideas need to be developed, there was not a necessity to have strict rules. There had to be an open flow of information and ideas.

2.1.2 Development stage

In the development stage, there was more discussion about how the group should be defined.
Initially, the roles were not assigned individually due to the uncertain direction of the project. However, as the project progressed, the necessity for defined roles became apparent.
The roles assigned for the development stage were as follows:

- **Chief Executive Officer**: Daan took on this role. As the CEO, Daan was responsible for making major corporate decisions and managing the overall operations and resources of the project.
- **Project Coordinator**: Janette’s responsibilities included ensuring that the project stays on schedule, managing deadlines, and coordinating timelines for different tasks.
- **Technical Lead**: Eve served as the Technical Lead. Her role involved overseeing all technical aspects of the project, providing technical guidance and support to the team, and ensuring that technical goals were met.
- **Workshop Coordinator and Data Supervisor**: Jasper was responsible for this role. His responsibilities included creating workshops for the team, helping with topics about transparency and ensuring accuracy in all data-related chapters.
- **Security and Risk Manager**: Melle oversaw this role. Because of his study and expertise, his duties included helping the team with chapters about security protocols, managing potential risks, and implementing strategies to mitigate those risks.

These roles were carefully considered and assigned based on individual skills and the project's needs. This structure provided a strong foundation for the project's success in the development stage.

Each chapter of the teaching material was assigned to a specific team member that had the most knowledge of the particular subject.

2.2 Strategies

The strategies that have been used in this project were discussed in the beginning of the project. This was done to make sure that the project ran smoothly.

2.2.1 Communication

Communication in a group project is an important thing to get right.
In the beginning of the project, multiple meetings were held. In these meetings the group discussed topics like how frequently a meeting will be held, what the best days and times for meetings are, whether meetings should be in person, or if they can be done online. These and more points of discussing were addressed. The final outcome was:

1. There will be at least one meeting every week. This meeting will be in person.
    a. If, a second meeting is necessary this can be done online. Everyone that has to attend this meeting needs to be active and turn on their camera.
    b. The meeting days will be on days that everyone is able to attend. Normally Monday and Thursday.
2. A meeting with the supervisor will take place every other week, only if necessary, if not, the important discussions or changes will be sent to the supervisor using an email.
3. During the meetings, the meeting leader will take the lead in the communication. The meeting leader will create a list of things to discuss and makes sure all points are addressed.
    a. The meeting leader will give everyone the opportunity to talk.
    b. The meeting leader will not force their hand in discussing a topic, they will however try to keep the topic the main discussing point.

2.2.2 Collaboration

Collaboration is intertwined with the communication, but it has certainly some real differences. The following are the most important things that were used to make collaboration successful in the team.

1. Everyone should be doing their part in the project: the tasks will be split evenly, and everybody should be in agreement about the tasks & the direction of the project.
    a. When new ideas arise, everyone should have a chance of giving their opinion and/or point of view of the idea.
    b. For big things like research, everyone should be able to get time to find multiple papers to discuss.
2. When going into the development phase, the assigned roles will be respected.
    a. The CEO will be the person to take the initiative in decision-makings. This however does not mean that they have more voting power.
    b. A role does not mean that that person needs to do everything in that role. Other members can help. This, only if discussed with the person with the role.
3. Everyone will have equal say in every decision. If not everyone agrees with a decision, an alternative or ultimatum should be sought.
4. When some problems arise in the group, the group will first try to remove the problems by discussing them with each other. When this is not possible the supervisor or an OsloMet professor will be asked to help.

2.3 Methodologies

In this project multiple methodologies were used. In this subchapter, these methodologies will be explained, as well as why they were used.

2.3.1 Agile

During the website development, the team decided to implement agile methods to organize the work. No clear vision was set and agreed upon prior, it was mostly about experimenting with the code, the graphic materials, and components. That is why using agile methods made sense, to be able to iterate on the product and improve as time goes. A development cycle would last a month, at the end of which we would reflect on the past work and exchange thoughts.

2.3.2 Waterfall

For planning & creating the workshop, the team followed the waterfall methodology. This seemed like the best choice of action, since there was a clear idea of what we wanted to produce: two interactive activities to get people to share thoughts & experiences and to make them more aware of the potential risks of SHDs. While working towards this goal, two deadlines were set: one for the draft of the activities and one for the final delivery (one week before the workshop). Two people worked on creating & designing these activities, and when the draft was done, feedback was gathered from the other group members. After incorporating this feedback & finalizing the design, everything for the workshop (printing the activities, organizing the location & the lunch, etc.).

2.4 Mission, Goals and Scope

To determine the best way to develop the project, a Mission statement, Goals and Scope (MGS) document needed to be created. These three elements served as the foundation of the project, guiding the team's actions and decisions.

Two versions of the MGS document were created, each with a different approach to the project. After careful consideration, one was chosen as the most suitable for the project's direction.

The full Mission, Goal and Scope document can be found in *Attachment 1.*

2.4.1 Chosen MGS Document

The chosen MGS document emphasizes the importance of research and education. The mission statement encapsulates this focus: '*Research the data transparency of smart home devices & empower end users by educating them through documentation about the dangers and risks.*'

The goals created from this mission statement were designed to assist a thorough understanding of smart home devices. The purpose of these goals was to conduct research, process survey results, and choose a target audience to focus the documentation on. The findings of the survey and our research were then used to create and publish documentation for the target audience. To ensure the effectiveness of these resources, the team planned to organize a workshop and gather feedback for continuous improvement.

The scope of the project established clear boundaries to maintain focus and manage resources effectively. The scope was made to not go to deep into some areas, like creating a commercial product, studying the security aspect of smart home devices, producing modification guides, providing personal recommendations or endorsements, and offering technical support or troubleshooting assistance. These scopes ensured that the team stayed on track with the mission and goals of the project.

The chosen goals have been modified halfway through the semester. The initial goals were maintained for the most part, however, points four, five and six have been changed or removed. These points mainly talked about explaining a specific device, showing the inner workings, and resending the survey. As a different approach was chosen later in the semester, these goals had to be modified a bit.

2.4.2 Alternative MGS Document

The alternative MGS document proposed a different approach, focusing on modifying a mainstream smart home device and documenting the process to give end users more control over their data and the device.

This approach had its advantages, as it offered a hands-on, practical perspective on SHDs. It aimed to provide end users with certain solutions to gain more control over their devices and data. However, this option was not chosen due to several reasons.

Firstly, it created a higher level of technical complexity and risk, which could have potentially steered the team's focus from the main goal of the project. Secondly, it did not align as closely with the project's aim of empowering end users through education and awareness about data transparency. Lastly, the supervisor was more interested in the first mission statement.

2.4.3 Conclusion

In conclusion, the chosen MGS document was more suitable as it aligned better with the project vision and focused more on the education and awareness aspects.

2.5 Software used

The software & tooling that was during the project will be explained in this subchapter.

To create all the documentation the following programs were used:

1. **Word**; to write down meeting notes, ideas and to create reports.
2. **Excel**; for the creating of tables and the Gantt chart.
3. **Notepad, MarkText & Neovim**; to write down quick notes.
4. **OneDrive**; to store all the documents and share them.
5. **Zotero;** to coordinate research efforts & easier reference sources in the correct format.

For planning & communication online, the following platforms were used:

1. **Teams**; for serious and overall, more work specific topics.
2. **Email**; for contacting the supervisor and teachers.
3. **Signal**; for the ability to discuss informal topics. As a general group chat or to inform team members if they are late.
4. **Miro**; for easily seeing who is the weekly meeting leader & notetaker and progress of the project and assignments.

To develop the survey and website the following software was used.

1. **Microsoft Forms**; for creating & hosting the surveys we used.
2. **Visual Studio;** for coding the website. It is easy to use and versatile.
3. **GitHub**; for storing the code and hosting the website.

To create all the visual elements for the workshop, the program **Canva** was used.

3 Diagram of Processes

This chapter goes over the project's timeline and the tools of the global project management that were used in this project.

3.1 The Global project management

Global project management is crucial for tracking the progress of the project. It helps to set goals, plan, and ensure that deliverables are done in time for the agreed deadline. In addition, there are many tools that could be used for project management. To ensure that the project stays on track, a couple of those were used.

As a part of the global project management, the group developed a Gantt chart to have a more detailed view of the project assignments and their progress. Moreover, the group decided to use Miro as a Kanban board to establish the project's timeline and progress in a more visual way. The choice of using Miro was driven by the project group members' prior experience with the platform. The Gantt chart and the Miro board, which includes the timetable, the assignment schedule, and the meeting leader/notetaker schedule, were developed in the beginning of the project.

3.2 Project timeline

In this subchapter, the project timeline is shown in more detail.

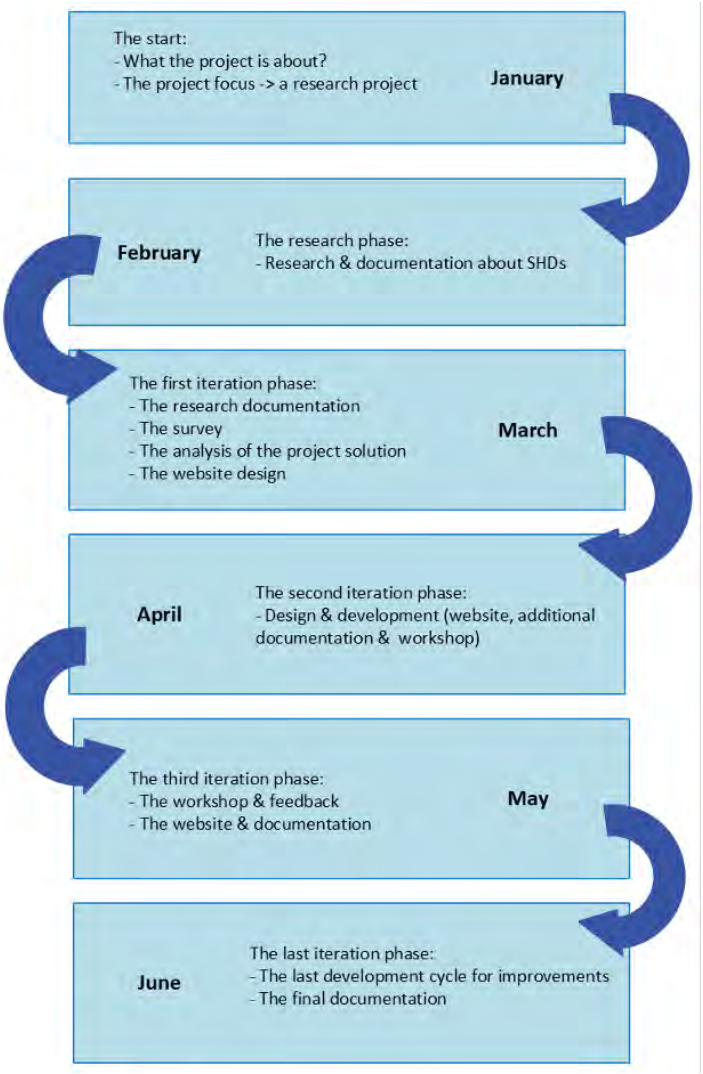


Figure 1 - Project Timeline

This project was set to run from January to June as shown in Figure 1.

January – The start:

- The project kicked off on the 22nd of January.
- The first group meeting and a meeting with the supervisor, Henry Mainsah were held.
- The project's focus began to clear up after several meetings with the supervisor, it would be a research project.

February – The research phase:

- The group started to research related work about SHDs and transparency, privacy, and security risks related to them.

March – The first iteration phase:

- After completing the research documentation, the group began to work on the survey.
- The group sent the survey to a varied target audience to gather information about their current knowledge of smart home devices on the 5th of March.
- The group had a meeting about the analysis of the project solution options and shared documentation responsibilities.
- A few members of the group started to develop & design the website.

April – The second iteration phase:

- The group began implementing the website, additional documentation, and planning a workshop.
- A few members of the group attended another RELINK workshop on the 12th of April, which was used as an inspiration for the project's workshop.

May – The third iteration phase:

- The workshop was held on the 16th of May and lasted three hours which included a brief introduction, two activities, feedback gathering and a lunch.
- Improvements were made to the website and documentation.
- A few improvements were made to finalize the website.

June (provisional timeline) – The last iteration phase:

- The plan is to finalize documentation.
- The final outcome of the project is set to be presented.

3.3 The Gantt Chart

The Gantt chart was created as part of the project management to have a clearer and more detailed view of the project's progress, tasks, and to see whether the project was on schedule.

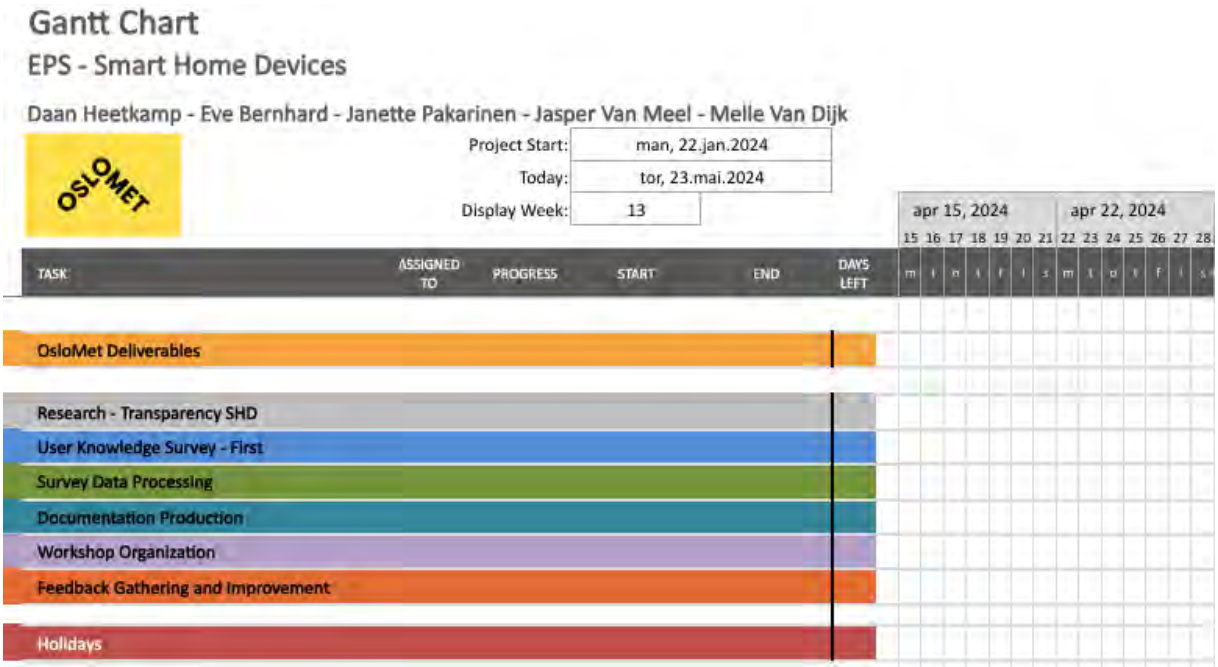


Figure 2 - Gantt Chart

The Gantt chart was made using Excel: there is a list of tasks and whom the task is assigned to. The task's progress, the start and end date and the number of days left are also shown. The chart was a useful tool to track the progress, schedule, and development of the project. There are several stages, as shown in Figure 2. These were created to represent the goals we identified in this project.

3.4 Miro

In addition to the Gantt chart, a more visual timetable, assignment schedule and the meeting leader / notetaker schedule were created in Miro.

3.4.1 Timetable

A timetable was created in Miro, incorporating all group meetings (purple), lectures (green), course assignment deadlines (pink), free weeks (blue) and meetings with the project supervisor (orange). A part of the timetable is shown in Figure 3.

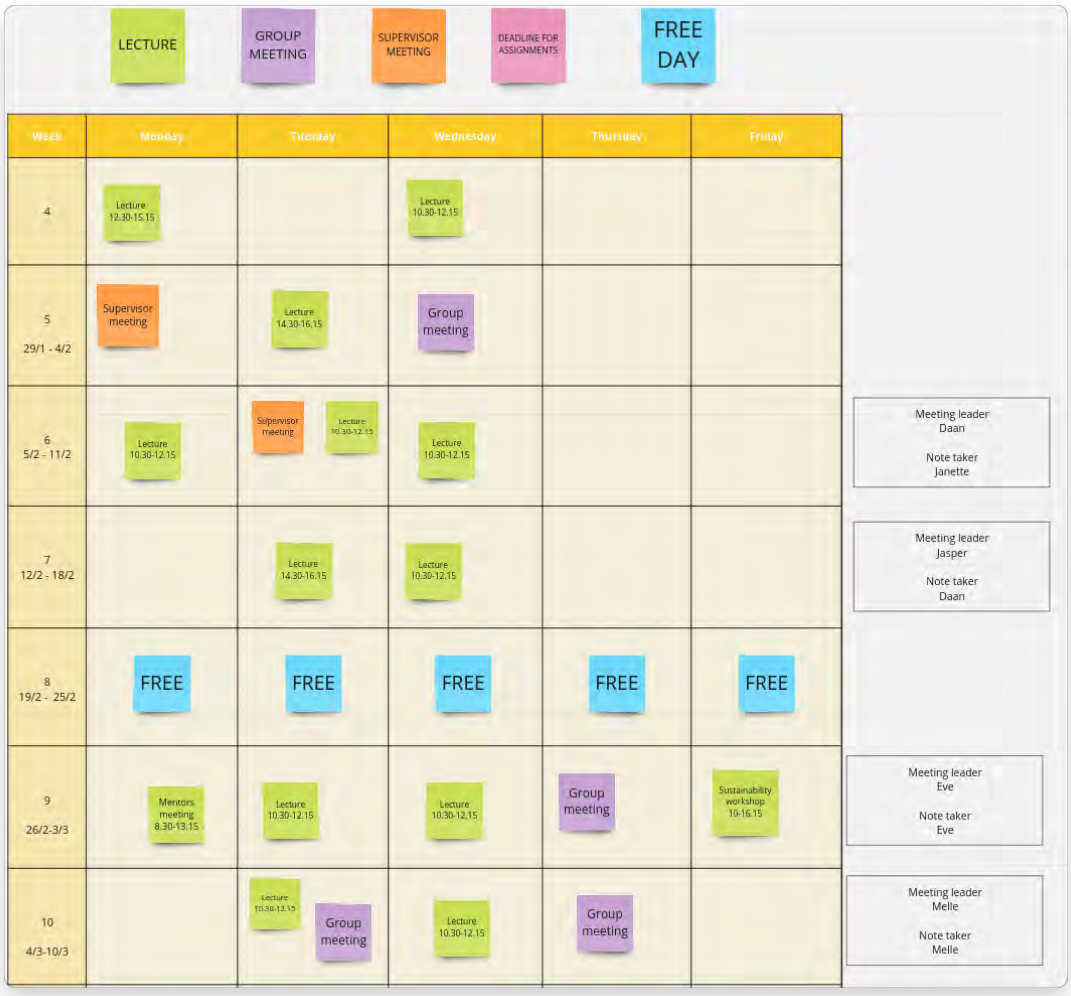


Figure 3 - Miro

3.4.2 Assignment schedule

A more visual schedule for assignments was created in Miro. The schedule was organized in the form of a to-do list with tasks distributed according to their progress status: backlog, in progress or done. Each assignment was assigned a start date and a due date. This system allowed the project group to stay on track with the course (yellow) and project assignments (blue) and submit them on time. This is shown in Figure 4.

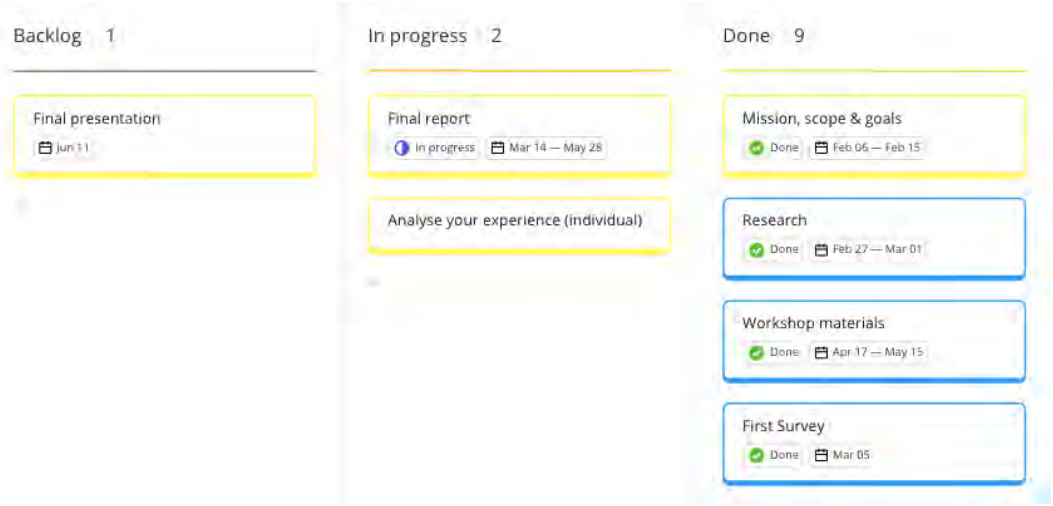


Figure 4 - Assignment schedule

3.4.3 The meeting leader & notetaker schedule

In addition to the assignment schedule, the meeting leader and notetaker schedule was devised in Miro, as presented in Figure 5. This schedule clearly delineated who was responsible for leading and taking notes during meetings and lectures with roles assigned on a weekly basis.

During the initial group meetings, it was decided that each week there would be two notetakers: Jasper and a second person who would rotate according to the Miro schedule.

Weeks	Meeting Leader	Notetaker
6	Daan	Janette
7	Jasper	Daan
8	-	-
9	Eve	Eve
10	Melle	Melle
11	Janette	Janette
12	Daan	Daan
13	-	-
14	Jasper	Eve
15	Eve	Melle
16	Melle	Janette
17	Janette	Daan
18	Daan	Eve
19	-	-
20	Jasper	Melle
21	Eve	Janette
22	Melle	Daan
23	Janette	Eve
24	Daan	Melle

Figure 5 - Meeting and notetaker schedule

4 Diagram of Solutions

The diagram in Figure 6 shows the solution we have researched and developed. The educational material is meant to provide people the information they need to make educated purchasing decisions when it comes to smart home devices.

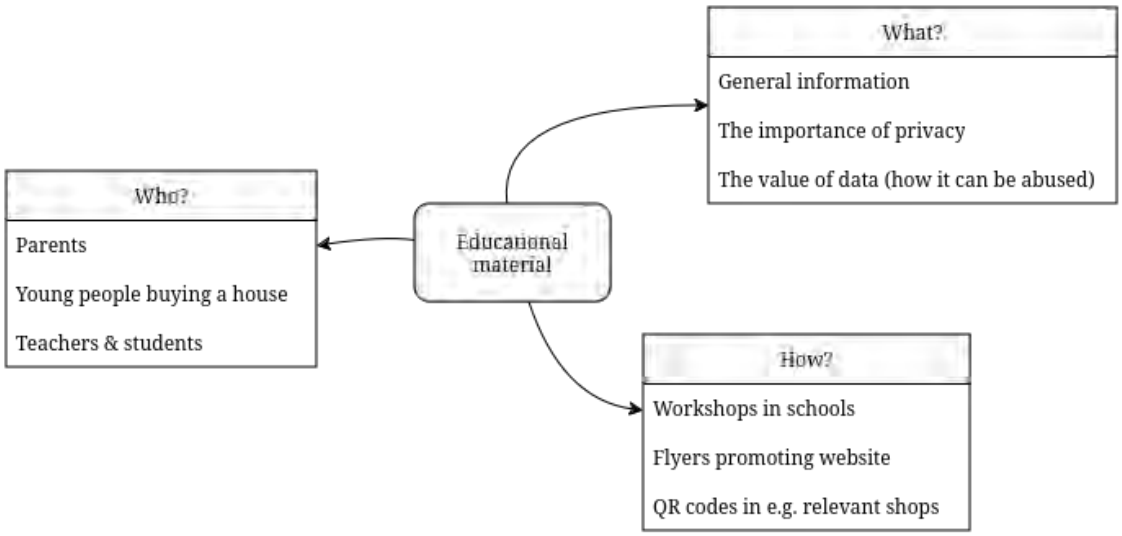


Figure 6 - Diagram of Solutions

Our target audience for the project are people who own a house or are looking to buy one. They might be interested in SHDs or concerned for their privacy or that of their kids. Highschool students are a good audience for achieving our goal as well, since they are quite tech-savvy these days and will eventually have to make decisions about SHDs themselves. Besides, teenagers being the target of excessive data collection and the targeted advertising that follows from it is especially worrying, since they are in general more susceptive to these tactics.

We hope to inform / educate these people on the importance of privacy, how easily data can be (ab)used and what they can do to protect themselves. Our website also includes a lot of basic information about SHDs to make sure that everybody can follow along, even for people without prior knowledge.

This information can be spread or taught in classrooms and in the form of interactive workshops. To reach non-students, the website can be promoted in and by relevant government institutions (e.g. In the town hall, by the data protection agency, etc.) or stores (IT stores, insurance companies, etc.) using flyers, QR codes etc.

After this short overview of our end result, the following chapter will detail our research process, the design choices and how we got to this point.

5 Research, Processes and Design

To lead our project, we have established several processes regarding research, design, and development. This section will first explain our research phase to then detail the design and development stages.

5.1 Research

Our initial research phase was conducted to provide a baseline to the project. That is why we began by exploring the SHD sector to understand its challenges and risks.

5.1.1 Brainstorm sessions and collecting research insights

To better understand the workings of an SHD and how it fits into our project, each team member selected and presented several research papers on the subject. Discussing these helped us gain perspective and make informed decisions during our meetings. These meetings also provided a better connection within the group, because everyone was in the know of which parts of the project intrigued each member.

Table 2 details the key papers that helped us to clearly orient the future of the project and define a basis for it.

Table 2 - Relevance and summary of the four key articles of our initial research

Name	Abstract	Relevance
User Perceptions of Smart Home IoT (Zheng et al., 2018)	This study consisted of interviews with SHD owners to investigate the purchasing decision process, user perceptions of the privacy risks and actions taken to protect themselves.	We understood that users are unaware of certain threats (e.g. devices that do not record audio/video) which is why we decide to dedicate a chapter to risks.
"It did not give me an option to decline" (Chalhoub et al., 2021)	This article reports on a study carried with six households from the UK. Households' members were tasked with selecting their SHDs to then integrating them in their home.	This made us realise that families constitute a primary audience for our solution as they often repurpose an SHD for parenting. That is why we meant to develop the website to be accessible to them as well.
I Want It Anyway: Consumer Perceptions of Smart Home Devices. (Wang & Klobas, 2020)	This study consisted of a survey that aimed to understand the behaviour of potential SHD consumers and their attitude towards risks and benefits.	This paper demonstrated that individuals tend to ignore the potential risks and focus more on potential benefits. With this in mind, we designed our solution to empower users to get more in control of their SHD.
Data rights in the consumer Internet of Things (Hudig et al., 2023)	This paper details research about 43 products in 11 categories of SHDs. A lot of time was spent contacting vendors to see if they were compliant with UK GDPR, and the article explains all of the steps taken.	The findings of this paper made us realise how opaque SHD are and motivated us to address this issue. We chose transparency as the main topic of our solution.

After discussing the research papers each member read, we did brainstorm sessions with our supervisor. Through these sessions, we decided to focus on raising awareness about privacy risks related to SHDs. Another topic we wanted to address is the transparency of SHDs and how users should be informed before deciding to purchase a SHD. This decision was based on research findings and discussions, aligning with the project's mission, goals, and scope.

5.2 Processes and design

Throughout the project, different processes were conducted to work towards the end goals and develop our solution to the mission statement. As our end solution is multifaceted, it is crucial to understand the decision-making processes and thought patterns that occurred.

Once the initial research was conducted and we built a basis to understand the SHD sector, the challenges and risks that accompany it, we reviewed our MGS document to decide upon a direction - as explained in chapter *2.4*. After careful consideration, we decided to focus on raising awareness on privacy risks and issues posed by SHDs.

5.2.1 Designing our solution

After defining the specific subject we would tackle, we designed the format we would use for that purpose. To that end we decided to list the pros and cons of each format. This allowed us to fully understand the different options we had, the advantages they present and how they are better suited for different audiences. This list can be seen in Table 3.

Table 3 - Pros and cons summary of the documentation types

Website	
Pros	Cons
- Accessible everywhere - Free - Information can be updated	- Harder to design for the team - If not designed correctly, not accessible to everyone - Internet connection required - Could be drowned in the ocean that is the web
Magazine	
Pros	Cons
- Accessible to all ages if user is interested - Physical format for people to keep	- Smaller reach than website - Information is not easily updateable - The team needs graphic design skills
Social media channel	
Pros	Cons
- Accessible - Free - Easily updateable - Could reach a big audience	- Should be updated frequently - Hard to showcase one issue only - Could be drowned in the ocean of Instagram
YouTube channel	
Pros	Cons
- Free - Video is a good support to explain hard issues in an easy way - Could reach a big audience	- The team does not have skills to create good quality videos - Would cost a lot of money to create - Time consuming
Posters / Infographic	
Pros	Cons
- Accessible to all ages if user is interested - Visuals are an easy way to explain hard issues	- Small reach - The team needs graphic design skills - Information is not easily updateable

We then decided to conduct a MoSCoW (Must have / Should have / Could have / Will not have) analysis of the format we chose: the website. MoSCoW is a method to help define the scope of a project and prioritize the objectives and features. It is essentially used in project management to categorize product requirements by their importance.
Reflecting on this analysis, we realized the need to define a more precise target audience. Our website was meant to raise awareness on privacy of SHDs, but we needed a more defined audience for us to design an attractive and engaging website.

We oriented our website based on the survey and its conclusion, namely that most students do not understand the risks associated with SHDs. Our new solution was to build a ready-made lesson for teachers to host as part of a class on this theme. The solution was concepted as threefold:

- A website tutorial on privacy in SHDs, suitable for mobile devices. The course can be followed by students in a computer room.
- Two sets of activities for the teacher to organize in a practical workshop lesson.
- A document that serves as teaching material to help with the administrative of organization.

The two new tasks were to develop the website and to develop the workshops activities. Therefore, we divided our group into two subgroups, each responsible for one side.

The MoSCoW analysis can be seen in Attachment 3.
The survey results can be found in Attachment 5.

5.2.2 Development process of the website

Before starting the programming, we did some graphic design to discuss the overall looks of the website. We wanted a rather modern and sober looking font, so we chose Open Sans. For that same reason we only picked two accent colours, as can be seen in Figure 7.

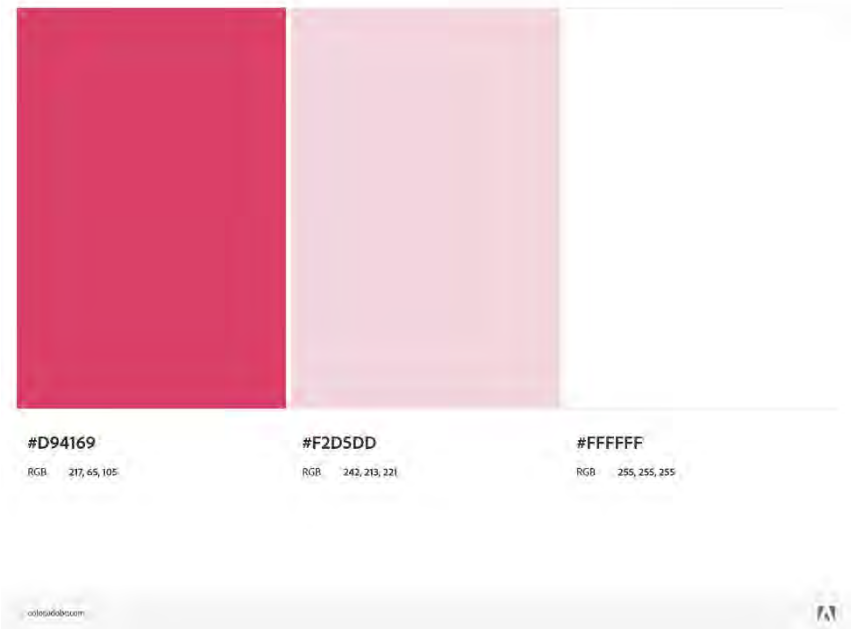


Figure 7 - Colour palette of the website

To give an idea of what this graphic designing rendered, see Figure 8 for the following website screenshots. The full website can be seen here: **https://evebrnd.github.io/eps/**.

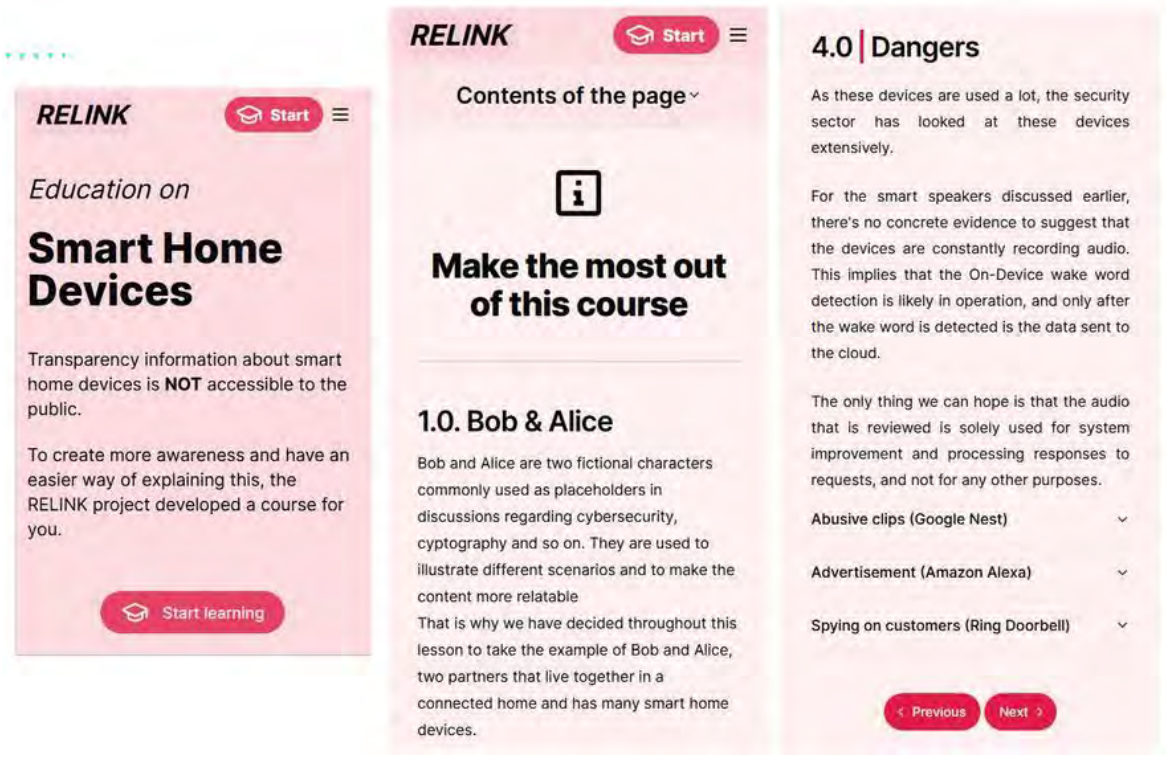


Figure 8 - Colour palette shown on the website

Then we went on to planning the work by laying out each task that would be carried out in GitHub Issues. GitHub Issues is a tool that allows you to create a tab to describe and explain the goal of a given task. One can then add labels to this issue, for example MVP to state that a given feature is required as part of the Minimum Viable Product. This issue can be assigned to someone, which helps assess the workload of the team members. We also used GitHub Issues to report bugs on the website. This helped us to track the issues for a future solve without having to drop the current developments.

Each task had to be explained with an explicit title, a short description to explain what was expected and its relevance, and a few resources to help orient the development. Every ongoing development was clearly stated, and each task could be assigned to any member. This was done to avoid having tasks dependent on specific individuals and for the work to be taken over easily by another member at any moment in case of illnesses.

Once the design phase of the tasks was done, each team member working on the website self-assigned the issues and started programming. When work on a given task was deemed ready to be added to the product, another team member was asked to review and comment on it.
The activity diagram for the website development process can be seen in Figure 9.

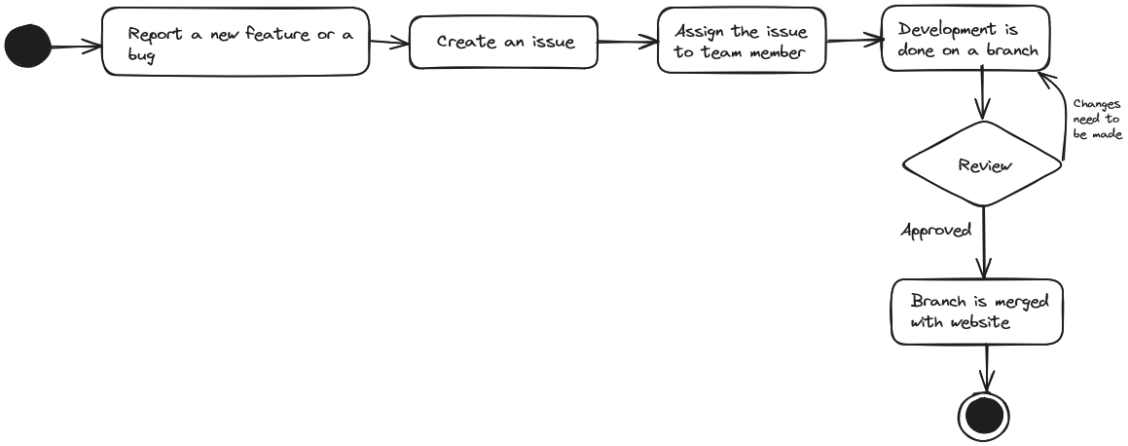


Figure 9 - Activity diagram to summarize the website development process

In sum, the different programming phases were the following:

- Creation of the website structure: home page, chapters and about us pages.
- Redaction and formatting of each chapter.
- Improvement of home page design and internal navigation.
- Creation of the teaching material and privacy risk calculator.
- Rewriting of every chapter to fit one sole writing style.

5.2.3 Development process of the workshop

As explained before, in addition to the website, we wanted to create two activities that could be used in the lesson. Developing a workshop was a way to test these activities.

We initially wanted to set clear goals for the workshop activities. What do we want to accomplish? Do we want participants to learn facts? Reflect on IoT sector? Only make them interact on these topics? That is why we detailed three axes that would guide our discussions on the format of the activities:

- Highlight the participants' knowledge and understanding of SHDs.
- Make the participants interact and express their opinions on SHDs' privacy.
- Make the participants reflect on their relationship with SHDs.

We emphasized in the workshop the need for users to be careful with their devices. We highlighted that if users are not cautious, manufacturers may not prioritize being transparent about how data is collected, shared, or sold to third parties. This highlighted the role users play in protecting their privacy and using SHDs responsibly. This was bundled in an introductory presentation during the workshop.

The next step was to brainstorm and imagine the form of the workshop activities that would fit these objectives. Would it be a card-based game? A board game? A game that uses phone or IT? We decided upon two sets of cards game.

We then went on to researching smart home facts and imagining some, plausible enough to be confused with real ones. All true facts are sourced and can be checked using QR-codes.

Finally came the designing part of the cards. Every deck of cards needed to have its own visual identity to avoid confusion between the activities. Furthermore, cards had to be designed in a clear and easy way to understand. Several tests were made to make sure that participants would easily grasp the activities. The cards were printed, proofread, and corrected.
The activity diagram for the workshop development process can be seen in Figure 10.

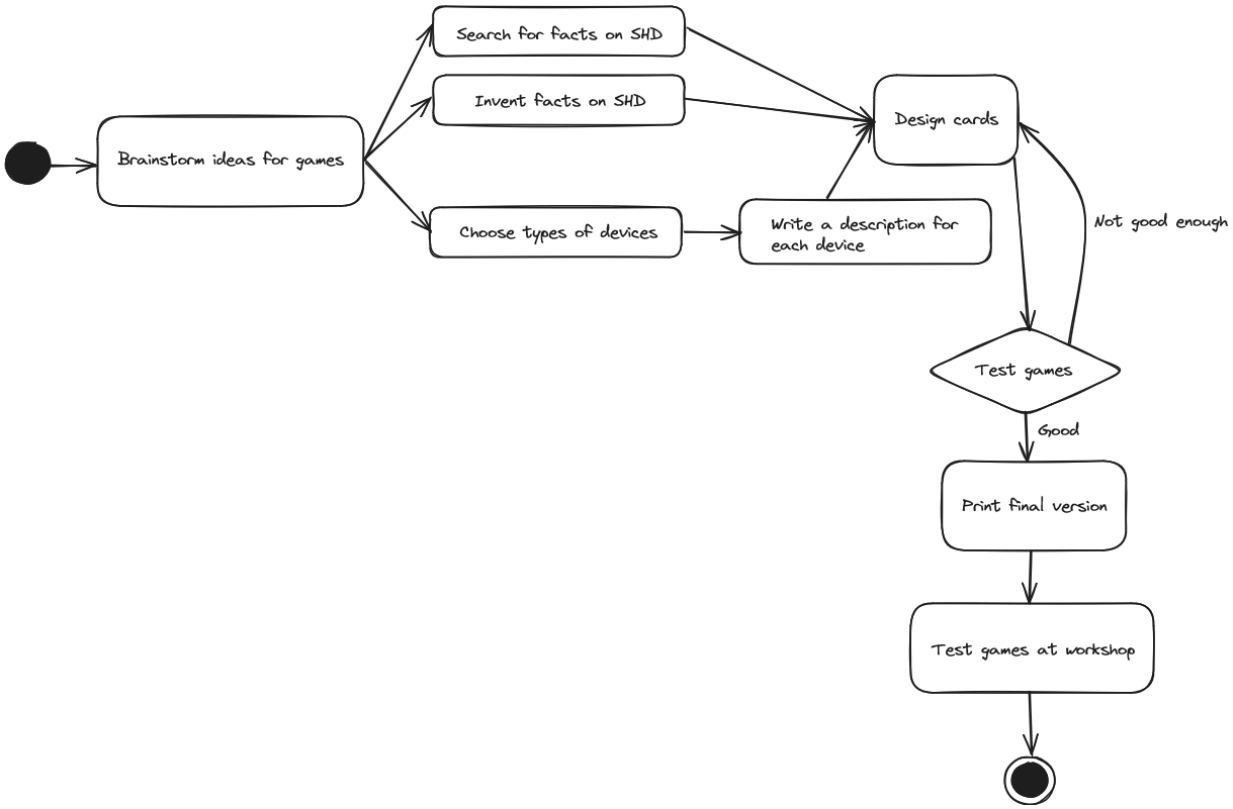


Figure 10 - Activity diagram to summarize the workshop development process

The workshop was considered a success according to participants. It was a great space for sharing knowledge, raising awareness about privacy risks in SHDs, and encouraging participants to think about using smart home technologies. By combining informative presentations with interactive activities, we created a learning experience that made participants make more informed decisions about their SHDs. The final goal of the workshop is to incorporate it into the classroom, so teachers can educate students about the risks of SHDs.

6 Solutions of the project

This chapter will describe the final product that has been created. It will include the most significant changes that have occurred to the team during the lifespan of the project. This final product will be explained in three parts.

6.1 Initial changes

At the beginning of the project, the final objective of the project was vague according to the team. The only concrete point that was clear, was that it had to educate the public about the transparency of SHDs.

The initial plan that was submitted to the supervisor included creating a physical product that could be recreated by the consumer with an explanation of each component. This however was not in the scope of the supervisor, so the plan had to be changed. In his eyes, it was not preferred to create a physical product due to time constraints.

The second plan that was discussed with the supervisor, was to use an existing smart home product and explain the transparency of that product using different chapters. In each chapter a part of the device would be explained together with the global description of what the part does.
As an example, a microphone in a speaker would be explained together with other sensors that are being used in the most used SHDs. This second plan was partly accepted by the supervisor but still not perfect. For the final product, according to the supervisor, we should think more about what target audience we wanted to market it to.

After these first two big meetings, with multiple small meetings in between, the final product was drawn up by the team. The target audience should be younger people that are in high school or university and parents. To advertise the final product the team decided it should be able to be used in the classroom. This constructed the final plan to create teaching material. It would be a mix between the second main plan together with a structured way of working so that it is easy for teachers to give a lecture about the subject.

6.2 Final Product

The final product can be split up into three parts, all of which have been incorporated into one website. The three parts as explained before in chapter 5.2.1 are:

1. The learning chapters where the students/parents can read the documentation.
2. The teaching material that includes the way of working for teachers, presentation, and homework.
3. The activities that can be performed during a workshop or lesson.

6.2.1 Learning chapters

The learning chapters consist of six main chapters. Each chapter is broken up into a separate subject.
For the main subjects, multiple chapters would need to be linked with each other, but also be usable independently. This structure of the chapters allows for the complexity to be gradually increased, which in turn should make it easier for students to read all the chapters.

The following chapters have been created:

1. Introduction – What is a SHD?
2. Opinions and studies - Opinion and studies of the general public on SHDs
3. Transparency – What transparency means and why it is important?
4. Internal Workings – The internal workings of a SHD
5. Artificial Intelligence – The role of AI in SHDs
6. Benefits and Risks – The benefits and risks of SHDs.

6.2.1.1 Chapter 1: Introduction

This chapter will explain the definition of a SHD. This in turn will give a scope to the reader.
During the survey and research of academic papers, it was discovered by the team that devices like a smart speaker or smart doorbell are associated with SHDs. This is correct, but almost nobody factored in that modern cars can also be associated with SHDs. This is why, following the definition of a SHD, a list of SHDs is shown to provide a new perspective on what a SHD can be to the reader.
At the end of this chapter, the view of the reader should be broadened to have a clear understanding of what represents a SHD. This will make the reader prepared for the next chapters.

6.2.1.2 Chapter 2: Opinions and studies

This chapter focuses on the public opinion of SHDs, and studies related to SHDs.
It will at first, give a quick summary of the most useful research papers that had been found during the research stage of the team. The most relevant papers that were discovered will be quickly and easily explained. After that, the most interesting survey results will be discussed. At the end, there is a summary of the findings in this chapter to recap all the information.
This chapter should give the reader a baseline understanding of the general perceived benefits and risks of SHDs. This also provides a basic outline to the reader of what and why the chapters following this chapter are explained.

6.2.1.3 Chapter 3: Transparency

This chapter discusses the concept of transparency in the context of connected home devices.
Transparency can be interpreted by individuals in numerous ways. It is also the main goal to explain the transparency in this project. This is why a separate chapter in the teaching material was created: to explain the transparency of SHDs.
It will explain items like General Data Protection Regulation (GDPR), the rights of users in the EU/EAA region and why transparency in SHDs should matter to the reader.
By the end of this chapter, the reader should have a deeper understanding of the importance of transparency in the scope of SHDs and the role it plays in user trust.

6.2.1.4 Chapter 4: Internal Workings

This chapter delves into the internal workings of different smart devices, their sensors, and where the data processing of the sensor data is happening. To explain this, the chapter will use two SHDs as examples.
The main point of this chapter is to explain to the reader where gathered data is processed (on-device or cloud) and the potential dangers regarding two chosen SHDs.
By the end of this chapter, the reader should have a general overview of how SHDs internally work, and where the data can be processed.

6.2.1.5 Chapter 5: Artificial Intelligence

This chapter discusses artificial intelligence, specifically neural networks, and deep learning.
When the team researched this subject and reviewed the survey responses, the team noticed that a lot of people got overwhelmed by the word “Artificial Intelligence.”
This is why a separate chapter in the teaching material was created: to define the differences between the different AI models and their wordings.
At the end of this chapter, the reader should have a solid understanding of the definition of AI and the potential implications of its use.

6.2.1.6 Chapter 6: Benefits and Risks

This chapter focusses on the benefits and risks of SHDs.
When the team discussed what the final chapter should be, this chapter was chosen. It explains the benefits and risks of SHDs one last time and hopefully gives a last impulse to the reader to really think about what the devices in your home can do. There are a lot of benefits, but at the same time, there are a lot of risks associated with that.
The chapter should provide the reader with more clarity on what a SHD can assist with in improving daily quality of life stuff. But should also highlight the risks of having such a device in your home.

6.2.1.7 Extra chapters: Kick-off and Resources

These two chapters are additional chapters that have been created to complement the main chapters.

The kick-off page will be the first page that the reader will arrive on. It gives an introduction to the reader about the chapters. In the main chapters, the example of Bob and Alice is used, these two characters will be quickly introduced to the reader. The ten commandments of the website will also be shown to the reader.

The resources page is created to give the reader the ability to take matters into their own hands. In the last chapter, 'Benefits and Risks,' the user should be thinking about how they use SHDs. To complement this way of thinking, resources are placed just after this last chapter. It includes easy actions the reader can perform on the spot in their own home. It also gives multiple articles that can be read through to get more information.

6.2.2 Teaching material

This part contains the course material for the teachers/organizers. It includes the flow of working, homework exercises and presentation that they could use.

6.2.2.1 Flow of working

The flow of working is a step-by-step plan for teachers to provide homework exercises, provide the lesson and explain the activities to the students.
It is built up in an easy-to-follow way and gives teachers a possibility to create their own spin to the lesson. The main steps are:

- **Starting homework assignment.**
  The first step is to give the students a homework assignment. This assignment is intended to prepare the students for the course.
  The student should locate three electronic devices in their residence and write down the name and the function of the device.
  The student should take this list to the main lesson.

- **Lesson part one.**
  The teacher should explain a bit about the topic. The teacher has around ten minutes to do this.

- **Lesson part two.**
  The teacher should let the students go through the chapters on the website. The students can do little quizzes on the website after each chapter. The students have around 40 minutes to do this.

- **Lesson part three.**
  The teacher should create groups of four students each. These groups should be assigned one of the two activities. This could be done on a 50/50 basis or in any manner the teacher likes. The students have approximately 30 minutes to do this.

- **Lesson part four.**
  The teacher should explain the finishing homework assignment and reflect on the lesson. The teacher has approximately ten minutes for this.

- **Finishing homework assignment.**
  The last homework assignment is about evaluating the risks raised by the devices listed during the first homework. The student will use the Privacy Calculator page available on the website to determine the risks of the devices and create a small report about it.
  The teacher can certainly rewrite the homework assignment to their liking.

6.2.2.2 Privacy calculator

This page has been made to create a possibility for the students or anyone else to analyse the risk of a device. The analysis form is based around the privacy and transparency of the device.

The form used was created by a previous EPS group working for the RELINK project. In their semester they focused on a way to make it easy for users to see the risks associated with a device. (Gau et al., 2019)

Their suggestion at the end of the report was to make it easier for people to fill in the form and make the sentences more understandable, since it was written in technical terms.
This form was taken, rewritten to a simpler form, and implemented into the website.

The implementation of the calculator on the website can be seen in Figure 11 and Figure 12.

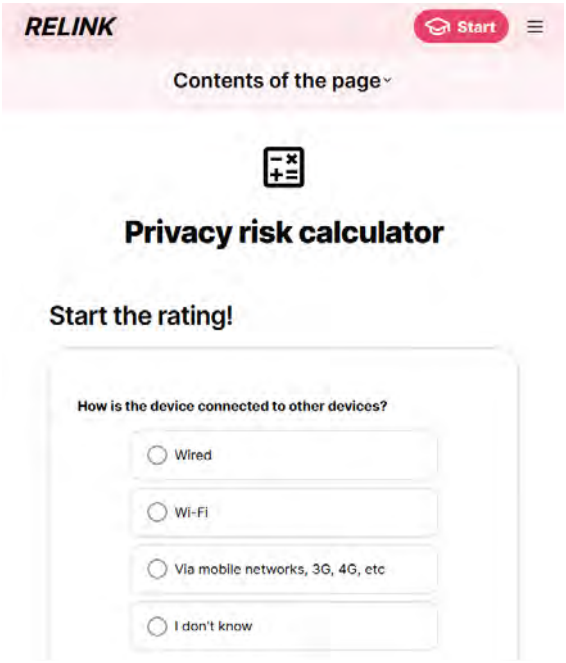


Figure 11 Privacy calculator

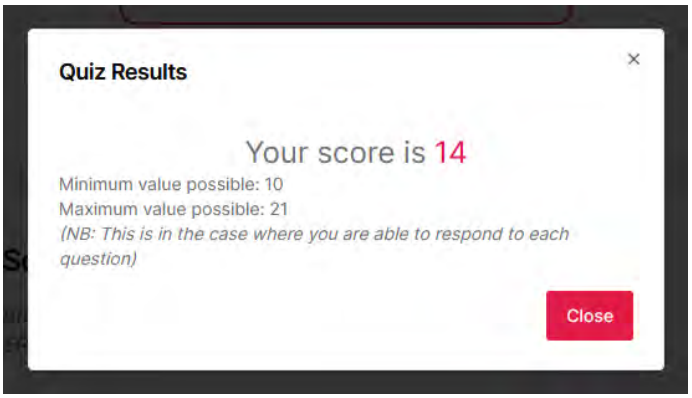


Figure 12 Privacy calculator results

6.2.3 Group activities

To enhance a lesson or to create a workshop two activities and a presentation were created for the students and teacher.
The main goal of these activities is to create a discussion within groups about different perspectives of SHDs.

6.2.3.1 Presentation file

The presentation file was created in PowerPoint to add-on to the lesson or to create a workshop. This file gives a quick introduction of the general information around SHDs. It also will explain how the two activities need to be played.

6.2.3.2 Activity one – The cards: True or False

This activity involves a set of cards with various real and fictitious events.
On one side of the card the real or fictitious event is written down. On the other side it shows if this event is true or false. Both sides are shown in Figure 13 and Figure 14.

The game works as follows:
Players take turns drawing a card from the stack and must decide without picking it up from the table where to categorize it on a scale of concerning/not concerning and true/false. Group discussions are encouraged to decide the placement of cards.
Once all cards are categorized, they can be flipped to reveal the correct answer and source. Post-reveal discussions about the group's conclusions and thought processes are also part of the game.

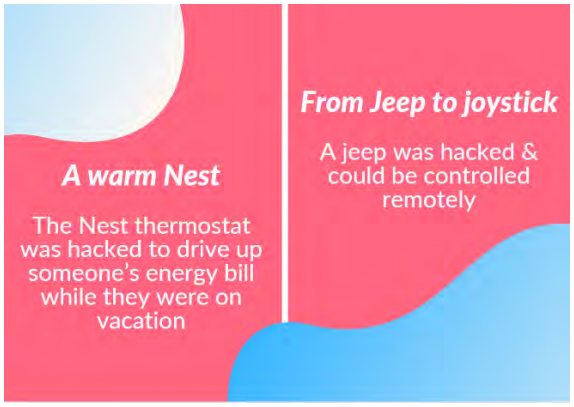


Figure 13 - Activity one - Top Side

Figure 14 - Activity one - Bottom Side

6.2.3.3 Activity two – Consumer vs hacker

This activity involves eight cards that are provided, each featuring a device, its properties, and associated questions. Two of these cards are shown in Figure 15.

The game works as follows:
Participants examine SHDs from both a consumer and hackers' perspective.
Players take turns picking a card and discussing the device, its usefulness in everyday life, its benefits, and the feasibility of living without it. Then, the perspective shifts to that of a hacker, considering potential exploits, damage to the user, spying possibilities, and potential dangers.
Finally, players reflect on their initial impressions of the device and discuss any changes in their opinion or new insights gained.

Figure 15 - Activity two

7 Commentary/Evaluation

Compared to our initial goals, a few changes have been made as explained at the end of chapter 2.2.1. At first, we wanted to write our documentation centred on one SHD. We wanted to try to raise awareness on privacy by taking the example of one existing commercial SHD. In the end we wrote a more general documentation that uses SHDs as examples from time to time. It was not about taking one device apart to explain how it works and how it poses transparency threats but more about why transparency in a SHD is important.
After careful consideration with our supervisor, we also chose not to do the second survey we had planned. We believed it was not relevant to send the same survey anymore as we would not receive much new data from it.

Although our final solution successfully fulfils the mission brief, several improvement points can be raised. Our workshop was well received by the participants, and they enjoyed the amount of knowledge and information that was presented to them. Nevertheless, for a future use in actual classrooms, the presentation slides should be further developed to contain more in-depth content, creating a more solid course.
Regarding the website, it could be interesting to research how it can be used & advertised more. The resource exists and is available, but we did not advertise it within OsloMet or elsewhere. Because developing the website was rather time consuming, we did not have the opportunity to test it on users. We had planned to showcase it to at least ten users with an evaluation grid they would fill in.

Before our group, two other EPS projects were conducted in partnership with Relink. In 2019, a team worked to develop a model of risk assessment that aims to evaluate vulnerabilities of SHDs (Gau et al., 2019). Therefore, it focused on the security aspect while we decided to investigate the transparency side. As the 2019 project theme was more relevant to our scope, we decided to incorporate their risk assessment in our work.
Then in 2022, a team chose to prove that a SHD can be a tool to reduce the environmental impact of tiny houses (Vagoulabaranane et al., 2022). They developed a proof of concept of a SHD coupled with an app and website that would help users reduce their water consumption. Both their project and ours differ in their approach: the 2022 team wanted to use a SHD as a tool, while we aimed to raise awareness regarding the risks of a SHD.

While trying to scope our project, we initially thought of another mission statement. We wanted to recreate a SHD in a way that respects the privacy of end users. We thought of trying to prototype a Ring Doorbell alternative to demonstrate that data transparent devices can and should be made. Our supervisor encouraged us towards another direction; however, this could still be a mission statement for a future EPS group.

8 Conclusion

At the beginning, the focus and the final outcome of the project were not clear according to us. The initial idea for the project solution was to create or modify a physical product, but after a couple of meetings with the supervisor, the project's focus got clarified: the project was not about creating a physical product, instead it was a research project.

The initial plan changed, and it was to use an existing smart home device and explain the transparency of the device using different chapters, where in each chapter a part of the device would be explained. This was partly accepted by the supervisor. According to him, the final product should be marketed to a specific group, which we decided to be younger people who are in high school or university and parents. We settled on creating teaching material that should be usable in a classroom.

As a result, we created a website, additional documentation, and a workshop. The final product can be divided into three different parts, all of which have been incorporated into one website. The three parts are: the learning chapters, the teaching material, and activities. The result of the project is in one place, on the website, which makes it easier to find.

9 Group Reflection

This chapter will show the individual reflection of each team member on the European Project Semester.

9.1 Eve Bernhard

These last five months we have led and worked on our EPS project. In the end the final solution we developed is split into two sections, the website and the workshop, which both contribute to the roadmap we aimed to build for a class on Smart Home Devices' privacy.

Although I believe we have successfully led our project and fulfilled our goals, the first month and the project kick-off were rather challenging. We all came from different fields of study and countries, have different customs, ways of communicating and in sum, different cultures. We also all had our ideas of what the project would be about and given the pitch, had formed hopes and expectations on it. It was then frustrating when we first got together and brainstormed on the solutions and directions we could take.

Working on a research project was a first for me. I am used to project based classes in my studies, however in software engineering and project management, the end goal is usually clearly defined, and the missions/goals/scope are quite obvious. Even though it was puzzling and frustrating at times to see the project take a turn that was not expected, it was a pleasant experience. Working in a multicultural group gave me insights on how projects are led in other countries, I learned about group contracts, attributed roles when I was used to implicit group contracts and tasks-based roles.

If I had been given the opportunity to start over this experience, I believe I would re-do the way we started the semester. The first meeting would be more informal and about each team member presenting themselves and their country. I liked how we each talked about our expectations and plans for the semester, but I feel we could have benefited from knowing more about our personalities, our hobbies, etc (which we got to know as the semester went on). As time went on, we of course got to know each other better and really became friends. I am glad to have been a part of EPS with great people and good energies.

9.2 Melle van Dijk

At the beginning of the project, I was very motivated in the beginning, because one of our initial ideas was creating a smart home device that was equivalent to the ring doorbell, but the data could be stored locally. this was more up my alley because I have some knowledge about Linux systems and want to learn about localizing data efficiently. our supervisor did not agree however and wanted us to focus more on a research paper or perhaps teaching material. Though I thought the subject was interesting, I have already done a bit of raising awareness amongst users in my previous semester, which made this semester a little less interesting for me. Additionally, we created a website that I was not that involved in. Luckily, I got to do my own chapter on the website so I could learn a bit more about Git and Tailwind HTML/CSS.

Because I was not incredibly invested in the project, I felt like I was lacking a bit throughout the project. The rest of the team was significantly more invested in the project than I was, which made it difficult for me to feel significant enough with my contributions. Of course, I only have myself to blame for this, because my teammates have been great throughout the entire project.

During the workshop, I did feel like I had more of an impact because to my surprise, I really enjoyed doing the workshop and seeing so many people who were initially not that invested in their privacy and data transparency change their minds about certain subjects. Though it was not a large group, it felt good to make at least a little bit of difference in improving people's security awareness.

I am very happy with the team itself and am glad I got to spend the semester with these people. The first few months, we had to get used to each other for a bit. I am very straightforward with people, as are my jokes. I think the team had to get used to me a little before we became friends.

Overall, I am happy with how the project went, and feel like I have grown a lot throughout the semester. Special thanks go out to Tom and Tengel, who were ready to assist us in any way possible if it were needed (instead of keeping a close eye on our project, hindering our creative freedom). A final note goes out to Henry, who gave us some good inspiration about steering our project in the right direction, and really think about where we want to go with the project

9.3 Daan Heetkamp

In the beginning of the EPS period when we got the groups and project assigned it was a bit of a search for me. This project my last chosen option, so I had little experience in this field (AI). Most of the others in the group did have more experience when it came to SHDs and AI. I for one did have electronic experience but that was of little use. After some discussing and meetings with our supervisor the project became clearer. The AI was off the radar and the focus was mainly on the SHDs. This was new for everyone.

The group was a bit rough in the beginning but after some weeks and two activities we really became to know each other in how we work/react. This was something I tried to look out for in the beginning. In the Netherlands I would be direct, and I knew this was different in other countries. I was trying to be more laid back and try to approach things from another side. I think that after two months everyone really knew how all of us acted. I knew what I was able to do/say and what would come over as rude.

While doing this semester, I think we all learned a lot about each other. Especially at the end of the semester when we were together for long days it changed from a project group to a friend group! I think we all have our strengths and weaknesses and acknowledge that. To be honest, I think it's a pity we didn't do more together at the beginning of the semester.

I'm proud of what we created. It might not have been the project that we wanted at the beginning, but we all pushed through and sought things we were interested in to create enthusiasm. The final result is something that I and we can be proud of. We all learned new things and created an amazing website/workshop with the created information.

During this project I learned many things that maybe were not related to the project, but more directed to communication. I learned that as explained earlier, directness can come over as rude quickly. Working with people from other countries also means that everyone has their own way of working. This is something I found quite interesting but also difficult at times, but that is fine. I took things from the discussions that we had and incorporated that to create a new way of working here. It is fine to do some things differently.

I want to thank all my group members for their commitment, openness and in general being amazing group mates and people. Especially thanks for going against me when I needed it but at the other hand being there for me when things were a bit "rough." You all are great!
I also want to thank Tengel, Tom and Henry for making this semester possible and helping us with the creation of the project. The communication and interest/care to us was great.

9.4 Jasper van Meel

As a cybersecurity student, this project was the only one out of the five that seemed relevant to my study. In the beginning, all of us were a little uncertain about this project & where it was meant to go. We soon discovered that there was no 'meant to go,' it was all up to us to decide what we wanted to do & what our scope should be. The only requirement is that our research project should aim to empower end users in the context of smart home devices. I do not think that anybody expected this level of uncertainty/freedom, so we were initially taken a little off-guard by it.

We had all the knowledge and skills necessary to pull off prototyping a smart home device, but since this was a research project, we gravitated more towards other solutions. This lack of direction and prototyping was a little disappointing, especially in the beginning, but soon after, we decided to just make the best of it & found a mission that satisfied everybody.

While this was not the project that we all envisioned it to be, it was an incredibly valuable experience – one I am very fortunate to have had during my studies – and I am incredibly glad that I had these four people with me on this journey, none of whom decided to bail out after the initial setback.

The most important thing I will take with me from EPS – apart from the countless friendships & good experiences – is that uncertainty in a project is not a bad thing. In contrary: uncertainty gives birth to potential. If your goal is not set in stone, that means that you can still go anywhere and do anything. Working in this international group has also proven once again that "not my way of doing things" != "an incorrect way of doing things," especially in such a multicultural setting, and that communication is the single most important factor to hold a group together. It can quite literally make or break the project.

9.5 Janette Pakarinen

Before the course started, students got to list three most interesting project topics. I put first this project, Contesting AI in smart home devices. I got excited when I read the word AI because I wanted to have more general knowledge about it, and I thought that the project is about not only programming, because I didn't have much experience about, but also learning about the topic. The first day when we got to meet our group, I was at the same time excited and terrified. I noticed that in our group, there were a lot of knowledge about programming and that terrified me at first because I thought that could I give something to the project when I didn't know almost anything about programming but then I realized that maybe I could add value to the project otherwise. After couple of meetings with the supervisor, the project became clearer, it was a research project, not only programming. Also, we got to define our own project which was a new thing for me. But it surprised me that the project was not all about AI.

As a group, we started to work in agreement, but maybe a little cautiously because we didn't know each other and other's ways of working yet. In addition, coming from four different countries and cultures made people maybe more cautious because someone else's approach may be a rude way in another's culture. After some meetings and free time activities, I believe our project group started to work better. I had already some experience about project work with people from different cultures from my home university. However, now that I was in a new country with a new international group, I felt sometimes that I wasn't able to add value to the project in the meetings due to being shyer than rest of my group. Although, our group worked really well together.

To sum up, I have learned that I should try to be more open about my opinions, get out of my own comfort zone and not taking someone else's approach in a rude way, they are not trying to be rude, it is just a way how their culture is. To clarify, I have learned from EPS experience that working with people from another cultures is an excellent learning experience, and I should try to approach the project work another way. Lastly, huge thanks to our teachers, supervisor, and my team members. The team was even better than I could have imagined in the start of the semester, and we really worked well together and became friends.

10 References

Gau, Caroline, Eray Kip, Eren Sensoy & Edjinam Siliadin (2019). Relink – European Project Semester. Oslo: OsloMet report. Ref: https://uni.oslomet.no/relink/wp-content/uploads/sites/193/2021/12/EPS-Group-M_2019_RELINK-report.pdf

Vagoulabaranane, N., van Dam, N., Garcia, L. S., Duly, A., & Spanjaard, J. (2022). EPS-2022_RELINK_SmartHome-report.

UN Department of Economic and Social Affairs Sustainable Development, (2024). "Sustainable Development Goals" Referenced on 07/03/2024 from https://sdgs.un.org/

Zheng, S., Apthorpe, N., Chetty, M., & Feamster, N. (2018). User Perceptions of Smart Home IoT Privacy. Proceedings of the ACM on Human-Computer Interaction, 2(CSCW), 200:1-200:20. https://doi.org/10.1145/3274469

Chalhoub, G., Kraemer, M. J., Nthala, N., & Flechais, I. (2021). "It did not give me an option to decline": A Longitudinal Analysis of the User Experience of Security and Privacy in Smart Home Products. Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems, 1–16. https://doi.org/10.1145/3411764.3445691

Wang, X., McGill, T. J., & Klobas, J. E. (2020). I Want It Anyway: Consumer Perceptions of Smart Home Devices. Journal of Computer Information Systems, 60(5), 437–447. https://doi.org/10.1080/08874417.2018.1528486

Hudig, A. I., Norval, C., & Singh, J. (2023). Data rights in the consumer Internet of Things. International Conference on AI and the Digital Economy (CADE 2023), 25–30. https://doi.org/10.1049/icp.2023.2560

Attachment 1. Missions, Goals and Scope

This attachment shows the mission, goals, and scope document.

Mission statements

1. Research the data transparency of smart home devices and empower end users by educating them through documentation about the dangers and risks.
2. Modify a mainstream smart home device and document how it can be done to provide end users with more control over their data and the device.
3. Recreate a smart home device in a way that respects the privacy of end users to demonstrate what can be done to enhance data transparency.

Goals

Mission statement 1 goals

1. Based on research regarding transparency in smart home devices, create a survey to get an idea of the knowledge of end users about smart home devices.
2. Process the results of the survey and choose a device on which we will analyse our data transparency research.
3. Decide on the type of documentation we want to produce.
4. Produce and publish documentation about the chosen device based on our research.
5. Organize a workshop in which we present our findings and the documentation and showcase the inner workings of the device.
6. Survey the original group again and see whether the documentation and/or the workshop made a difference (if they attended / read the documentation)
7. Gather feedback about the documentation from the survey and workshop and improve it where necessary.

Change halfway through the semester:

1. Based on research regarding transparency in smart home devices, create a survey to get an idea of the knowledge of end users about smart home devices.
2. Process the results of the survey and determine the general knowledge of the users.
3. Decide on the type of documentation that is going to be created.
4. Produce and publish documentation and activities based on the conducted research.
5. Organize a workshop in which the group presents the findings and the documentation and showcase the created activities.
6. Gather feedback about the documentation and activities through the workshop and improve it where necessary.

Mission statement 2 goals

1. Decide on what smart home device we will modify, taking research regarding the market share of different devices into consideration.
2. Open the device up and analyse its inner workings to determine what modifications can be made to give the user more control over the device.
3. Enhance the device in a way that gives the user more control over its data handling.
4. Document and publish the reverse-engineered aspects of the device.
5. Create a workshop for the general end users and show the modified smart home device.
6. Gather feedback about the documentation and improve it where necessary.

Mission statement 3 goals

1. Decide on a smart home device that we want to recreate based on the market share and usage of popular smart home devices.
2. Implement similar functionality as the mainstream smart home device, but in a way that is more transparent to the end user and that gives them more control.
3. Document the functioning of our prototype for end users to appropriate the device.
4. Create a workshop to analyse how people use our device, identify where we can improve and iterate on the feedback.
5. Document the functionality of the device and how we implemented all of it.

Scope

We as a group – after meeting with our supervisor - have decided on the project scope. Once the smart home device has been chosen, we will not go back on this decision. We will also utilize the kanban methodology to keep track of tasks and assigned people. On top of that, we will hold weekly stand-ups to stay informed about what our team members are doing. This way, we can prevent people getting stuck on an issue for too long and intervene where necessary. Regarding the scope of the project, these are the limits we have decided upon:

1. We will not create a commercial product.
2. We will not study the security aspect of smart home devices.
3. We will not produce tutorials / guides for modifying smart home devices.
4. We will not provide personal recommendations or endorsements for specific brands or models of smart home devices.
5. We will not provide technical support or troubleshooting assistance to people who modify their device based on our documentation.

Attachment 2. UN Goals

This attachment will talk about the UN Goals that have been identified as relevant by the EPS group.

Goal 7 – Affordable and clean energy

The key focus of Goal 7 is to *'Ensure access to affordable, reliable, sustainable and modern energy for all*'. (UN, 2024) This means that this goal emphasizes the importance of universal access to cost-effective, dependable, sustainable, and contemporary energy sources.

Target 7.3 aligns with one of the biggest benefits of smart homes: energy efficiency: *"Double the global rate of improvement in energy efficiency."* (UN, 2024) Smart devices are able to turn off automatically when they are not actively in use which can save energy and money.

Furthermore, they can monitor the production of green energy and activate a program or start an automation when there is enough green energy available. If someone has a battery in their home to store for example solar energy, this could also be integrated in those automations.

Goal 9 – Industry, innovation, and infrastructure

The central aim of Goal 9 is to *'Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation*'. (UN, 2024) This signifies that this goal underscores the need for reliable and sustainable infrastructure, inclusive industrialization, and the promotion of innovation.

The most relevant target is 9.4: *"Upgrade infrastructure and retrofit industries to make them sustainable with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes."* (UN, 2024)
Smart home devices are just a small part of a way broader concept: Internet of Things. IoT devices have already proven to be very useful when it comes to safety, data gathering and automating time-consuming or tedious processes. Just like with smart homes, they could help to reduce the CO2 emissions of factories and entire cities and allow them to optimize their resource usage.

Goal 11 – Sustainable cities and communities

The fundamental objective of Goal 11 is to *'Make cities and human settlements inclusive, safe, resilient, and sustainable*'. This means that this goal highlights the necessity for creating urban spaces that are accessible, secure, adaptable, and environmentally friendly.

The target chosen is 11.3. This target goes as follows:
'*By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries*.' (UN, 2024)

The goal/target and the project connect because research about smart homes could provide the project with valuable insights into how technology can be integrated into urban planning and management.
Smart homes and/or cities can contribute to the development of more inclusive and sustainable communities.
These two points justify why target 11.3 unites with the main project goal.

Goal 12 – Responsible consumption and production patterns

The primary purpose of Goal 12 is to 'Ensure sustainable consumption and production patterns'. This implies that this goal stresses the importance of managing global resources efficiently and reducing the overall ecological footprint. It calls for businesses and individuals globally to collaborate. Achieving this goal cannot be accomplished in isolation.

Target 12.2 states *'By 2030, achieve the sustainable management and efficient use of natural resources'.* (UN, 2024)
Smart home devices are part of the IT sector which is responsible for about 4% of CO2 emissions. It may seem responsible for a small part of emissions overall, but it is rapidly growing. Beyond these emissions, the sector has a high material footprint notably for data centres and servers.
IT devices require many materials such as precious and rare metals which are hard to mine. Smart home devices add to this issue by producing many small IT devices that sometimes seem superficial and unnecessary.
This project is relevant to that extent as the project aim to inform users about the functioning of these IoT devices to help them make aware decisions about what they want to buy. (UN, 2024)

Target 12.6 is about 'encouraging companies, especially large and transnational companies, to adopt sustainable practices'. In the smart home ecosystem, there is a recent movement called Green IoT which is about incorporating sustainable and environmentally friendly practices in the development of smart home devices. The project revolves around smart home devices, so it is relevant in that sense.

Target 12.8 aims to 'ensure that by 2030, people everywhere have the relevant information and awareness for sustainable development'. It wants to promote universal understanding of sustainable lifestyles. By producing knowledge and information on smart home devices, the project empowers consumers. It informs them about a product, its features, and potential risks, enabling users to make informed decisions when selecting and using smart home devices. (UN, 2024)

Goal 17 – Partnerships for the goals

The main meaning of Goal 17 is to '*Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development*'. This means that this goal emphasises the need for strong global partnerships and cooperation.
It requires governments and companies worldwide to work together. The reaching of these goals cannot be done alone.

The target chosen is 17.8. It states as follows:
'*Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology.*'

This target certainly connects with the project.
By creating the documentation and empowering users with transparent and easy to follow information as the project makes it more accessible for least developing countries to learn about new technologies.
In the case of this project, it would be Smart Home Devices and Internet of Things devices.

When giving everyone the same possibilities for accessing the documentation, the project complies with the first part of the target.

The project is designed to empower users to form their own opinions about the technology, encouraging an open and transparent environment. The project enhances the enabling of new technologies. This complies with the second part of the project.

Attachment 3. MoSCoW analysis

Must:

- Be focused on the general public (Writing style)
- Writing should be attractive and eye catching.
- Be functional
- Keep attention of reader
- Be mobile first, desktop second.

Should:

- Focus mainly on one device.
- Keep the same style throughout the website.
- Be grounded and sources.
- Be lightweight and friendly to bad internet connections.
- Be easily accessible at the backend to update things after the EPS period.

Could:

- Have short, animated videos.
- Include an extension that creates social media posts.
- Be able to download page as PDF/documentation.

Won't:

- Be a concise product documentation
- Be a user guide documentation
- Be bias to one brand/product
- Communication will not be possible between users/no social media.

Attachment 4. Activity instructions

TRUE OR FALSE - CARDS

1. There are a bunch of cards with different events / scenarios on the table. Some of them are real, some are made up, and it is up to you to figure that out.
2. Each player, one at a time, takes a card from the stack.
3. Do **NOT** pick up the card from the table, as doing so will reveal the answer on the back to the others.
4. Your task as a group is to rank every card on the 2 axes: Concerning/Not concerning & True/False.
5. After ranking all the cards, you can turn them around. On the back side of the card you will find the answer & some context, as well as the source.
6. After this, you can discuss with the other group about what you have answered and opinions behind it. Also, you can use these discussion questions below.

NOTE: if you know the answer to one of the cards, you may also decide to stay silent & let the others discuss it.

Discussion questions:

- What if this scenario happened to you? Would you still use the device? Why (not)?
- How can we prevent events like this in the future?
- Is there someone to blame for this? The user? The company? The government? Someone else?

Figure 16 - True or False Activity Instructions

Consumer vs. Hacker - Devices

In this activity, we want you to look at smart home devices from two different viewpoints: as a consumer and as a hacker.

1. There are 8 cards in the table, each has information about a device, its properties and some discussion questions.
2. Each player, one at a time takes a card from the stack.
3. Take note of the device & its properties.
4. Look at the device from 2 different standpoints & discuss in group:
   a. First, think of the device from a normal consumer standpoint. There are some discussion questions below & on the card itself.
      - How can this device be useful to you in your daily life?
      - What are some benefits of using it?
      - Why should or shouldn't you use this device? Are there any risks
   b. Next, imagine yourself a hacker:
      - How can you exploit the device to make someone else's life as miserable as possible?
      - Could it be used to spy on someone? Camera? Microphone?
      - What are potential consequences of the device getting hacked?
5. Now, reflect on how you initially thought of the device:
   - Has your opinion changed?
   - What insights have you gained?
   - Would you still use a device like that?

Figure 17 - Consumer vs Hacker Activity Instructions

Attachment 5. Survey results

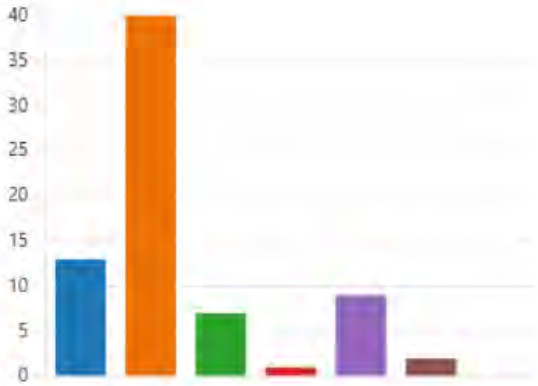
72	06:37	Active
Responses	Average time to complete	Status

1. What is your gender?

Male	41
Female	31
Non-binary	0
Prefer not to say	0

2. What is your age group?

16-21	13
21-29	40
30-39	7
40-49	1
50-59	9
60+	2
Prefer not to say	0



3. How would you rate your knowledge of IT & technology in general?

No knowledge	3
Some knowledge	11
Average level of knowledge	33
Advanced knowledge	23
Expert knowledge	2

4. How would you rate your knowledge of smart home devices?

No knowledge	5
Little knowledge	24
Average knowledge	26
Advanced knowledge	15
Expert knowledge	2

5. Do you own a smart home device?

Yes	20
Yes, multiple	19
No	33

6. What smart home device(s)?

35
Responses

Latest Responses
"Google home and Google Nest "
"Heating system "

9 respondents (**26**%) answered **Google Home** for this question.

7. When thinking of smart home devices, which one comes to mind first?

30
Responses

Latest Responses
"Alexa, temperature control"

10 respondents (**33**%) answered **Alexa** for this question.

8. When considering to purchase a new smart home device, how important are privacy and data transparency in your decision-making process?

Promoters	22
Passives	27
Detractors	23

9. If you were to buy a smart home device, would you rather put your trust in a big company (Google, Amazon, etc.) or in a small company?

Promoters	8
Passives	19
Detractors	44

10. Indicate which of the following data you are comfortable with being transferred to the cloud and/or third parties.

Audio	17
Video	9
Non audio/video (temperature, ...	41
None of the above	23

11. How **transparent** do you think most smart home devices are?

Promoters	3
Passives	11
Detractors	58

12. How confident are you that your **personal data**, like voice recordings, is **stored** on your local device?

Promoters	8
Passives	23
Detractors	41

13. How confident are you that your **personal data**, like voice recordings, is being **processed** on your local device?

Promoters	9
Passives	19
Detractors	44

14. Rate your understanding of what makes up Artificial Intelligence (AI)

Promoters	5
Passives	30
Detractors	37

15. Do you know if there is AI in any smart home device you use?

Yes	12
Not sure	38
No	21

16. Specify which device

12
Responses

Latest Responses

2 respondents (**17**%) answered **Google home** for this question.

17. Would you be concerned if your data was being processed by AI?

Promoters	8
Passives	10
Detractors	53

18. Do you have anything you want to mention / tell us about?

17
Responses

Latest Responses
"No"

7 respondents (**41**%) answered **no** for this question.