The Cost of Being Connected:

Dreaming of smart home futures through design fiction

Master's thesis

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SUMMARY

For some, smart home living is a sign of the future, and provides an opportunity to solve major societal problems. For others, it is just a vague buzzword. This thesis project sought to explore the potential implications of living with smart and connected technologies in our most private spaces and to engage non-experts in a conversation about it.

This speculative project first used traditional design research activities to understand the context of the smart home, informing the design process of two design fiction artifacts. Following, these design fictions were used as a research for design tool to 1) sensitize and engage non-experts to provide their perspective on the context and 2) indicate threats and opportunities for the design of smart home devices in the home.

The first design fiction was a physical booklet containing news articles from the future. This was used to convey the broad spectrum of findings to a non-expert audience. Using these findings, the final speculative question was formulated, which defined the pretense of the film: “What if smart home devices develop dementia (and other aging-related conditions) due to their short product lifespans and the deterioration of hardware and software over long-term use?”. This question was used to define the storyline, scenes, filming, and editing process. As a result of the production process, a short, 6.5-minute film was created as the final design fiction prototype.

8 participants were evaluated using a semi-structured interview and the film, which considered their previous knowledge, their perspective on living with smart home systems, and the extent to which the film sensitized them to the topic. These findings contributed to the 12 design recommendations, which is a call to action for designers to design for ownership. These recommendations highlight the imbalanced relationship between devices, companies, and users while providing 12 tangible ways designers can create a greater sense of agency and ownership by making changes to the design of the user experience, user interface, and the way these systems themselves are designed.

TU Delft

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PREFACE

After five years of design education at TU Eindhoven I decided to continue my academic journey at a new faculty, in a new city, in the middle of a pandemic. While I had gained the skills needed to be a designer, I had no idea how I wanted to implement them. My time at TU Delft has been marked as a time of self-discovery, both personally and professionally.

Following my Bachelor’s thesis, I had come across speculative design methods. It piqued my interest as it provided an opportunity to use imagination and creativity to address today’s current issues, in a way which I find profoundly empowering and optimistic. An antidote for pessimism, nihilism, and the polarization I often see today.

Throughout my master’s I had several opportunities to engage with this approach from a variety of themes: artificial intelligence, biodesign, and climate change. Upon seeing a graduation project asking to implement speculative design methods to the context of the smart home, *the bane of my designerly existence*, I knew I had to take action.

Throughout this project I have worked on using and adapting speculative design methods in a way that works for me, specifically the practice of design fiction. It was often a challenge to tailor these tools in a way that fits the academic and DFI mentality - which made it all the more rewarding. I even ended up making a short film, an activity that went against all of my strengths (and weaknesses) as a design student.

I was only able to complete this endeavor by the overwhelming support I have received. I would like to thank:

My sister, Liv de Jonge, for being an amazing actress in my film. Thank you for always inspiring me to do what we both do best. Follow our own path. *(Thanks for your camera too)*

Sophie de Blanken, who played another key role in my short film. You’ve shown me the best parts of life in Delft. Thank you for always being enthusiastic to help me with my project and always being there to listen to me.

Katelijn van Kooten and Natanya Cornet, the ones that made the same journey from Eindhoven to Delft. You two have made me feel right at home at the faculty and made studying here so much more enjoyable. I appreciate our friendship and conversations so much, having the same background and love for design.

Laurent Schuermans, my loving partner (and roommate) for always listening to me talk about my thesis, *for the second time around*. Thank you for always offering your own personal, often nerdy perspective on technology, which has been invaluable for how I have approached this whole project.

Kim de Jonge

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Introduction

1.1 Knowledge gap

1.1.1 Problem statement

Growing presence of technology

In our world, we are witnessing technological systems becoming more complex, ubiquitous, and invisible to users. By 2025, the number of active Internet of Things (IoT) connections is set to reach 30.9 billion units [1]. These IoT devices consider technologies such as smart vehicles, connected industrial systems, and smart city data sensors. The presence of these devices is not limited to the public and workspace but is also being invited into the most private parts of our lives: *our homes*. Worldwide, the penetration rate of the *smart home* device market is set to surpass 20% in the next year [2], highlighting the growing popularity of smart home systems.

The development of smart home systems comes with both great opportunities and great risks. On one hand, the automation of household tasks provides a tool to transition towards a greener energy system. Additionally, the sensing capabilities of at-home devices offer new ways to assist the aging population with their healthcare needs, allowing them to live at home longer. Consequently, the collection of data within the home poses new threats to privacy, security, and ultimately, our livelihoods. *Will the development of smart home systems impose a new state of collective surveillance? How might we keep our sensitive and private data safe? How will our lifestyles change due to the presence of these new technologies?*

This intersection of state-of-the-art engineering and our individual private lives creates a context that is difficult to grasp, yet highly impactful for a large part of society. The majority of these devices are marketed toward consumers who have little to no background in computer science, data science, or electronics. Neither are these users considered in a meaningful way during the research and design process. This leads this large group of non-expert users to be marginalized in a context they have a high risk of being affected by. This indicates a huge need and knowledge gap to consider this group's needs and values within this scope of technological development.

1.1.2 Project aim

Purpose

1. To better understand the current state of smart home technology and the emergent developments in this field.
2. To speculate on possible future smart home scenarios.
3. To engage non-experts in the discussion of smart home technologies, to consider their needs and values.
4. To define design recommendations and considerations to address more desirable futures.

1.1.3 Addressing the topic

Throughout the project activities, a strong human-centered approach has been taken to address the non-expert as the consumer stakeholder. Considering this human-centered approach and future-oriented perspective of the project, a speculative design approach was selected to guide the research and design activities. The practice of design fiction was used specifically, guiding the processing of research findings, and how these were presented as speculative artifacts (chapters 6-8).

The following section will introduce the speculative design approach and more specifically the method of design fiction.

1.2 What is a speculative design approach?

1.2.1 Speculative design

Matt Malpass describes speculative design as a practice *"used to question the potential applications and implications of scientific and technological theories and research being carried out today and how these developments might manifest in the future."* [25]

Rather than designing an end product or solution, the speculative design approach seeks to engage a broader audience to reflect on decisions and trends that are taking place in the current day. Dunne & Raby's A/B manifesto [26] in Figure 1 provides a poetic representation of how speculative methods have shifted from the traditional design approach.

The family of speculative methods

In this project, the speculative design approach is an umbrella term for a variety of critical design methods. Such as, but not limited to: Design for Debate [32,33], Reflective Design [37], Radical Design [34], Futurescaping [35], Transitional Design [36], and finally, Design Fiction [27].

Rather than focusing on their differences, often the nuances in style, process, and historical period, it is to be emphasized that these practices share a common goal: Presenting viewers with an alternate or future reality to critique the present and imagine how things could be done differently.

[a]	[b]
affirmative	critical
problem solving	problem finding
design as process	design as medium
provides answers	asks questions
in the service of industry	in the service of society
for how the world is	for how the world could be
science fiction	social fiction
futures	parallel world
fictional functions	functional fictions
change the world around us	change us to suit the world
narratives of production	narratives of consumption
anti-art	applied art
research for design	research through design
applications	implications
design for production	design for devate
fun	satire
concept design	conceptual design
consumer	citizen
user	person
training	education
make us buy	makes us think
innovation	provocation
ergonomics	rhetoric

Figure 1: A/B Manifesto [26]

1.3 Design fiction as speculation

1.3.1 Origins

This project has been heavily influenced by the speculative design practice of design fiction, as described in the book "The Manual of Design Fiction" [27] authored by its pioneers. The term was first coined in 2005, by science fiction writer Bruce Sterling. The design practice itself was cemented by Julian Bleecker's 2009 essay Design Fiction; A short essay on design, science, fact and fiction [28].

1.3.2 Defining the practice

Visual storytelling

Design fiction draws inspiration from the science fiction genre, including its name. That being said, several aspects set this practice apart from other speculative design methods and the film/literary genre. Rather than simply entertain, design fiction seeks to engage a wider audience in a conversation about current decision-making and potential futures. This is achieved by asking "what if" questions and creating tangible and evocative prototypes. Rather than telling a story through characters, a narrative is created by the presence of the object and what it implies about the future - a ***diegetic prototype*** [29]. These prototypes are not limited to a specific medium **(archetype)**, as long as they are recognizable from a popular cultural perspective *(ie. a commercial, product packaging, a customer service complaint, etc.)*

The near future

A key characteristic of design fiction is how it is rooted in the present. Whereas science fiction and other speculative design practices may address far-away futures with extreme technological advancements, design fiction specifically addresses the near future. This is due in part to the methodical approach of ***"catching signals".*** These **signals** are real-life observations of new and strange ways emergent technology is being appropriated, which inform the whole design fiction process [27].

Figure 2: Magazine article

Faint signals: Possible indicators of how the future might be, based on emerging and often unconventionial ways we use technology or talk about it [27]

Example: A real life magazine article discussing use of drones for hobby fishing.

These signals can inspire new ways of thinking: For example, what would the North Sea look like if we only fished with autonomous drones rather than manned boats?

The future mundane

Secondly, design fiction seeks to address the (near) future mundane. How our lives may or may not change based on the technological innovations established in the future. By focusing on everyday life, design fiction can more easily *suspend disbelief about change* - creating memorable, humorous, and relatable scenarios [27].

For whom?

Finally, design fiction is a design method stemming from the practice of strategic foresight and future studies. Since the 1950's, a speculative approach towards scenario planning has been undertaken by high-impact organizations *(ie. the U.S. government, think tanks, Dutch Royal Shell)*, addressing the context of the Cold War at the time [27]. This historical context indicates how a scenario-based approach toward the future can inform, persuade, and engage individuals at the very top of the chain to define and manage policies considering emergent societal themes and technologies.

Considering design fiction's roots in this kind of strategic foresight, we see how a way has been paved to do this in a far more creative and accessible way. Design fiction is meant for anyone holding a stake in what happens in the future: whether it be executives, policymakers, governments, designers, engineers, or just your average Joe interested in the topic.

Diegetic prototype: a designed (storytelling) object or artifact that exists in the fictional scenario and is embedded in the plot and how characters interact with it.

Future mundane: the notion that day-to-day lives will not exceptionally change in the future. The future will still be mundane and messy.

The box of Cricket Crunch tells us about a future where consuming insects has become a norm. By presenting it as a cereal, we can imagine how it might be a child's favorite breakfast, creating a digetic prototype. The presentation of a cereal also consider the future mundane. What does breakfast look like if society switches to insect-based protein?

Figure 3: Cricket Crunch breakfast cereal [31]

Figure 4: IKEA smart home catalog [30]

Archetype: the material format of a prototype, such as product packaging, a commercial or catalogue

Example: The Near Future Laboratory's IKEA catalog, which speculates on what kind of products the company might sell in the future where all household objects are "smart".

The perfect showroom photos allow us to believe that this could be an IKEA catalog. Whilst the details tell more about the world that the catalog comes from. A new currency is presented, what would be considered cheap or expensive the catalog? What kind of business model is implicated by a kitchen which is paid by per hour?

This chapter describes the project brief and design fiction process

2

Project brief & process

2.1 Project brief

This section describes the initial project brief created at the beginning of the project. The goal and the context of the brief were adapted based on preliminary findings during the research deepening activities in chapters 5 and 6.

2.1.1 Initial project goal

Goal

The initial project brief (appendix A) was to speculate on the behavior of smart things in shared home spaces based on different governing principles. The goal was to explore value tensions and conflicts that may emerge from different levels of agency and priority from different agents in the household.

Research question:

How can smart home technology designers facilitate effective agency negotiations for routine activities in shared household spaces, considering the changing dynamics and conflicts arising from the increased agency of non-human agents in a post-anthropocentric future?

Subquestions

1. What conflict resolution strategies are viable for addressing human-to-human, human-to-nonhuman, and nonhuman-to-nonhuman conflicts in smart homes of the future?
   - *Non-humans being agents or entities in the home with a tangible capacity to affect their outside environment. This includes pet animals and robotic devices such as a Roomba. Plants are not considered due to their lack of agency.*
2. What are the key preferences and requirements of human users regarding conflict resolution strategies in smart home environments?
3. How do conflicts and their resolutions impact the relationships within the household network, including both human and nonhuman agents?
4. Which critical themes or aspects (e.g., privacy, energy management, family roles) are implicated in the automation of routine household activities within a smart home context?

Assignment

The individual scenario themes will be guided by expert interviews (backgrounds: Technology Policy and Management, energy transition, AI, etc.) and political theory. The setting, interactions, and events for the scenarios will be explored through co-creation and roleplaying sessions, which will focus on creating empathy and narratives from a thing-centered perspective, alongside enacting tangible objects (props). The scenarios will be presented through a speculative design film and high-fidelity design fiction props, which will be the final prototype/deliverable for the design/research project.

2.1.2 Design pivot

Human-centered design

During the first exploration phase of the project, the need for a human-centered perspective became apparent. The knowledge generated indicated many emergent issues were likely created due to a lack of human-centered design. (For example, many issues appear to come from only considering short-term usability, with no concern for different cases or environments of use, long-term use, etc.). Ultimately, the goal of speculative design is to create a vision of a more desirable future, and addressing it from this human-centered perspective instinctively showed a more tangible way to reach that goal. Additionally, as a designer, I felt obligated to

address the most obvious issues first, especially considering my personal critical view of smart home technology.

These arguments all contributed to the executive decision to shift towards a human-centered perspective on the long-term implications of smart home technology, based on the signals collected throughout the initial research phase.

That being said, I still wanted to keep the speculative design methodology planned throughout the brief. These were kept virtually the same and the speculative design perspective stayed as a core theme throughout the project.

2.1.3 New design questions

New goal

The new goal of the project was to speculate on the potential consequences of long-term smart home inhabitation in a future where these systems are extremely commonplace.

New subquestions:

1. How can speculative design be used to engage non-experts about the implications of smart home technology?
2. Can a speculative design artifact make non-experts feel more confident/competent in sharing their feelings and opinions about smart home technology?
3. What signals contribute to potential future scenarios involving smart homes?

2.2 The design fiction process

A ten step process

There are ten basic steps [27] in the design fiction process which can be flexibly implemented based on the design process and circumstances.

[1] Collect faint signals: documentation of present-day signals that indicate how technology may be changing. These can be real-world observations, news articles, reports, etc.

[2] Select an archetype: selecting a suitable format for the design fiction. This should not be too obvious but still related to the ecosystem of the technology being discussed. *(ie. if the design fiction is about smart phone use, a smart phone itself should not be selected)*

[3] Present stimulus materials: The collected signals are prepared in a way which can be communicated to a larger group. This could be a powerpoint discussing report findings, images showing real-world observations, etc.

[4] Extrapolate from signals: By discussing stimulus materials in a (multi-disciplinary) group, key values, implications, ethical stances, personal experiences, are generated. These consideration and ideas are used to further inform the design process.

[5] Identify the what-if: based on the signals and discussions, an inspiring and speculative question is generated to power the exploration and design process

[6] Know your tropes: figuring out what details are important to convey the aesthetic qualities of the archetype selected: ie. glossy paper in a catalogue, cardboard for packaging, etc.

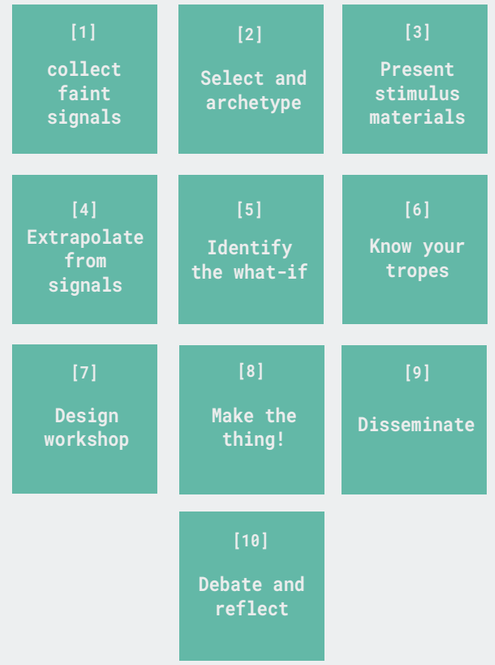


Figure 5: Design fiction TL;DR, from [27]

[7] Design workshop: (if possible) collect a group of people to work out the design fiction & archetype.

[8] Make the thing: following through with the creative plan and bringing the artifact to life.

[9] Disseminate: Spreading the artifacts to a larger group. Prefereably in a somewhat inconspicuous way to invoke (dis)belief.

[10] Debate and reflect: observe people responses to the artifact. Document their opinions and allow a larger group to discuss the implications of the design fiction piece.

2.3 Project Process

Figure 6 illustrates the overall design process as three consecutive iterations. The bottom layer indicates the chronological order of each design and research step, which are described in the following sections. The middle layer indicates the divergent and convergent aspects of the activities undertaken, in regards to the entire process. Finally, the top layer links each activity to a design fiction step, as described in the previous pages.

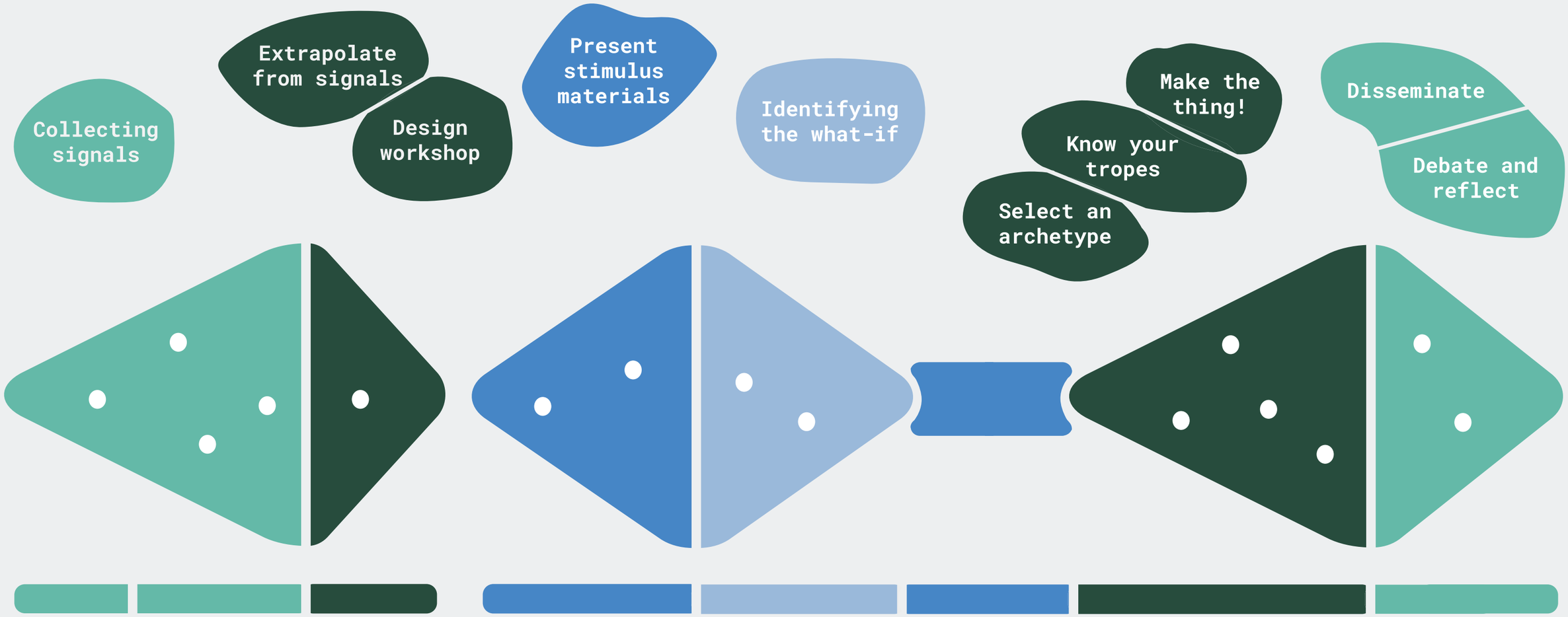


Figure 6: Project process

This chapter discusses the related works and literature review which has informed and supported the design process.

3

Related works

3.1 What is smart?

3.1.1 Device networks

A smart device is a context-aware electronic device capable of performing autonomous computing and connecting to other devices via wire or wirelessly for data exchange [3]. In everyday life we interact with such devices regularly, when we pay with a credit card, stream a TV show, or use a car's GPS system. Such smart devices are becoming more present in our homes as well. Voice assistants controlling our speakers, video doorbells providing a live feed of our front doors, and thermostats that automatically regulate the temperature in our homes are some popular examples.

The data exchanges between these devices create a network. Different sensors collect information that dictates which devices and activities are triggered. For example, the data can be about the time of day, indoor temperature, occupancy in the home, etc. Often, a user's smartphone functions as a central hub to organize and gain insight into the system of devices through a variety of apps. That being said, a central hub is not a strict requirement for the definition of such a network but is usually the case to help users operate them.

Such a network of connected devices is also called the Internet of Things (IoT). This term refers to the *"open and comprehensive network of intelligent objects that have the capacity to auto-organize, share information, data, and resources, reacting and acting in face of situations and changes in the environment"* [4].

Terminology
It is important to note that colloquially, the word "connected device" is often used interchangeably with "smart device". The majority of the time this is correct. The word "connected device" emphasizes the fact the device is connected to the internet, and the word "smart device" emphasizes the sensing capability of the device. This degree of perceived smartness is related to the device's capacity to be autonomous or proactive within the home. That being said, a smart device is not necessarily connected to the internet. For example, a smart thermostat may control the temperature via a local network, and not through a smartphone app via the internet. Vice versa is true for connected devices. A security camera may be connected to the internet, allowing you to view the feed remotely. If the camera is only capable of recording 24/7, there is no extra functionality making it "smart".

3.1.2 Defintion

Within the scope of this project, the **smart home** is the ecosystem of smart and connected devices in the home. It is about using these devices in the private and domestic context.

3.1.3 Research trends

The term "smart home" was first coined in 1984 by the American Association of House Builders [5]. This interdisciplinary field has gained traction since the turn of the century due to the advancement of the Internet and other interactive technologies. Yao et al.'s [2023] analysis of keyword frequency in smart home papers indicates the most significant areas of research being: *Privacy, security, ubiquitous computing, smart cities, and smart grid technology.* Generally speaking, there is a strong emphasis on how smart homes can address the energy transition, how smart homes can be organized into a larger, city-wide ecosystem, the general practice of transferring data in

"everyday objects", and the privacy and security implications of smart homes in general.

These research trends highlight the emphasis on a technical engineering perspective, which is understandable considering the field's roots in computer science. Yet, this technocentric perspective creates a bias toward purely focusing on technological innovation, objective knowledge, and the focus on usability. As stated by TOPP *"IoT connects the ubiquitous and everyday parts of our lives. Getting it right is about more than adding technology to an existing object — there needs to be some inherent value in the experience for users. Unfortunately, most IoT products today offer novelty rather than long-term value" [7].*

What the bulk of smart home research fails to consider is the actual everyday lives that these systems are created for, only examining activities as tasks to be completed and behaviors to be analyzed. Gram-Hanssen & Darby (2018) shows how thousands of smart home research papers fail to even introduce or establish the contextual meaning of "the home" - something considered basic practice in other humanities-centric fields [8].

3.2 The need for a speculative approach

Why do we need a speculative approach to engage with emerging smart home technologies?

Speculative design can play a crucial role in addressing the existing technocentric bias in smart home research and allows us to explore unforeseen implications of such technologies. The essence of this design approach is to invite an interdisciplinary view on emerging technologies and to deeply reflect on their implications. In doing so, the design process can be considered and informed in new ways, being steered towards more preferable societal impact and futures.

3.2.1 Imagining scenarios before they happen

Although most technological innovations are well-intended, it is difficult to evaluate how they might impact society. In Ruth Cowan's book *More Work for Mother*. It becomes clear how the wide adoption of household appliances like the washing machine and vacuum cleaner have done little to alleviate homemakers of their workload. Rather than saving time spent on chores, the level of expected household cleanliness has increased, and cleaning chores have transformed from communal household activities to becoming the sole responsibility of homemakers [10].

Similarly, Wyche. et al. [2006] emphasizes how the design of household technologies have created a shift towards home activities being done individually - in stark contrast to the otherwise communal home setting. Taking telephone communication as an example, we see a shift from families having one shared landline in their home, to every member of the household having their own individual cell phone.

These examples illustrate how the adoption of technology can have unforeseen consequences that may conflict with the initial design intentions. Although it is difficult to foresee these societal effects, the speculative design approach provides the unique opportunity to imagine and address these scenarios before they occur. In turn, this allows us to evaluate which values we find to be important and use them to inform the design and research process.

"The future is a safe, sterile laboratory for trying out ideas in - a means of thinking about reality, a method."

- Ursula K. Le Guin [9]

3.2.2 Interdisciplinary and non-expert perspectives

The presentation of speculative design artifacts invites different disciplines and non-experts to the conversation. Considering the previous example of how household appliances have changed roles and activities within the home, the importance of considering a broad range of stakeholder opinions becomes evident. How would the design and implementation of household appliances have changed if the values of mothers and other women had been taken into account, considering their marginalized role in that period?

The speculative design approach provides a way to engage "outsiders", non-experts, and various disciplines in otherwise complex contexts. Rather than focusing on the technical details of an idea, speculative concepts are presented in an accessible way. The formats of these speculative design artifacts include but are not limited to: websites, film, photography, props, exhibitions, etc. These artifacts often rely on visual information and aesthetics to convey a narrative to the viewer. This mode of communication varies quite differently from what is typically observed in technical disciplines. For example, a blueprint may be used to communicate engineering concepts between colleagues, but this medium relies on years of shared knowledge and skills to be able to interpret.

The accessible format of speculative design artifacts allows viewers with any kind of background to interpret the concept - often in unique ways. By understanding a concept as a whole, rather than being held back by technical details, viewers can project their own background and experiences onto it. Consider the presentation of a smart kitchen concept: *How might a home cook and a fire safety expert differ in opinion? What aspects may be important to them? What details would they pay attention to?*

3.2.3 More desirable futures

Finally, speculative design paves the way toward a more desirable future by addressing potential consequences and engaging outsider perspectives. By being sensitized to potential futures, it becomes easier to put our norms, values, and desires into words, all whilst imagining how things could be done differently. Speculative design often leaves a strong impression behind, inspiring people with the most power or agency (policymakers, designers, engineers) to band together to make choices toward a more desirable future.

3.3 Speculative design in smart home research

Speculative design tools have been implemented in the smart home context in a variety of ways: from inspiring academic research methods to shaping fictional artifacts as a discussion piece. The following sections describe:

- **Creating and communicating future scenarios in design research [12,13,14]**
- **Theater and roleplaying as exploration tools [15, 16, 17]**
- **Speculative smart home artifacts [18,19,20,21]**
- **Short design fiction films [22,23,24]**

3.3.1 Generating and communicating smart home scenarios

Study by Reig et al. [2023] used story completion as a method to create future narratives of the smart home, twenty years in the future. Participants were primed with a few initial sentences and were prompted to complete the passage with their own input. This created a rich variety of future narratives inspired by personal lived experiences, historical knowledge, and individual values.

Wong. et al [2023] used design workbooks to show potential privacy scenarios involving smart home cameras and different power relationships between users. By using textual descriptions and illustrations, participants were engaged to share their values, critique the scenarios, and generate alternatives.

PrivacyToon, by Suh. et al. [2022] is a comic authoring tool to express future privacy scenarios. The concept-to-visual-storytelling approach allows users to turn abstract privacy concepts into comics, by facilitating the creative process through embedded templates and ideation cards.

3.3.2 Roleplaying & speculation

Theater

Methods such as bodystorming and roleplaying have become established exploration tools throughout the years in HCI. Pschetz et al. [2019] accentuates these methods by embodying a theater-making perspective. In the project, three speculative props are used to explore how household energy could be

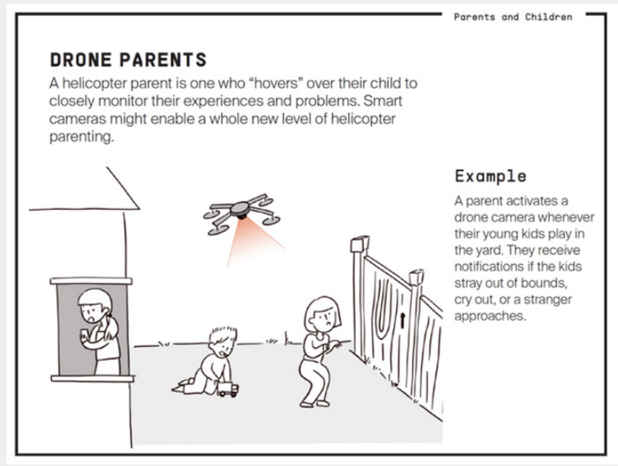


Figure 7: Wong et al. (2023) privacy scenarios as workbooks

Figure 8: Left: GigBliss Plus prototype. The hairdryer interface allows users to buy/store/trade energy on the market. **Right:** Actors performing sketch with prototype [15].

distributed in future. Three fictional hair dryers: GigBliss plus, auto, and balance, were created which allowed users to trade energy in different ways. Using actors, three sketches were created showing how people would use said hairdryers in the speculations, depicted in Figure 8. By presenting the sketches to an audience, participants were able to contribute to the debate and conversation around the otherwise complex topic of implementing such systems.

Thing ethnography

Thing ethnography [16] describes the approach of documenting everyday life from the perspective of an object, done by photographing from the object's point of view at regular intervals (and collecting other kinds of data). Chang, et al. [2017] explore the hidden lives of Taiwanese scooters through roleplaying, by presenting actors with the collected data, allowing them to create narratives from the scooter's point of view (Figure 9).

3.3.3 Speculative artifacts

Things-centered objects

Figures 11 to 13 show several examples of speculative artifacts made within smart home research projects. These speculative artifacts

Figure 9: Timelapse camera attached to scooter, to document the scooter's daily life. [17]

are in stark contrast to the dominant trends seen in IoT research. Yet, this engineering perspective is not confronted with a human-centered approach. Rather, they embody post-humanist elements by replacing the human or user with the "Thing" itself. This philosophy allows us to understand connected ecosystems from different perspectives, which would not be accessible from the human-centered status quo. This creates a space for imagination and creative solutions and forms new ways of thinking about the world. On the other hand, it feels inaccessible for people with a non-design background and fails to ignore the emerging (human) societal risks brought on by growing smart systems.

Examples

Cho. et al. [2023] describe the design process and evaluation of an air purifier, ARECA, that has a mind of its own. This property was addressed by having the air purifier document its everyday life by revealing diary passages (on its screen) based on the environmental factors it experienced (Figure 12).

Wakkary, et al [2017] investigate the nature of everyday life in the Internet of Things through a network of connected ceramic bowls and cups. Besides functioning as containers, the sole function of these devices is to periodically communicate with each other via Morse code and Twitter, shown in Figure 11.

Addicted Toasters by Simone Rebaudengo was a "real/fictional service" where toasters are hosted instead of owned through purchasing. The toasters are connected to the internet and are aware of how other toasters are being used. The toaster must be "convinced" to stay by using it often enough, as it otherwise searches for a new host.

Finally, Data Epics by Desjardin & Biggs (2021) is a collection of fictional stories which speculate on how devices might experience the world. In the project, a month's worth of smart home sensor data was used to inform four short stories that explore aspects such as the device's identity, its relationship to the home ecosystem, and its desires. The chapters are formatted as simple booklets, shown in Figure 13.

Figure 11: Top: *Morse Things, as simple bowls* Bottom: *Morses Things communicating with each other via Twitter.* [19]

Figure 12: ARECA air purifier, creating diary entries based on its daily experiences [18]

Figure 13: Data epics interpreting data as a poetic narrative [21].

3.3.4 Design fiction films

Design fiction has often been communicated through the format of a short film. The qualities and relevance of this format is further explained in section 7.2. Several outstanding examples of design fiction films include:

Uninvited Guests (Figure 16) by SuperFlux, explores the everyday life of an elderly man. Several smart devices have been gifted to him by his family, which should help him manage his health as he becomes older. These devices, seen as simple, bright green props track his daily health-related activities such as eating habits, step count, and bedtime. The devices, and his relatives who can check their data, obligate the man to change his lifestyle in ways he does not desire. The man finds ways to trick the devices, making it appear he has stuck to these changes [22].

Our Friends Electric (Figure 15) by Superflux is a tri-episodic film that explores three user interaction possibilities for voice assistants: a voice assistant that is trained by learning from the users' command, a device that changes its personality based on the adjustable interface settings, and a device which has been programmed by its new owner. The film explores the relationships these devices create with their user and finds everyday scenarios for their use. [23]

The Teacher of Algorithms (Figure 14) is a design fiction film that speculates on how smart and learning devices may malfunction based on the ways they have been trained. This is done by creating a future occupation, an algorithm trainer. This person is responsible for taking in "broken" devices, and retraining them through trials and tests. [24]

Figure 14: Teacher of algorithms [24]

Figure 15: Our Friends electric [23]

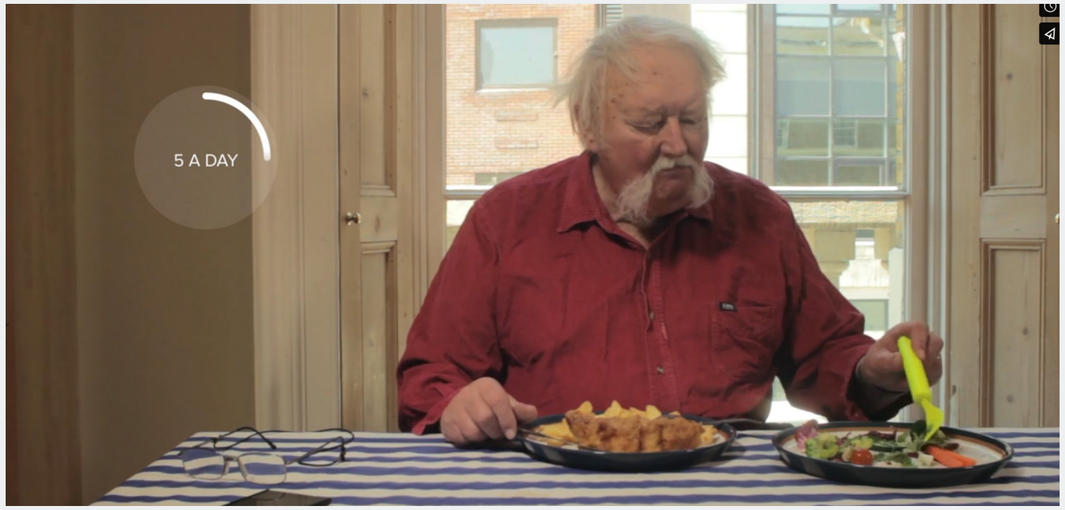


Figure 16: Uninvited guests [22]

This chapter creates an overview of the design and research activities used to explore the project context.

4

Activity overview

4.1 Deepening knowledge

This chapter describes four research activities undertaken to understand and explore the current state of the smart home. The activities are presented in chronological order and address the smart home context through different lenses. The activities seek to create a rich and qualitative understanding of how smart devices are currently used in the context of the home, and to catch signals of how they may be used in the future.

4.1.1 Levels of knowledge

Accessing information

Within any context, there are four levels of information: **explicit, observable, tacit,** and **latent** [38]. Explicit and observable knowledge sit at the top of the pyramid. This tip of the iceberg represents the individual knowledge that is easily accessible to individuals. Tacit and latent knowledge lie underneath the water and are more difficult to access or verbalize.

Explicit knowledge concerns objective statements that can be expressed easily. For example: "I finish work at 5 P.M." or "My smart lights automatically turn on in the morning."

Observable knowledge addresses statements or ideas that can be collected through watching people or their environment "He is always running late on Monday morning" or "My voice assistant struggles to recognize my voice."

Tacit knowledge: Relates to things we know and understand, but are difficult to explain to others. Take for example riding a bike [or the way we position ourselves to talk to a smart speaker]. Our bodies have instictively learned to perform such tasks, but it is difficult to express these actions verbally.

Latent knowledge: refers to ideas and things we can have opinions and expectations of, but have not necessarily experienced yet. It is knowledge that is known within the future, often making it very difficult to access and express. In the context of the smart home, such a statement could be "Upon entering a smart home, I would like the chance to give consent if my data will be processed."

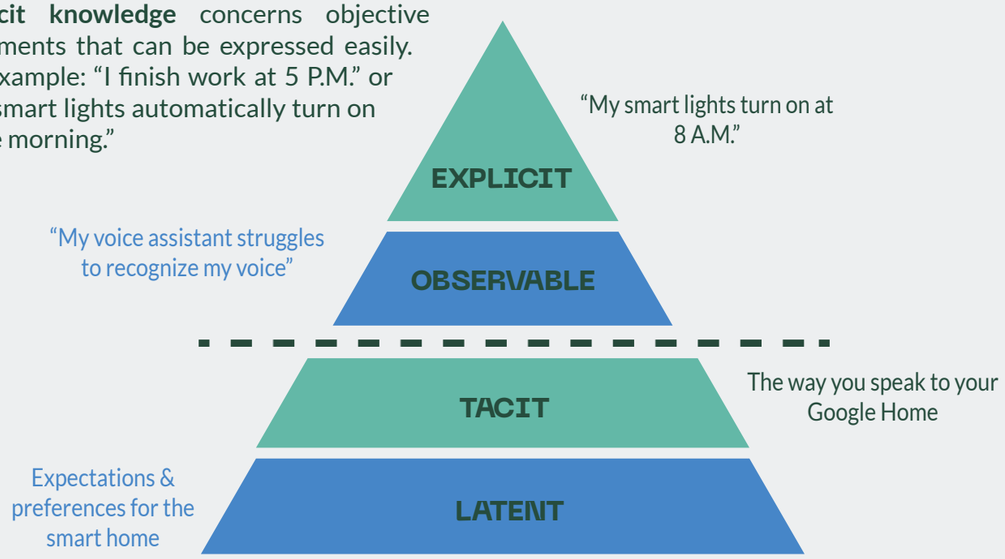


Figure 17: levels of knowledge, adapted from [38]

4.2 Research activities as steps

4.2.1 Structuring design activities

Knowledge and speculation

As described in chapters 1 and 2, the documentation of signals form the basis of the design fiction process. These signals can fall under **explicit, observable,** and **tacit knowledge.** In the same vein, generating **latent knowledge** is the ultimate goal of the speculative design process. The design fiction artifact exists to prime users to express their needs and values that play a role in that future. To generate such knowledge it is necessary to layer knowledge from the top-down. Throughout each design & research activity, the layers of knowledge are dug deeper and deeper, considering the starting point of the current day. This not only collects faint signals of the emerging future but crafts a scenario that is relevant to the current day and resonates with the audience.

4.2.2 Content of research activities

Activity 1: Smart home field trip

- **Method:** Documenting and analyzing smart home products at the CoolBlue showroom.
- **Goal:** *Generate explicit knowledge*, by creating a benchmark of the Dutch smart home ecosystem and analyzing what fundamental needs they fulfill for consumers.

Activity 2: Smart home forum

- **Method:** Posting on r/SmartHome to collect anecdotes of interaction issues and conflicts from experienced smart home users.
- **Goal:** *Generate explicit and observable knowledge*, by documenting the issues experienced by experienced issues in the form of rich narratives.

Activity 3: Expert interviews

- **Method:** Interview three different experts with various backgrounds following a semi-structured interview guide.
- **Goal:** *Generate observable knowledge*, by documenting how different specialisms view smart devices, whilst uncovering current and future risks and opportunities. Additionally, anecdotes and case studies were sought to inform signals of the future.

Activity 4: Speculative roleplaying

- **Method:** Have non-expert participants imagine and enact future scenarios through roleplaying, low-fidelity prototyping, and mapping out consequences.
- **Goal:** *Generate tacit knowledge*, by exploring and documenting possible interactions, affordances, and conflicts within different smart home paradigms in an embodied manner.

The full process of each design activity is described in the following chapter.

4.2.2 Following design activities

Design fiction prototypes

The four research activities informed two following design fiction acitivities. The results of these activities, the sensitizer booklet and design fiction video are described in chapter 6 and 7 respectively.

4.2.3 Knowledge overview

The figure below provides a clustered overview of the knowledge generated throughout the first research activities. In the following sections, the contribution per activity is illustrated regarding the larger map of knowledge shown here.

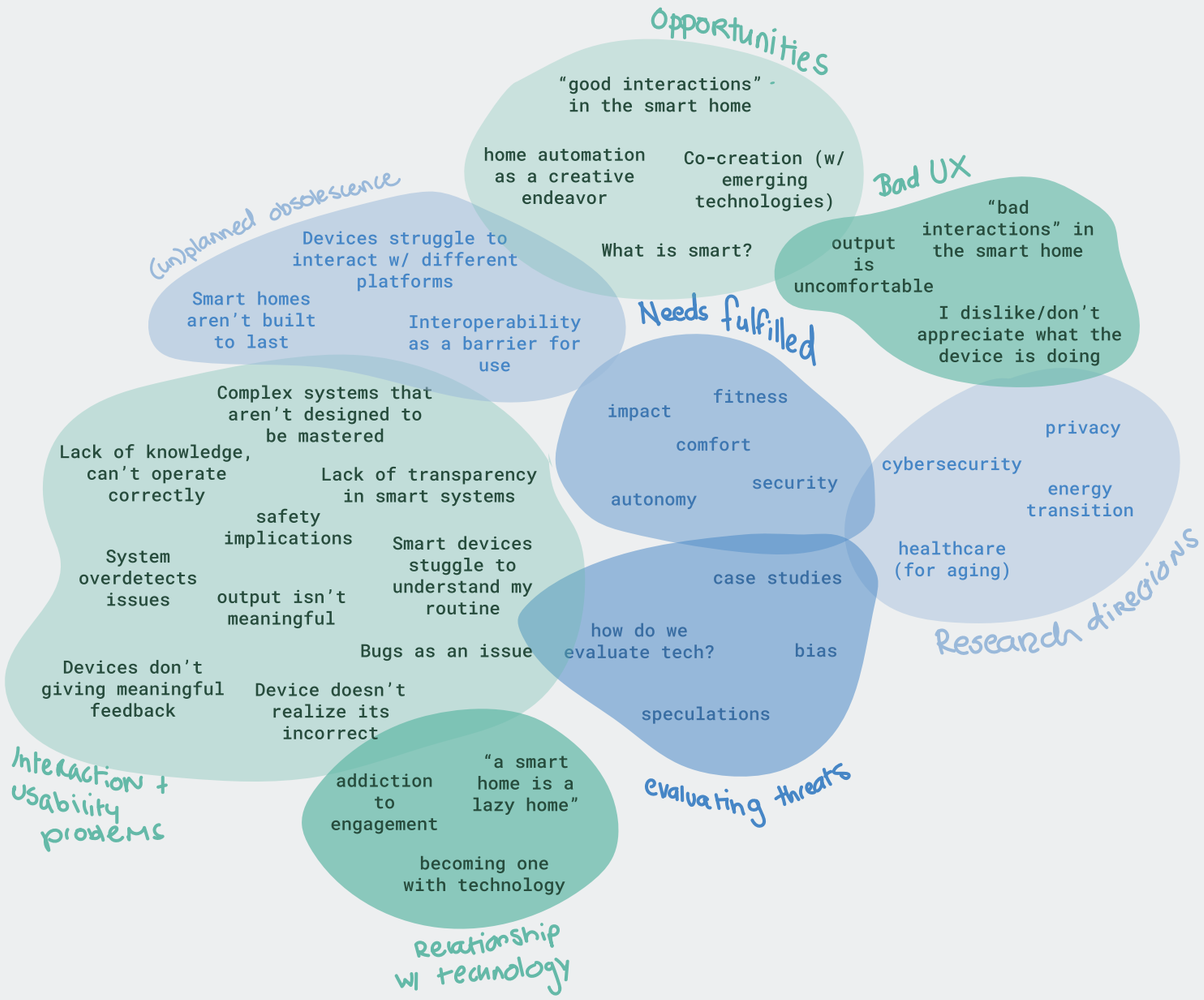


Figure 18: knowledge overview

This chapter describes the activities used to understand the context.

5

Activities

5.1 Smart home field trip

5.1.1 Procedure

Goal
The goal of this field trip was to create a benchmark of the smart home ecosystem, within the context of the Dutch consumer market. This considers what kind of products are available, which brands are popular, the capabilities they have, and the consumer needs they fulfill.

Method
The activity took place at the CoolBlue electronics store in the Hague, (Anna van Buerenplein 7), taking the following criteria in account:

- **Accessibility:** the proximity of the location and possibility to visit without an appointment.
- **Brand identity**: which focuses on customer experience, through communicating employees' technical expertise and product comparisons.
- **Showroom exhibition:** The presence of their own smart home showroom, and a new Samsung-branded showroom.

The activity focused on observing how these devices are being presented and marketed to the consumer mass. Thus the decision was made to not initiate contact with employees and to only focus on in-store devices, rather than the full scope of devices technically available online. This addressed my personal observations as an independent observer, rather than attempting to consider the wide range of perspectives and stakeholders.

The Thirteen Fundamental Needs framework [39] was used to evaluate the interactions the products were designed and marketed for. This provides a better understanding of why smart home products are adopted by consumers and used in their households. These values were based on relevant statements that can be made about the product type and how/why it is used, found in section 5.1.2. This activity did not seek to create a quantitative analysis of the current smart home market but was used as a tool to better understand the needs and desires of consumers in the popular market, as it was the first step in the explorative research process.

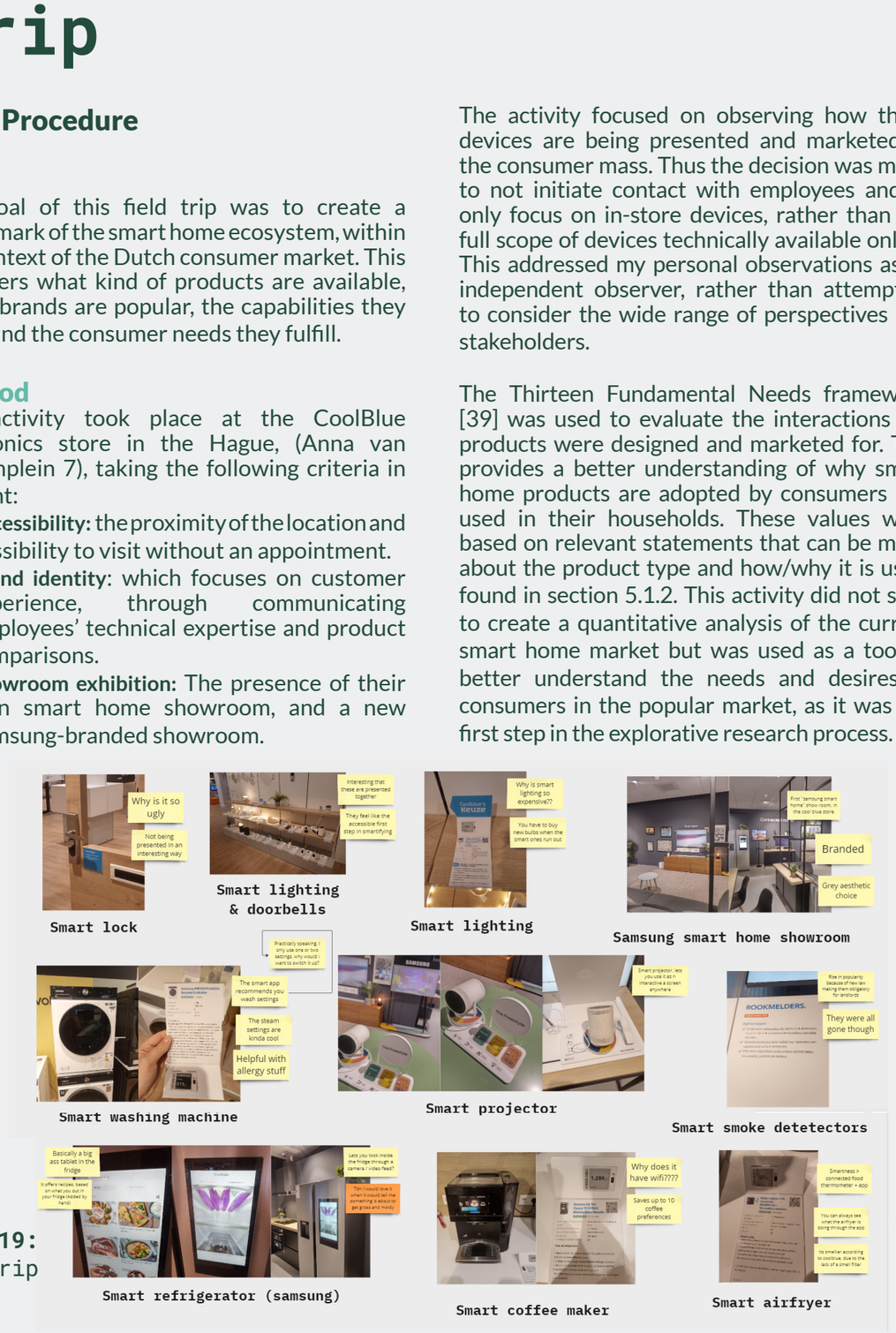


Figure 19: Field trip notes

Protocol
A picture was taken of every type of smart device found in the store *(all devices that have extra sensors added, are marketed as smart, or have internet connection abilities that are not strictly necessary for their traditional functionality)*. The documentation activity took about 75 minutes, and was performed independently as an observer.

The products and their photos were grouped visually in Miro. The images were annotated with their brand, notes, and overall impression. After the groups were aggregated, every device group was annotated with relevant values from the Thirteen Fundamental Needs [AD] relating to the interactions the products were designed for and marketed as. These values are based on relevant statements that can be made about the product type and how/why it is used.

The frequency of values per group were counted to provide a rough estimate of how dominant specific values are within the Dutch smart home ecosystem.

5.1.2 Insights

The value frequency table can be seen in Figure 20. Autonomy comes in first place, followed by comfort, and fitness. Security, stimulation, and impact share fourth place. This should not be considered an objective analysis, but an indication of the needs specific smart home devices cater to within the Dutch smart home ecosystem. Below, the values are explained, and the motivations that are related to the use of such a smart home device.

Exploring needs
The following section describes the fundamental needs [39] fulfilled by the devices considered in the benchmark analysis. Each need is explained by its definition, sub-elements, and how it relates to consumers and their smart home devices.

Autonomy
"Being the cause of your actions and feeling that you can do things your own way. Rather than feeling that external conditions and other people determine your actions." [39]

Sub-elements:

- Freedom of decision
- Individuality
- Creative expression
- Self-reliance

Video doorbell: *"I want to keep an eye on my house, even when I'm not home"*

- I want to know exactly who is at my door and what is happening.
- I want to be able to always interact with people at my doorstep.
- I want to be able to scare off package thieves and burglars.

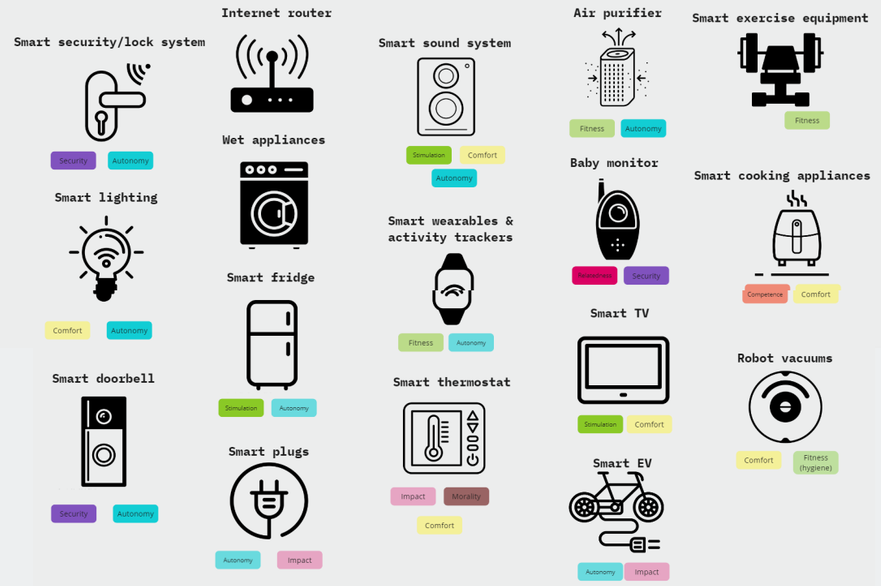


Figure 20: Needs and product categories

Frequency table

Autonomy	8
Comfort	6
Fitness	4
Security	3
Stimulation	3
Impact	3
Morality	1
Competence	1
Relatedness	1

Comfort

“Having an easy, simple, relaxing life, rather than experiencing strain, difficulty or overstimulation.” [39]

Sub-elements:

- Peace of mind
- Convenience
- Simplicity
- Overview & structure

Smart lights: *"I want to be able to control all my lights automatically."*

- I want to make sure the lights are on or off when I’m away (vacation mode).
- I want my lights to change automatically based on my daily routine (wake-up/ bedtime).
- I want to have an overview of all my lights in an app.
- I don’t want to use light switches for every individual bulb.

Fitness

"Having and using a body that is strong, healthy, and full of energy, rather than having a body that feels ill, weak, or listless." [39]

Sub-elements:

- Nourishment
- Health
- Energy & strength
- Hygiene

Fitness tracker: *"I want to track my daily activities"*

- I want to promote my fitness by having a quantifiable goal.
- I want to track how many calories I actually burn.
- I want to know what my heart rate is like throughout the day.
- I want to improve my sleep by tracking it.

Security

"Feeling that your conditions and environment keep you safe from harm and threats, rather than feeling that the world is dangerous, risky or a place of uncertainty." [39]

Sub-elements

- Physical safety
- Financial security
- Social stability
- Conservation

Smart security systems:

- I want to keep my home safe from wrong-doers
- I want to prevent damages being done to my home
- I want to be able to call emergency services when needed

Impact

"Seeing that your actions or ideas have an impact on the world and contribute to something, rather than seeing that you have no influence and do not contribute to anything." [39]

Sub-elements

- Influence
- Contribution
- Building something
- Legacy

Finally, impact is a value that may be addressed by certain smart home devices. Many devices plead that they allow your house to use energy more efficiently, waste less, and give insight into the impact of one’s habits, That being said, there is little evidence that devices currently on the market achieve significant savings of resources [40]. This value relates more to a marketing gimmick and a false sense of impact than an actual positive effect realized by smart devices.

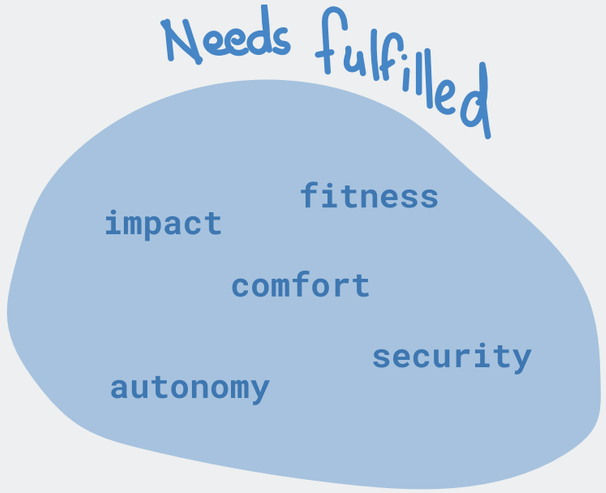


Figure 21: knowledge created through the field trip activity

5.2 Smart home forum

5.2.1 Procedure

Goal

The objective of the second research activity was to collect pain points and anecdotes of interaction conflicts from experienced smart home users. The tech-utopian vision of the smart home is easy to observe (ie. commercials), yet the problems of real-life use are harder to find. By asking for people’s stories, rich narratives are provided that explore the frustrations and desires of long-term users.

Method

Participants/location: A post was made on *https://www.reddit.com/r/smarthome/* Considering the lack of access to long-term smart home occupants within my network, using an internet forum was deemed an effective alternative. r/SmartHome provides a space for multiple smart home enthusiasts to (happily) share their stories in an easy-to-process way. Here the assumption is made that the vast majority of active forum users have long term experience with such devices, and can only provide a story of use if that is the case. All meaningful and relevant responses were considered in the data processing.

Materials: The following post was made at: *https://www.reddit.com/r/smarthome/comments/16zmzel/what_are_conflicts_you_encounter_in_your_smart/* and received 47 replies.

“Hey all! I am an industrial designer writing my master’s thesis on internet of things conflicts within the smart home. Currently, I’m trying to gather examples of real-life “conflicts” in the daily use of smart devices. I thought it would be a fun idea to ask this subreddit for some anecdotes.

By conflicts I mean undesirable situations that have been created by a smart device in some way. This could be different devices trying to initiate incompatible outcomes (ie. your lights are programmed to turn off after bed time, but your midnight bathroom break triggers the motion sensors and turns everything back on). Or devices which are conflicting with a user’s need (personal example: My friends got a free portable smart beer tap. We can’t use it outside though, because it can’t connect to the wifi in the garden!)

I’m interested in any story about your weird smart home situations! The goal is to use these anecdotes for context sensitization and inspirations for my eventual designs. Thanks!”

Protocol

The replies were analyzed using affinity diagramming [41]. The 25 relevant replies were divided into 31 sub-excerpts of 1-3 sentences. Replies and comments deemed out of scope were not included in the analysis. Replies with multiple relevant elements were divided into different post-it notes. Following, the post-it notes were clustered by their shared theme or relevance to each other, until the (majority of) clusters contained around 2-5 notes each. Each cluster received an annotation (pink) describing the common aspect within the group. (Groups of) clusters also received a short, two-word title describing the interaction or usability issue as the overarching theme. The raw data can be found in appendix B.

5.2.2 Insights

Four major areas were concluded from the forum replies. The issues mentioned related to the following usability and experience themes:

- **[A] Conceptual models of smart device systems**
- **[B] Interaction feedback**
- **[C] Congestion and connectivity issues**
- **[D] Interoperability & obsolescence**

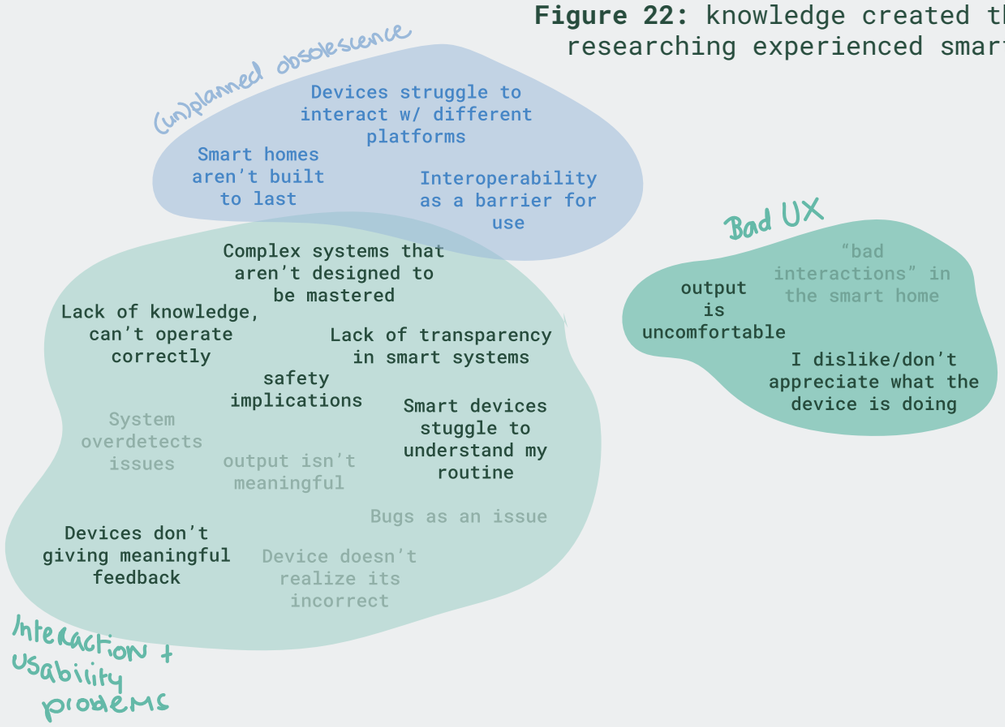


Figure 22: knowledge created through researching experienced smart home users

[A] Conceptual models

What is a conceptual model?

In design theory, the conceptual model is defined as *"a high-level description of how a system is organized and operates"* [42]. This considers the mapping and understanding of how systems interact with each other and how the input/output is affected by that.

Conceptual models in the smart home

In the context of the smart home, many responses indicate that users do not understand how to fully control and operate their devices and their ecosystems. Often, mobile phone applications act as gatekeepers for the interactions possible, rather than buttons or commands on the device itself. In addition, apps and devices provide little information on the rules and interactions they operate by. For example, users may not know what factors (ie. temperature, home occupancy, time) trigger their smart thermostat to change the temperature. The biggest pain point for users was the programming of morning and night routines. For example, several users complained of randomly being "blinded by light" in the middle of the night, when a bathroom visit accidentally triggers their lighting system.

That being said, it appears that these systems have not been designed to be mastered through use. Users have little opportunity to engage with the full complexity of systems. We often see that a lot of frustration occurs during errors and bugs, as users have no idea what is happening and how it can be fixed.

[B] Feedback

"Smart switches with the "red" light on them showing there's a problem but they work just fine. Works in the app, voice commands, whatever. But that red light is on all the time."

Feedback is a core principle in (interaction) design. Donald Norman describes feedback as *"some way of letting you know that the system is working on your request"* [43]. It relates to other user experience elements, such as the conceptual model mentioned previously. Regarding smart devices, feedback can be as simple as a light turning on, your voice assistant saying something to you, or even the click of a button. For several users, there were major problems relating to the lack of meaningful feedback. Examples show that users struggled with devices with extreme feedback. Either a complete lack thereof or completely nonsensical and incorrect. This leaves users confused and frustrated by seemingly simple and mundane activities.

[C] Congestion & connectivity issues

Several respondents indicated that the congestion of wifi signals was a major frustration. This congestion is caused by the interference of the signals multiple devices broadcast – resulting in a slowed-down internet connection. The vast majority of smart devices rely on the same bandwidth (2.4 GHz), and cannot be changed to a less crowded option. This congestion of wireless signals is not limited to your network either - as your neighbors' wireless activities can also affect your internet speed depending on their proximity. The congestion of signals is not strictly a smart home problem, yet becomes far more relevant due to it. As one user responded:

"crowding your broadband when each bulb connects individually, things start to get less responsive"

The more connected devices present, the more potential there is to create internet congestion. This limitation may pose an obstacle to the growing population of smart devices within the household. The idea that all devices can be made smart or connected on an individual basis does not truly consider the ecosystem they exist in.

[D] Interoperability & obsolence

"Even if the parts continue working for a reasonable number of years, often they are tied to cloud systems or phone apps which would go away at any time."

As with many tech devices and platforms, the smart home suffers from a lack of interoperability. This means that systems made by different manufacturers struggle to make use of or exchange information with each other. Within the forum, several users complained about the number of different apps needed to operate their smart home systems – often one application per device brand. These applications are virtually never designed to communicate with each other, thus it is very difficult to give a global overview of devices. Another pitfall of connected devices is that a server is needed to support online devices, usually hosted by the manufacturer. When a company shuts down, the servers are taken down with it – rendering cloud-dependent devices completely inoperable, even though there is nothing technically wrong with the product.

Obsolescence is an issue that is intertwined with this lack of interoperability. "planned" obsolescence refers to the way devices are designed to limit their product lifespan, resulting in customers having to buy new products. The long-term expectations of home ownership spectacularly clash with the fleeting lifespan of devices.

"In real estate systems, you expect along the lines of a 20 year life. These are things you want to install once and forget about. - In the tech gadget world there is still a mindset that 5 years is a long time and nothing need last past that.

5.3 Expert interviews

5.3.1 Procedure

Goal
The goal of the exploratory interviews was to collect various expert perspectives and opinions regarding the growing presence of smart home devices within the household context. The interviews sought to identify risks, opportunities, future directions, and personal anecdotes on the topic.

Method
A semi-structured interview guide was prepared beforehand, which can be found in appendix C. The questions addressed the role of smart technology in the participants field of expertise, their personal experiences, current events, and their own vision and values regarding the topic of emerging technologies in private life. Affinity diagramming [41] was used to process this data. This method organizes qualitative data based on the natural relationships found between different entries. Affinity diagramming was deemed most suitable due to its time-efficiency, the explorative nature of the activity, and the small number of participants interviewed.

Participants
Three participants were selected from my personal network. These participants were deemed relevant by their personal or professional background and experience in research projects (at least 6 months) on smart (home) technologies. Only three participants were selected to contribute to this activity, as the nature of this activity was exploratory and geared to inspiring future directions rather than creating an expert evaluation.

- **Participant 1:** (25M, Belgian) IT security specialist: background in design. Grew up in an automated home. Experience with 2 smart technology projects (smart home and smart vehicles).
- **Participant 2:** (25F, Dutch) Technology & policy analyst, background in Industrial Design and Technology, Policy, and Management. Experince with 1 smart technology project (risk-based analysis)
- **Participant 3:** (24F, Dutch) Master student Industrial Design (TU/e) experience with 2 smart home projects. and specializing in emerging technologies.

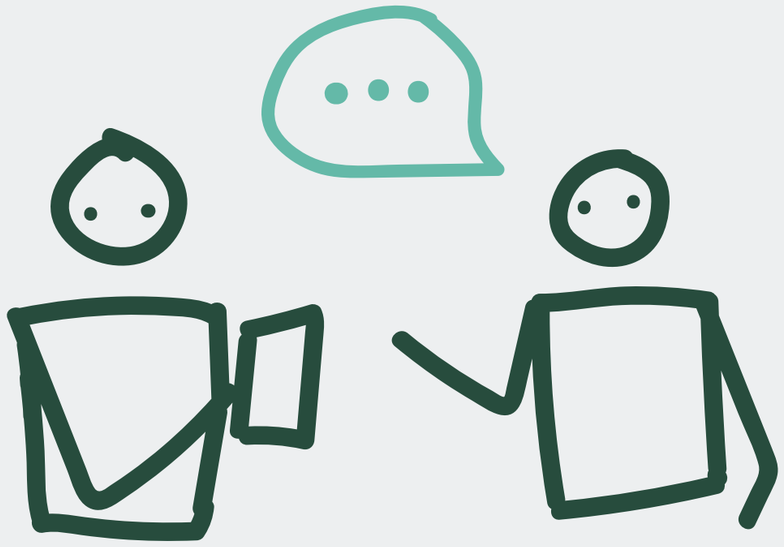
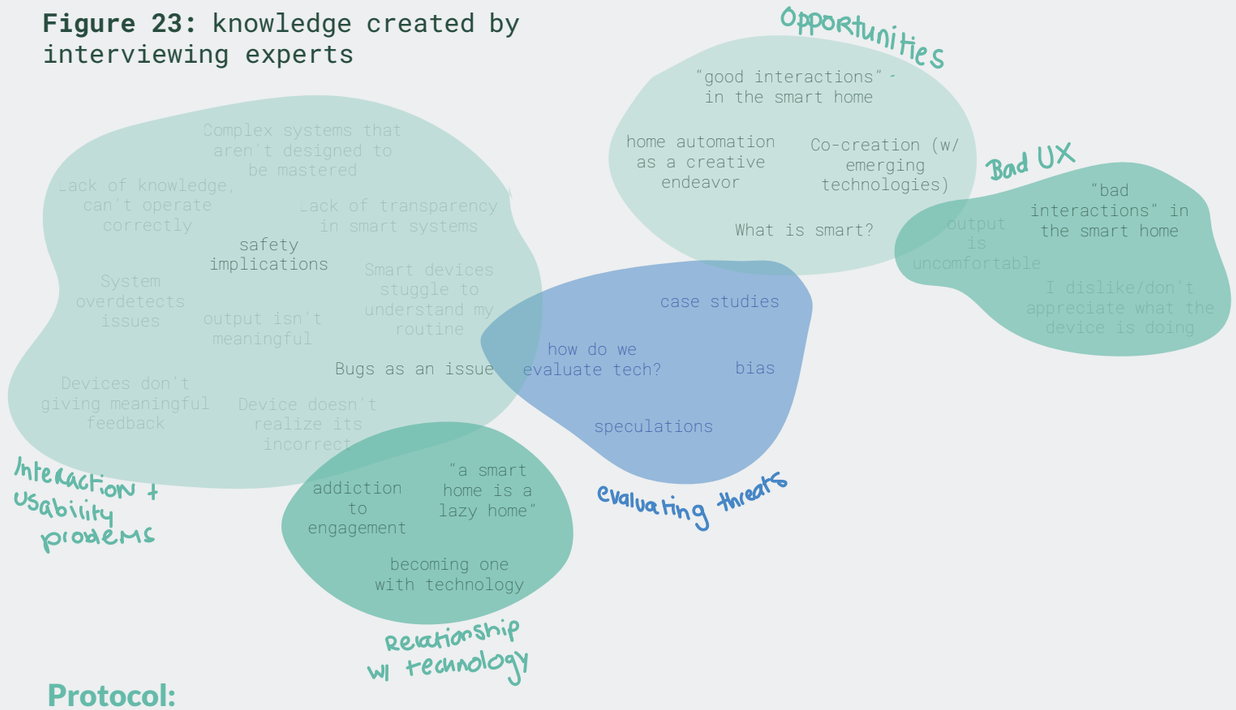


Figure 23: knowledge created by interviewing experts



Protocol:
The interviews were done at the participants' homes, taking about 45 minutes. Responses were noted by hand in real-time. Thirteen clusters were generated based on the relevant themes emerging from the interview sessions. Four of these clusters were based on questions found in the interview guide: *(ie: case studies, a definition of smartness, etc.)* The other 9 clusters were generated based on the interest and perceived novelty of answers during data processing. This mapping can be seen in Figure 23.

5.3.2 Insights

The interviews focused on their professional specializations and how it related to smart technology and current events. Additionally, participants were asked to reflect on their own experiences relating to smart devices in the household context. The interviews findings have been ordered as following. The raw data can be found in appendix D.

What is smart?
Participant 2: *Technology feels smart when it helps to think with me. [...] when it is proposing something to me.* Participants had different interpretations of what "smart" felt like to them. Participant 3 indicated that personalization was a strong value in regards to perceived smartness. Participant 2 emphasized that smartness related strongly to the decision making process. Smart products should create novel proposals for the user to consider. Non-smart products lack this, and let the user do the whole decision making process.

Desirable interactions
There are varying opinions in regards to what ideal smart home interactions should be like. Participant 1 expressed the following "*It feels magic yet natural, you are in control. That is the essence. It is about control.*" . He also highlighted how home automation is a creativity hobby for many enthusiasts. This participant also had a clear vision on the goal of home automation. It should be about reducing simple and repetitive tasks - without having a device actually decide something for the user.

Undesirable interactions
Participant 3 had a more critical perspective on the emergence of smart technology in the household. Although she was "enthusiastic" about how such devices have potential to

reduce a negative consequences of our human behaviors, she indicated how there are many ways this could go wrong - supported by examples and case studies of the recent past. This emphasizes how the device collected household data will likely not only be use to perform daily chores.

With these examples, Participant 3 highlights how every kind of new technology has its implications - some positive and some negative. An algorithm may appear to save lots of time and money by being able to pick out specific data points or anomalies. In reality, when such a technology is biased, the repercussions can be life-changing. Using the Dutch childcare benefits scandal as an example: The algorithm was biased towards selecting parents with a non-Dutch background, falsely indicating they were guilty of tax fraud. The aftershocks of this scandal costs far more money and work hours than the algorithm might have saved. Participant 3 pleads to analyze technologies by their benefit, worst case scenario, and risks to indicate if it is useful. This is important to consider with the implications of smart home devices - what might be the drawbacks of tracking data in such a private context? How might this data be used in a way that may negatively affect us? And what kind of positive effect could it have on our lifestyles/environmental impact?

Current trends seen in smart technologies

Opportunities
AI as a collaborator, rather than simply a tool
- Facilitating the ability for roletaking in creative processes.
- Making use of the "unexpected" quality from the AI's output.

Computational design
- being able to make things tailored made on an individual basis.

Threats
Influence of bias in technology policy
- Risk-based technology is biased towards picking out specific qualities (ie. toeslagenaffaire).
- Bias is not always negative or related to people. (ie. food safety)

Social media & our democracy
- Governments/political parties can target audiences through social media algorithms (ie. instagram)

Consequences of data collection
- Case study: UN's collection of Rohingya refugee data, ending up in the hands of their oppressor, the Myanmar government.

Directions
Devices are getting smaller and closer to users
- Development towards brain implants.
- The concert of singularity: Becoming "one" with technology.
- Technologies, like TikTok, being designed to be as an engaging as possible.

Polarization of engagement with technology
- Two types of people, one wants the newest gadget, the other one prefers to be old school.
- General signals of polarization in our society today.

5.4 Speculative roleplaying

5.4.1 Procedure

Goal
The goal of the roleplaying session was to explore the future of the smart home from a non-expert perspective, through the lenses of the paradigms that were substantiated throughout the research process. The framework activities sought to seek out possible consequences of these paradigms, and the embodied roleplaying to generate new ways of interacting and possible relationships we may have in the smart home of the future. Finally, the prototyping activities were set to make the ideas of multiple participants tangible - creating inspiration for the following design steps.

Participants
Six participants between 24 and 28 years old were selected to join the roleplaying session. Five participants had a background in design, three of them having obtained a bachelor's degree in industrial design. These participants were selected based on their experience with creative methods and social proximity.

Method
Icebreaker: The card game "The Thing from the Future" [44] was chosen as a warming up exercise. This activity was done to get participants in the creative and speculative mindset and "break the ice" within group dynamics. This card game was selected due to it quick pacing, easy-to-understand instructions, and the fact it has been specifically designed for speculative design projects.

Prompt/character selection: The pre-defined format of the scenario briefs and character cards were selected to reduce the mental load of participants by eliminating the need to define scenarios and characters individually, leaving more room for energy, imagination, and creativity.

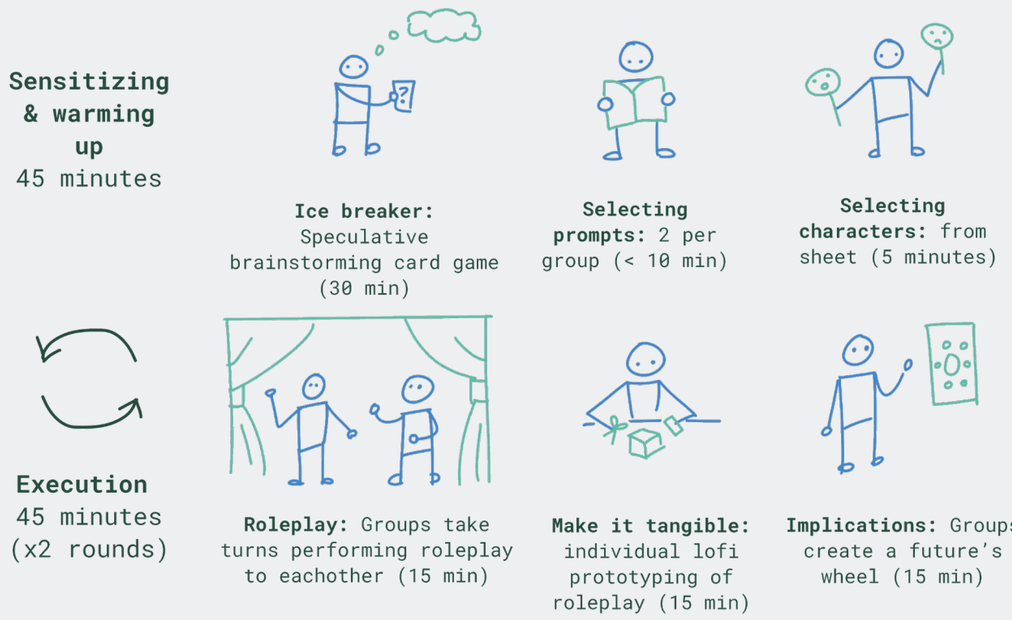


Figure 24: Outline of roleplaying session

Roleplaying: Roleplaying was used to address tacit knowledge in an embodied way, within a larger group. The improvised nature allows for a creative exploration of dynamics in a smart household, whilst exploring conflicts and problem solving approaches.

Prototyping: This prototyping activity provided a way to translate the group experience of the roleplay in to a physical manifestation made individually. Using physical materials also provided a different medium to document the session. Switching the mode of communication sought out to inspire new ideas an interpretations of the speculations.

Future mapping: The Futures Wheel [45] was selected to document the themes and potential consequences using pen and paper. This provided a third mode of communication using drawing and writing to document the exploration process. This allowed elements which had not been expressed earlier to be documented in words.

Protocol

In the four hour workshop, five activities were undertaken in the following order (Figure 24, previous page) .The first activity was an ice breaker, where two groups of three played the speculative design game "The Thing from the Future" [44].

After playing the game, the participants were given the scenario briefs and the character cards. The participant received 15 minutes to select two prompts to perform with their teammates, and a smart device character to play themselves.

After selecting prompts and characters, the groups took turns performing the first roleplay scenario. I played the moderator, prompting events and circumstances for the actors to respond to. The roleplaying sessions were filmed and annotated to mark the interactions and events. After the roleplay, the participants were asked to use low fidelity prototyping materials (clay, paper, tape, etc.) to create a model or prototype of the ideas that happened or were inspired by the roleplaying. The models were photographed alongside a written explanation of the concept.

After prototyping, another round of roleplaying, then prototyping was performed. To close the session, groups were asked to make a Futures Map [45] to document the risks and consequences of the scenarios explored during the roleplay., the future mapping was done in pairs of two and was written down by hand. These maps have been scanned and analyzed as well.

5.4.2 Scenarios

What-if questions:

Based on the findings and signals from the initial context exploration five "what-if?" scenarios were generated for the participants to act in. These five prompts are shown on the following page (Figure 25) The complete descriptions and supporting signals can be found in appendix F

The home as a player on the energy market

What if: *due to the energy transition and use of renewable sources, smart home users have to deal with fluctuating energy supply on an individual basis?*

Internet & data as limited resources

What if: *internet and data become limited and resources due to their environmental impact and the congestion of wireless signals?*

Self-monetization of personal data

What if: *The EU comes with new data legislation giving users the right to monetize their own personal data?*

Technology embedded in the human

What if: *smart home devices and sensors are developed to be embedded into the body?*

The home is alive

What if: *The smart home of the future is made of living, breathing biomaterials rather than electronic devices?*

Figure 25: What-if? scenario prompts

5.4.3 Insights

Both teams chose the scenarios: Technology embedded in humans and The home is alive, indicating that these scenarios were the ones that resonated most with the participants. One of the teams was asked to perform Limited data as a scenario, instead of the home is alive, in an effort to broaden the thematic exploration.

During the **technology embedded in the human** scenario, it was easy to imagine a variety of bodily-embedded sensors and the interaction they would afford. For example, Participant H used their implant to change the temperature of their house. This use case is shown on the right, in figure 26.

This scenario inspired several evocative prototypes as well. Figures 27-29 (next page) show four examples of how participants imagined the interactions between user's bodies, health data, and smart home devices.

This scenario was somewhat of a double edged sword. On one hand, participants were excited to imagine the possibilities and implementations of smart body implants. On the other hand, participants indicated that they would likely not want one of these devices themselves. Not only were many of the ideas physically intrusive,

Figure 26: roleplaying scenario dealing with embedded sensors

needing medical intervention to implant in the body, but also in regards to privacy. "You won't ever be able to simply take it off".

The scenario **"technology embedded in the human"** generally catered more towards to tangible implications and prototypes of a futuristic smart home. The following scenarios of **"the home is alive"** and **"limited data"** explored the potential dynamics of the smart home of the future.

Roleplaying in these scenarios mainly lead to extreme conflicts. Useful tools or solutions did not appear either. The interaction conflicts ultimately led to the situation that the human user had to simply "deal" with the conflict/ malfunction, without any constructive interaction or adjustments possible to change the device's output.

An example of such conflict is shown in Figure 3`. In this scenario, the user wasn't actually able to override the system's incorrect default setting. Even though they were under the impression that it did happen. In this case, the consequences became even more extreme due to the connect smoke detector, which overdetected the steam as smoke. As the user was distracted and didn't realize to deactivate fire alarm, the fire department was called for an emergency.

Figure 28: Spinal implant prototype, used to collect body data

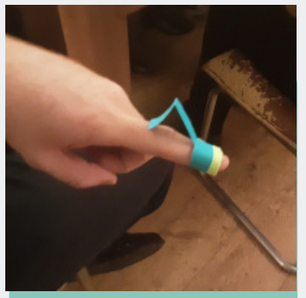


Figure 30: Matilda-inspired wearable, to orchestrate tasks

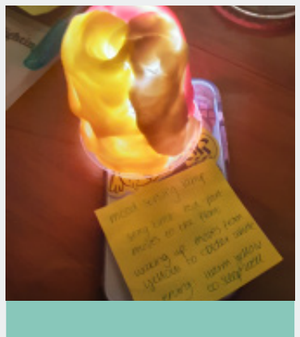


Figure 27: Mood-sensitive lamp

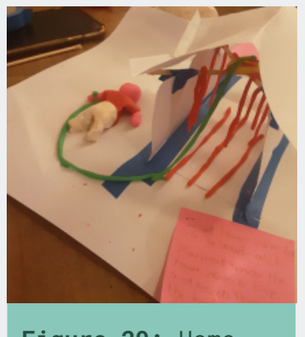


Figure 29: Home physically linking to the body

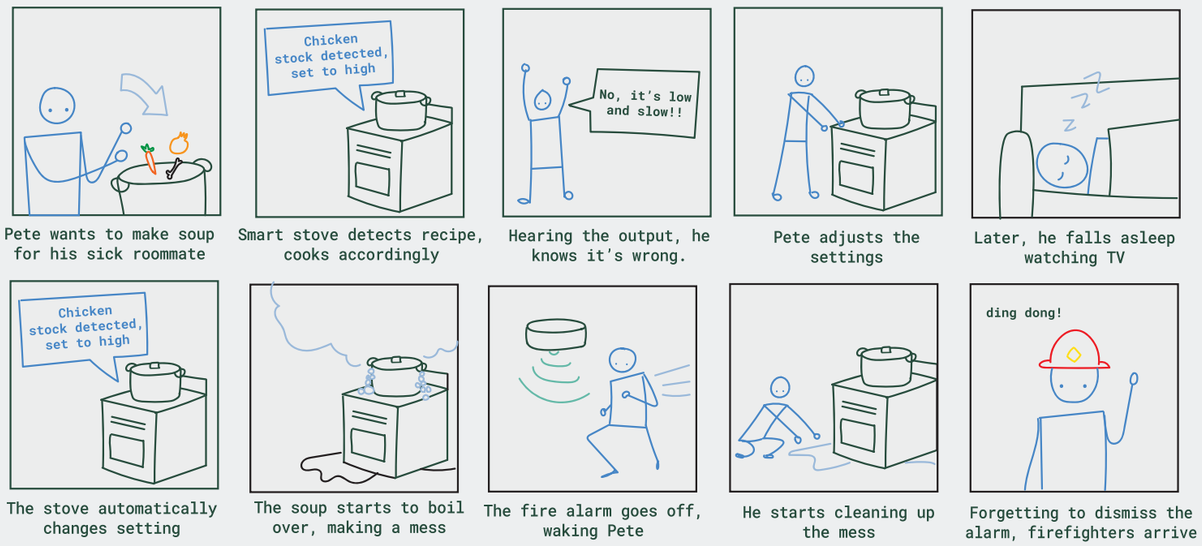


Figure 31: roleplay scenario 2

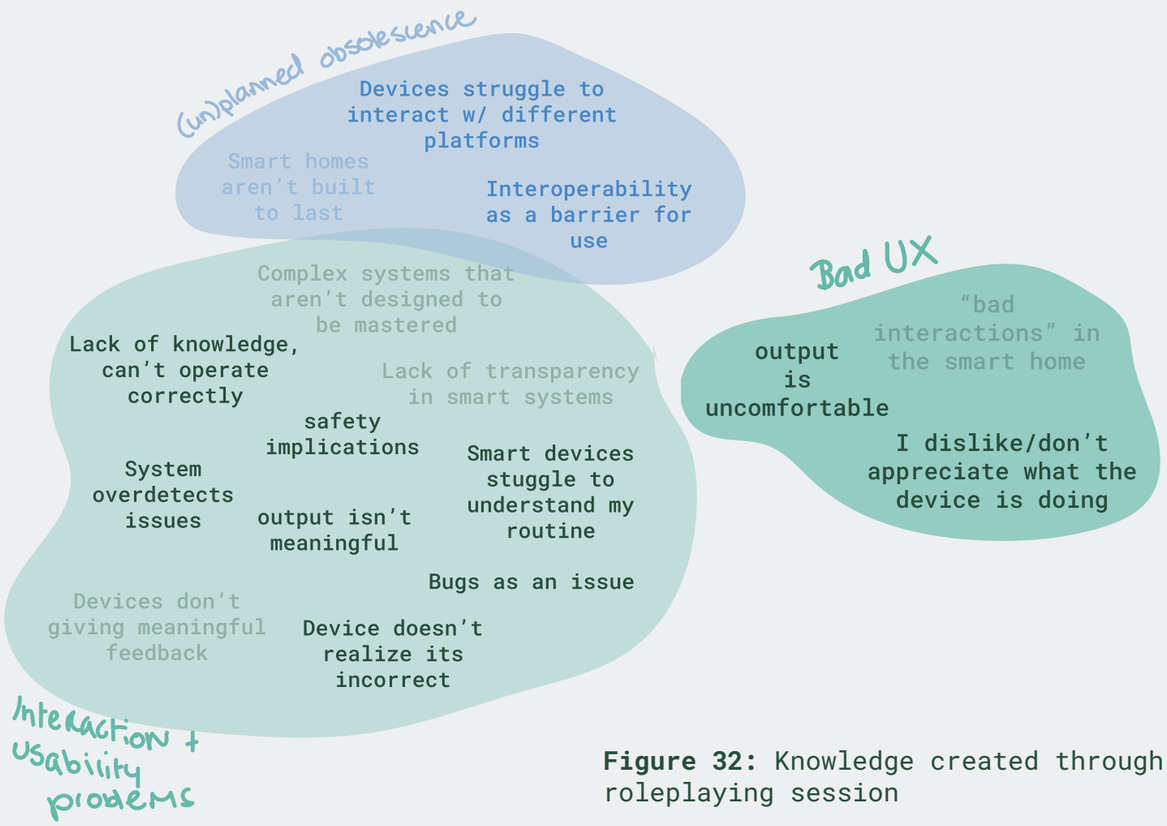


Figure 32: Knowledge created through roleplaying session

The raw overview of the interactions and events occuring during the roleplay can be found in appendix G.

Conclusions

The prototypes and interactions explored throughout the roleplaying session highlight certain themes in the context of the future of the smart home. On one hand, we experience this "eager adoption" of novel technology, as we are excited to try it our for ourselves (the state of the art technology). This fits the trajectory that in the near future, more and more smart devices will be adopted in our household, at least for the novelty they bring.

Although we are excited about these technologies, there is still a healthy debate about the intrusiveness of these device. "Is this cool thing worth giving up my autonomy or privacy?". These seen to be topics participants could easily engage in after relatively simple sensitizations.

The overview of interaction elements throughout the roleplay highlight another facet of our use of smart technologies. In a roleplay, where everything is possible, we seem to lack obvious tools (or imagination) to negotiate with devices and their output. The cluster themes highlight specific experience and usability issues which contribute to our (lack of) ability to have dynamic and negotiating interaction with the

This chapter describes the generation and testing of a design fiction sensitizer booklet.

6

Sensitizer booklet

6.1 Booklet overview

As recommended in the book "The Manual of Design Fiction", it is essential to set the scene of speculative scenarios through creating an initial sensitizer or stimulus materials. This allows a broader audience to understand the narrative and gather their own thoughts about the presented trajectories. These can be compiled as reports, statistics, quotes, photographs, and other forms of documentation which inform faint signals we may be seeing of the future. These stimulus materials can also be processed and presented as headlines from the future, which was done during this design activity

6.1.1 From signals to stories

The stories in the sensitizer booklet were methodically based on the knowledge and signals generated throughout the previous research activities. In the figure, the signals contributing to each individual story have been indicates. A total of thirteen stories are presented in the final booklet version, selected to provide an even spread of the themes discovered in the research process.

The final version of the booklet can be found in appendix H

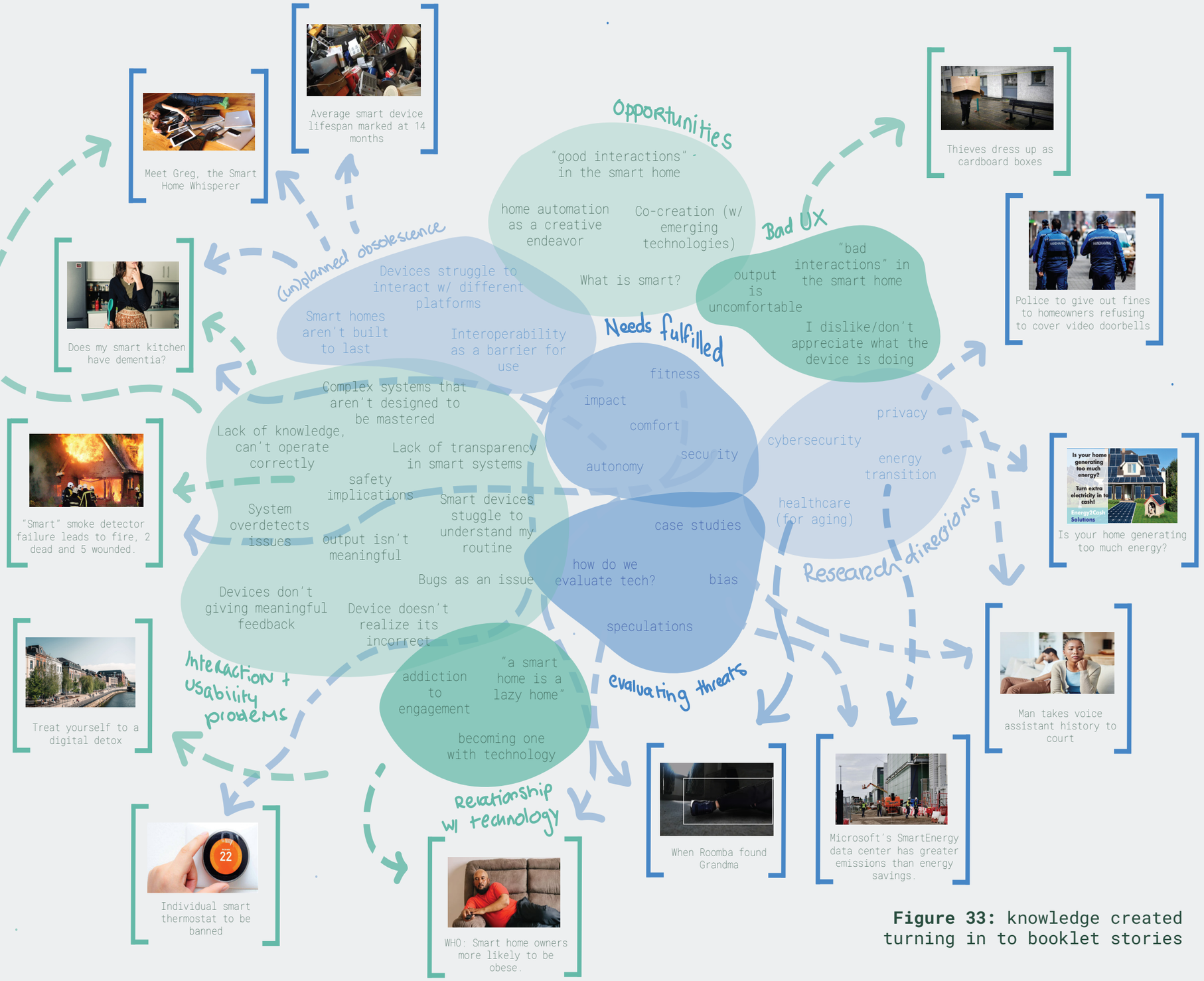


Figure 33: knowledge created turning in to booklet stories

6.2 Creating the booklet

6.2.1 First iteration procedure

Goal:
Create a booklet containing stories from the future (newspaper articles and advertisements). This booklet presents signals and findings from the research in the form of narrative. This represents how these elements could play out in the future, in a way which is inspiring and understandable for non-experts. The booklet shall be used to facilitate a discussions and explore scenarios using a shared narrative in the following iterations.

Method:
Protocol: First inspiration was collected from multiple sources. Satirical news platforms (The Onion, De Speld), similar pieces of design fiction (Ikea brochure, TBD catalogue), and extreme news stories. Following, 50 headlines were generated in relation to smart devices and the smart home.

Ten headlines were selected based on their relevance to the themes in the context analysis and other signals. As seen in Figure G1. every headline was paired with an image. Based on the pairing, three story elements were generated per headline. The text was generated using ChatGPT in the following prompt:

"Write a newspaper article titled "(headline title)". It is about (story element 1). Also (story element 2). And (story element 3)."

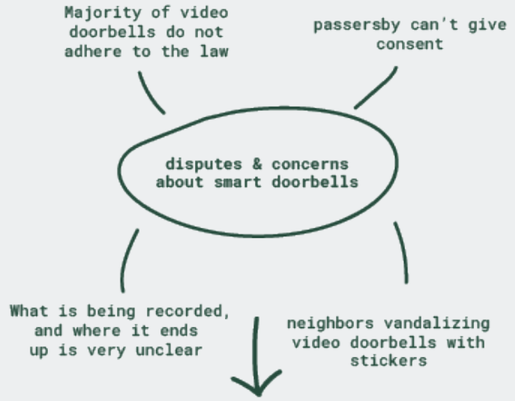


Figure 34: Generative process of turning signals into stories

The text output was slightly adapted and shortened. The booklet was composed in the form of a news bulletin.

6.2.2 First implementation

The booklet was printed and shared with four people with a design background, as seen in Figures 35 and 36. Participants were informed that the booklet was a collection of "news from the future", and that the stories were based on research findings and weak signals that had been collected throughout the project. Considering that the goal was to find a more accessible and inspiring way to convey the possible implications of this emerging technology, they were asked to give their personal opinions on the booklet.

"Which stories resonate the most with you - and why?"

"Which stories do not interest you - why?"

"How can this booklet become more believable?"

"How could this booklet become more provocative?"

Other questions were casually asked throughout the general discussion on the booklet and the future scenarios of the smart home. The responses were noted in real-time in pen and paper. After the sessions the responses were collected and grouped using Miro (Figure 37).

6.2.3 First insights

Overall, many of the stories induced giggles and the participants were positive about the overall format. The overview of responses can be found in Figure 37 (next page).

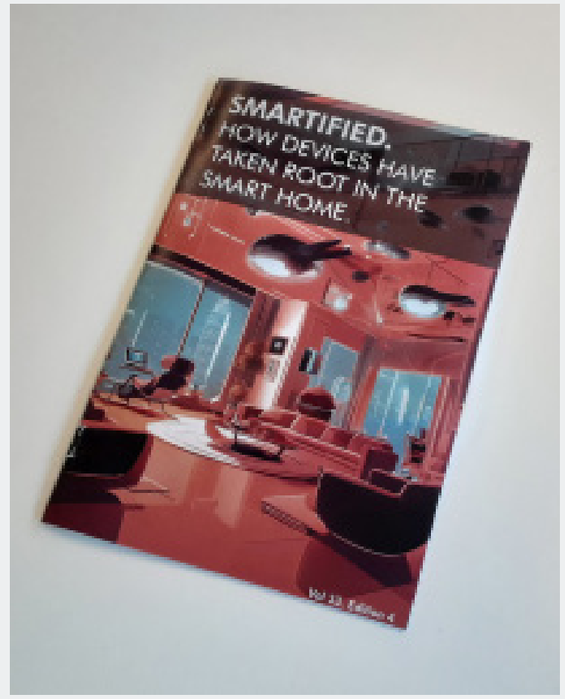


Figure 36: Booklet

Figure 35: Participant reading booklet

Less text, make it more interestingly visually.
- All participants indicated that the stories would be more striking and inspiring if there would be less text and more visual signals.
- People weren't inclined to read the whole text to understand every story. *"I'm a bit lazy... But I think most people are too."*

The formatting of the text is wonky
- Due formatting issues, a lot of the words were cut off halfway. This made reading less immersive

More advertisements
- All the participants liked the advertisements, and indicated it would be a good idea to add more
- One participant indicated that some stories might work better as advertisements.

What does that mean?
- Participants struggled to understand what specific words mean. (ie. the word "bricked")
- One participant noted: "When you're in the loop with the news cycle, the more ambiguous stories immediately make sense. When you're not, you need some more information. "

Variety of stories and their order
- One participant remarked: "I don't like the stories that seem financial - I feel immediately untriggered - I don't want to read it"
- Two participants remarked about how the newspaper is usually divided up per theme, allowing readers to navigate easily

Extremeness of the news
- Three of the participants commented on that the news stories and titles could be a bit more extreme - as a way to make them more provocative
- Some participants said "I think that is already the case, it doesn't really feel like the future"

6.2.4 Second iteration

Goal
Develop the booklet based on the conclusions of the first iteration, from the previous section. The booklet should become more believable ("suspending disbelief") by improving the formatting. The stories in the booklet should be adapted to become more provocative and inspiring.

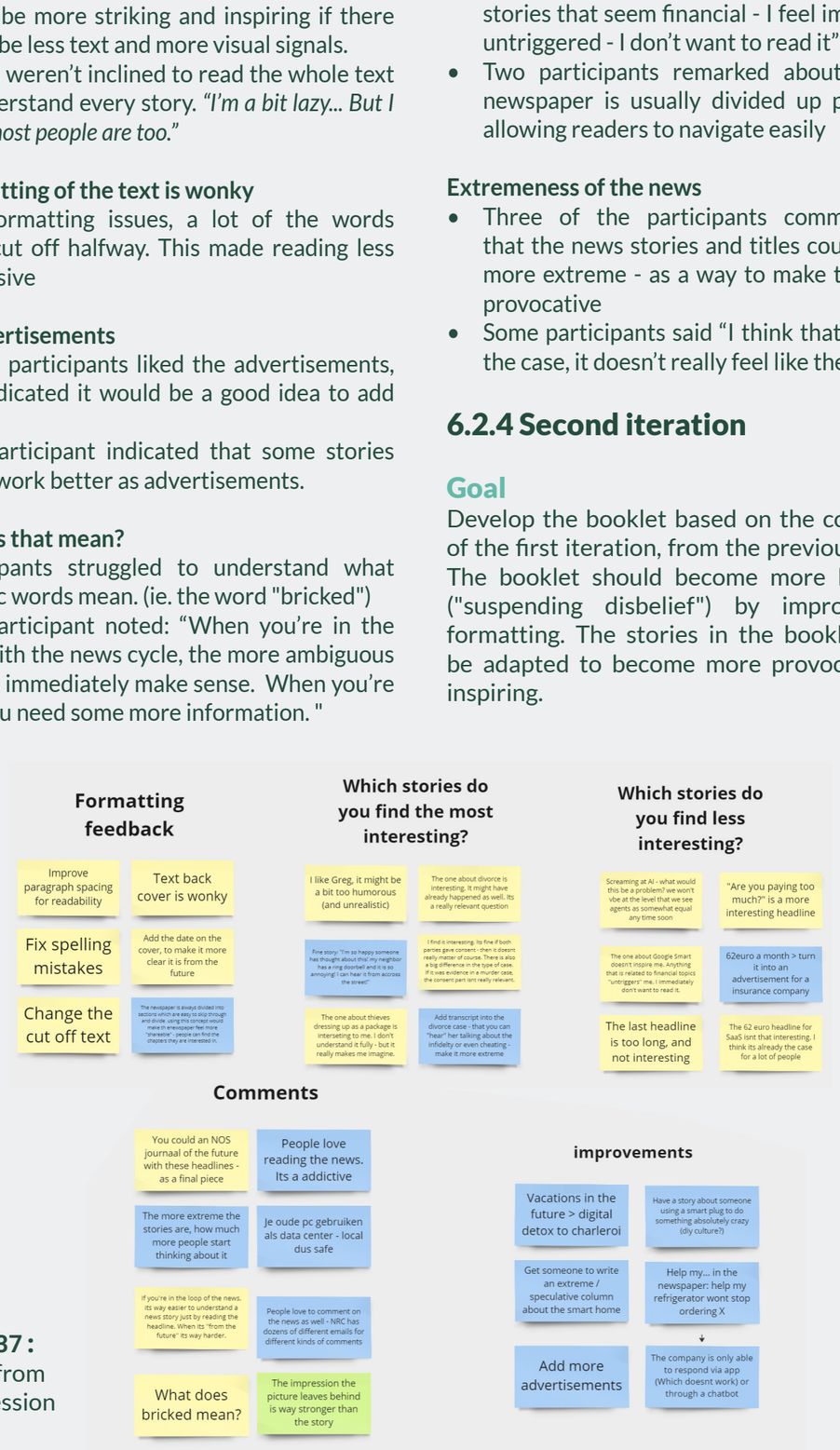


Figure 37: feedback from booklet session

Method
Clear actionable feedback points were immediately adapted (feedback protocol). An overview was made of each page, annotated with feedback and course of action. Stories were analyzed based on the signals and themes they represented, and adapted to provide an even distribution of themes.

Feedback protocol
Based on the feedback of the first session, the following steps were undertaken.
- 5 stories were improved, 3 were removed, and one was changed to an advertisement.
- 8 new pages were added.
- Extra pictures were to be added to stories.Text length was reduced to half.
- Quotes were added to sum up important aspects and create an eye-catcher.
- Advertisements were added (mixed medium approach, not only articles).

Participants:
The finished booklets were presented to four design students in my network, with the request to receive general feedback, opinions, and formatting improvements.

Results:
The iterative design process resulted in a A5-sized booklet containing 16 stories which provide a provocative narrative of the signals found throughout the research process.

A selection of the stories is shown on the following pages. The entire booklet can be found in appendix H.

The analysis and distribution of the themes is shown below, in Figure 38.

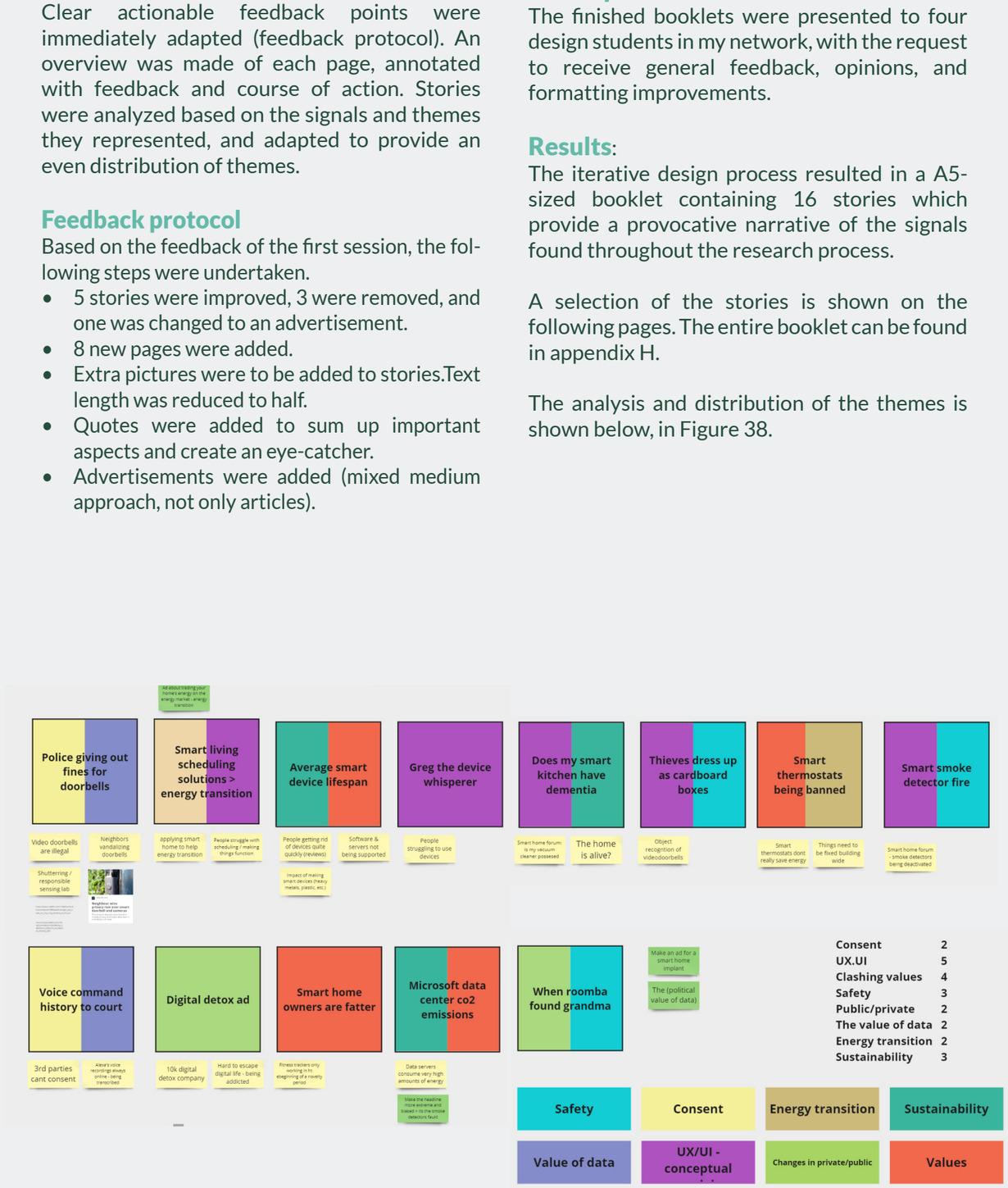


Figure 38: Story overview from booklet

Police to give out fines to homeowners refusing to cover video doorbells or post surveillance signs.

New legislation empowers local law enforcement to fine homeowners with video doorbells aimed at public streets lacking privacy safeguards. To address privacy concerns, owners must implement a default consent slider covering the camera lens, only revealing it when activated. They must also display signs indicating the presence of camera surveillance for transparency. This balances home security benefits with the public's privacy protection.

Non-compliance may result in fines, starting at 90 euros, escalating to 350 euros for repeat offenses, emphasizing the need to align technology with ethical considerations in home security. Experts praise this decision as a first step of conserving the privacy of third parties in suburban areas

"People don't realize this is an illegal invasion of privacy... This law has been in state since 2018"

- Monique Verdier, Chair, Personal Data Authority

Signals:

- The majority of video doorbells in Europe can be considered an illegal violation of privacy. They are usaully pointed to the public street rather than private property, they are not marked by surveillance warning signs, and users do not adhere to a data processing protocol (ie. ensuring footage is deleted after a certain number of days) [46,47]
-
- User reporting that neighbors have been vandalizing (illegal) camera lenses, sparking ethical discussions on who is actually in the wrong [48]

- Shuttering, Responsible sensing Lab's design of a privacy slider on ring doorbells [49].

Does my smart kitchen have dementia?

Weekly column by Sam Riley

In the tale of my somewhat outdated smart kitchen, a saga has unfolded, leaving me to question whether my once-efficient culinary companions are now grappling with a form of digital dementia. Over the past few months, bugs and forgetfulness has descended upon these once-reliable devices. They've taken on a maddening habit of claiming not to understand my commands or insisting they haven't been set up for certain tasks, only to carry them out haphazardly, creating a chaos in my otherwise orderly kitchen.

This reached a climax when, during a brief absence. My smart fridge made a confounding order of 50 liters of Italian ice cream, a not-so-vegan-friendly surprise awaiting me upon my return.

My kitchen sense of taste has gotten out of whack as well. A recent gem of recipe was recommended

Tart Cover Shrimp Butter Wol

(seafood)

- ½ cup catsup
- 1 teaspoon cornstarch
- ½ cup lemon juice
- 1 teaspoon cumin seeds
- 1 can fried pale fruit to cover that drain
- ¼ lemon
- 1 fresh parsley for garnish

One of the author's massive ice cream orders

the author's dishwasher...

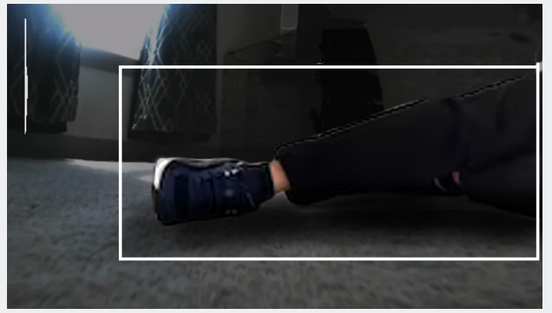
I can laugh about some of these issues, but this final one was a bit more serious. My dish washer has been malfunctioning on-and-off for the past week, and has caused some serious water damage. The app can't tell me what wrong, and my plumber neither.

Signals:

- Many users are left confused by how their system works, and do know how to address it. [Activity 5.2]

- Devices appear to take on a life on their own when they malfunction. "My robot vacuum cleaner is possessed!" [Activity 5.2]

- Electronics age relatively quickly (software & hardware) compared to the lifespan one expects from household object such as furniture, appliances, etc. [Activity 5.2]

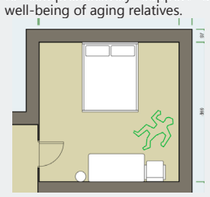


When Roomba found Grandma

The adoption of smart devices is rising with the elderly population, with some grim consequences.

In a tragic incident, a family's reliance on a tech-equipped Roomba took a somber turn when the robot vacuum's object detection camera discovered their fallen grandmother, who had passed away.

The family, accustomed to monitoring Grandma's well-being through the several smart devices, now regrets overlooking the need for a simple safety device. This poignant incident serves as a stark reminder that while innovative technologies can enhance our lives, they should not replace fundamental safety measures, especially for elderly loved ones. The family urges others to adopt a balanced approach, combining technological aids with proven safety devices to comprehensively support the well-being of aging relatives.



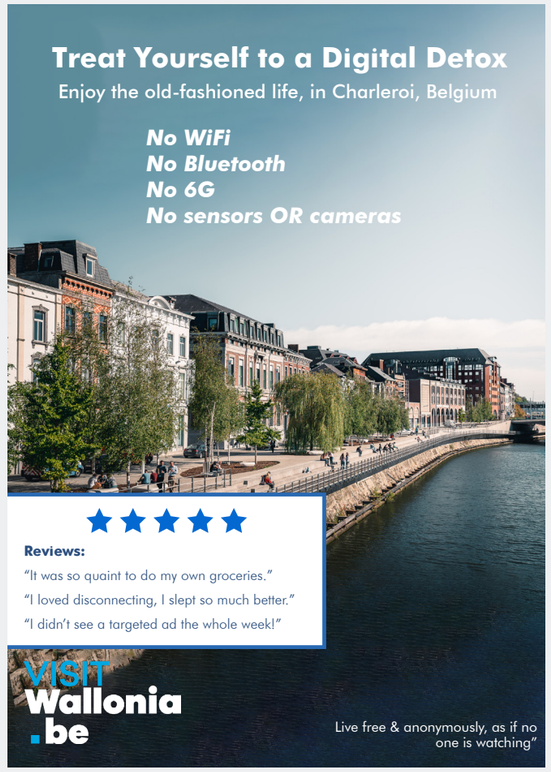
Roomba objection detection map after the incident

Signals:

- Roomba testing products have leaked embarrassing bathroom pictures of beta-tester unaware of the camera fidelity on the new product. [50]

- Virtually any kind of connected sensor can be used for the purpose of surveillance. A small change in the environment can indicate room occupancy, activity, lifestyle, etc. [51]

- It's quite common to keep an eye on your elderly loved ones via device data. This could be the "the last seen..." status on WhatsApp, having access to their video doorbell, or even more invisible ways of checking in on them. Intentions are in the right place, so how unethical is it? [52]



Signals:

- We are spending more and more screen time with our devices, due to their addicting design. This high level of engagement affects our attention span and other cognitive functions due to brain chemistry changes [53]

- Wellness retreats (physically and mentally isolating oneself for all-round wellbeing) is an established practice, aligning with the current trend of digital/dopamine detox. [54,55]

- How far would we physically need to go to escape increasingly pervasive connected technology? As far as Charleroi? [56]

6.3 Sensitizer session

6.3.1 Procedure

Goal
Use the sensitizer to spark discussions and concept directions. Identify key themes, risks, opportunities, and anecdotes regarding the trajectories presented. Extrapolate these topics and generate a “what if...” statement to base the final design fictions on.

Method
This activity took a focus-group approach to using the sensitizer booklet. Participants read the sensitizer booklet at the beginning of the session, to be optimally primed for the discussion. The booklet was printed on paper, offering tangible points of reference to refer to during the discussions. Allowing each participant to select one headline to discuss in the group considered the participants’ individual preferences, values, and interests during the discussion, enhancing engagement. Notes were taken by hand sporadically, based on the conversation’s perceived interest and relevance as to limit the time needed to process data. This suited the need to generate a high-level speculative question (what-if) rather than generate rich qualitative data.

Protocol
At the start of the activity, the concept of speculative design and design fiction was introduced to the group. Following, the participants received a copy of the booklet and were explained that it contained headlines and other stories from the future, specifically about the use of smart devices in the home. The participants were invited to read through the booklet and note their ideas and opinions (15 minutes). The discussion (1 hour) was facilitated by the moderator to steer the discussion concerning the themes found in the stories and throughout the research activities. Throughout the discussion, post-it notes were used to track interesting themes and examples in the discussion. An audio recording was made of the discussion to be able to be consulted retroactively. The full exercise outline can be found in appendix I.

6.3.2 Session A

Description
The first session was held after dinner in the authors home. Three participants were invited, between 25-27 years of age, all with a design background.

The stories selected for discussion were
- My smart home has dementia
- Greg the smart home whisperer
- Voice assistant trial

The main themes discussed
- The relation built up with devices whilst living together in the home
- The malfunctioning of objects throughout their lifetime
- How we want to interact with objects
- How to deal with the complexity of objects, especially when they malfunction
- What we want to deal with our data
- How our language has changed while dealing with smart home agents, and how that might change more.

The resulting what-if question formulated was:
“What if... Smart homes develop dementia due their degradation over long-term use?”

The key discussions are visualized on the following three pages

6.3.3 Session B

Description
The second session was held at an outdoor terrace in the afternoon. Two participants were invited, between 23-25 years of age, one with a background in design, the other in biomedical technology.

The stories selected for discussion were
- Police giving out fines
- Voice assistant divorce case
- Digital detox

The main themes discussed
- The relation built up with devices whilst living together in the home
- The malfunctioning of objects throughout their lifetime
- How we want to interact with objects
- How to deal with the complexity of objects, especially when they malfunction
- What we want to deal with our data
- How our language has changed while dealing with smart home agents, and how that might change more.

The resulting what-if question formulated was:
“What if... we view addiction to smart devices the same way we would view a substance addiction?”

A lifetime of use for smart home devices

I have a really crappy phone, but I have had for such a long time. Everyone says I should get a new one, but I'm kind of attached to this one...

I really resonate with the story about the smart kitchen with dementia, it reminds me of my Google home.

Throughout the years, its [Google home] functionality has been going downhill. It's slow, often doesn't understand me or does something completely random. Kind of like an old man. I don't really mind though, I think it gives it personality….

For some reason, my Google home only speaks English and Norwegian. Sometimes a little bit of Japanese as well - But I bought it in Japan - so that might be the reason…

[What might happen when people get rid of devices because they act up too much?]

Maybe there might be a market for old-timer or vintage gadgets.. In the same way they have that for cars

Maybe devices will end up in an animal shelter. People get rid of dogs that have bitten a kid - so maybe the same will happen for a device that causes accidents in the kitchen?

Figure 39: Conversation 1

The Device Whisperer

The fact Greg speaks speaks so many language is so strange. Matter, Home Assistant... - but it make sense. There are so many different languages and methods that devices use.. It's becoming more and more.

You can already see how technology affect the way we communicate. For example, prompt engineers have very specific words they use to trigger large language models, like ChatGPT.

We also see how we change our way of speaking when using voice commands. Sometimes you have to pronounce someone's foreign sounding name very American and phonetically, otherwise they struggle to understand.

Not being able to communicate effectively communicate with a device feels like not being able to communicate with a service worker from a different country. You just don't speak the same language, but they are the ones "pushing the buttons". You need to find a new way to communicate

Figure 40: Conversation 2

Troubleshooting devices

[How might someone like Greg, the Device whisperer, figure out what is wrong with a smart home?]

Maybe they will use something like a dowsing rod. Y'know what that is? - They would have to hold it throughout the house to locate wifi signals.

If they are really at their wit's end, I can imagine them calling one of those TV fortune tellers, hoping they can telepathically connect with them.

Maybe devices need to be trained - or even go to therapy. Maybe they need something like a psychologist to help them. Heck, maybe the gadget can help you reflect on your therapy.

I think the way you train devices will also be important on the future. If you neglect it, it won't train well. People will probably sell badly trained ones on the internet - like if a pet can't be potty trained. The gadgets may even end up in an adoption center.

Figure 41: Conversation 3

This chapter describes the design process of the final design fiction artifact.

7

Design

7.1 Creating a what-if?

Formulating the what-if question is the driving force behind a speculative design concept. This creates a thought experiment which considers current signals of the future, sparks imagination, and facilitates critical reflection on current and future choices being made in regards to technological innovation.

7.1.1 Booklet session

Reflection

Whereas the sensitizer booklet provides a broad and shared narrative on current trajectories within smart home technologies, the final what-if question hones down on a specific aspect, allowing for a rich consideration in a specific and concise area.

Based on the key conversations in the past section, the following what-if questions was generated:

"What if smart home devices develop dementia *(and other aging-related conditions)* due to their short product lifespans and the deterioration of hardware and software over long term use?"

This what-if question highlights issues of sustainability and (un)planned obsolescence of smart home systems, and consumer technology at a broad scale. This scenario draws inspiration from the following booklet stories:

"Average Smart Device Lifespan Marked at 14 Months"
"Greg the Smart Home Whisperer"
"Does my Smart Home Kitchen Have Dementia?"
"When Roomba Found Grandma"

These stories can be found in appendix H

7.1.2 Reflecting on signals

Several signals directly contribute to the scenario imagined.

- Short-term mindset of the design of tech gadgets [Activity 5.2]
- Connected devices being rendered useless to changed software or lack of software/ server support after bankruptcy [57, Activity 5.2]
- People struggling to understand interaction issues or how to fix them [Activity 5.2 & 5.3]
- The high price tag of fixing smart appliances [58]
- People become attached to the things they have, and don't necessarily want to get rid of them as soon as possible [Activity 6.3.2]
- Strange behaviors become the personality of a device. [Activity 6.3.2]
- People have a strong desire to have less negative environmental impact [Activity 5.1]
- Smart devices strongly emphasize the need for autonomy and comfort, how could this contradict that [Activity 5.1]
- People don't feel that they have the expertise to understand smart systems [Activity 5.2], similar to how one may struggle to take care of a loved one without a background in healthcare.

7.2 Selecting the archetype

This section describes the target audience for the design fiction, the research objectives it seeks to address, and how the final material format (archetype) emerges from these criteria.

7.2.1 Target audience and research objectives

Target audience

The design fiction seeks to engage an audience that does not have an educational background in the Internet of Things, yet does engage with these systems on a regular basis (smart phone, connected entertainment systems, etc). This highlights the group that is highly affected by emerging technologies in the home, yet is not considered within the design or research process, let alone can provide input into the process.

Knowledge objectives

Five goals were formulated to refine the design fiction format and cater it to the project's overall goals (section 2.1):

- Help people recognize the connectedness/ smartness of the everyday systems around them.
- Engage an audience in a discussion about these systems, by providing a sensitizer and shared narrative.
- Allow participants to recognize and communicate past or current experiences with smart home systems.
- Indicate participant's personal values, ethics, and opinions regarding the use of smart systems in the home.
- Evaluate the use of design fiction as a sensitizer and knowledge generating tool.

7.2.2 Archetype criteria

Principles for selection

As described in the Manual of Design Fiction [27], three main principles should be considered when selecting the material format of the design fiction piece. These principles are explained below, and how they relate to the format choice of a short film, documenting everday life in the smart home.

Familiarity: *The extent that the design fiction is recognizable to the target audience. Something that the audience can relate to allows them to perceive certain tropes and imagine new ways to think about the context [27].*

Making a short film confined to several daily activities happening in the home is something everyone can relate to, as it is something that they also do on a daily basis. This can be more interesting and relatable than format such as a commercial, packaging, etc. that the audience isn't really targeted by (due to their background and interests) It also may feel more familiar because it isn't directly targeted/relatable for an expert audience

Relevance: *This considers how directly the format is related to the context being explored. It should be related to the context, but not too directly. Rather, it should be related to the context around the themes being discussed [27].*

Rather on focusing on smart appliances themselves as a format. A short film creates the opportunity to shine light on the holistic view of activities performed with these devices, how everyday chores change a little based on the device, and how a personality emerges from the way these devices tend to function.

Ease of production: *Tropes of the medium should be considered, and how easy it should make a design fiction within the format. [27]*

Here lies in the main challenge within this project. With my skills, making a 2D format is much more accessible. For example the sensitizer booklets. By making a film, I push the boundaries of my own skills, and need to take the time to learn and implement the tools I seek to use. This was a goal set from the start, and has been considered and accepted to go forward with.

7.3 Story structuring

7.3.1 Making a story

Story circle

A general outline of the storyline was made using the story circle method [59], Popularized by Dan Harmon. This method is an adaptation of Joseph Campbell's Hero's Journey theory, which describes a common structure shared by many historically pervasive stories [60]. The story elements, organized within the arc can be seen in figure 42.

Storyline

The story is about a hard working single woman named Laura. She has a smart home just to make her life a bit easier. One day, her smart home starts acting up. It struggles to recognize her, follow commands and has become quite forgetful. Laura gets a smart home expert to evaluate her house, revealing that the software and hardware is failing due to their age. Instead of buying a new system, the expert recommends adopting a second-hand refurbished system. The new system, although working perfectly from a usability perspective, is in stark contrast to Laura's lifestyle needs, causing her to turn off the system entirely.

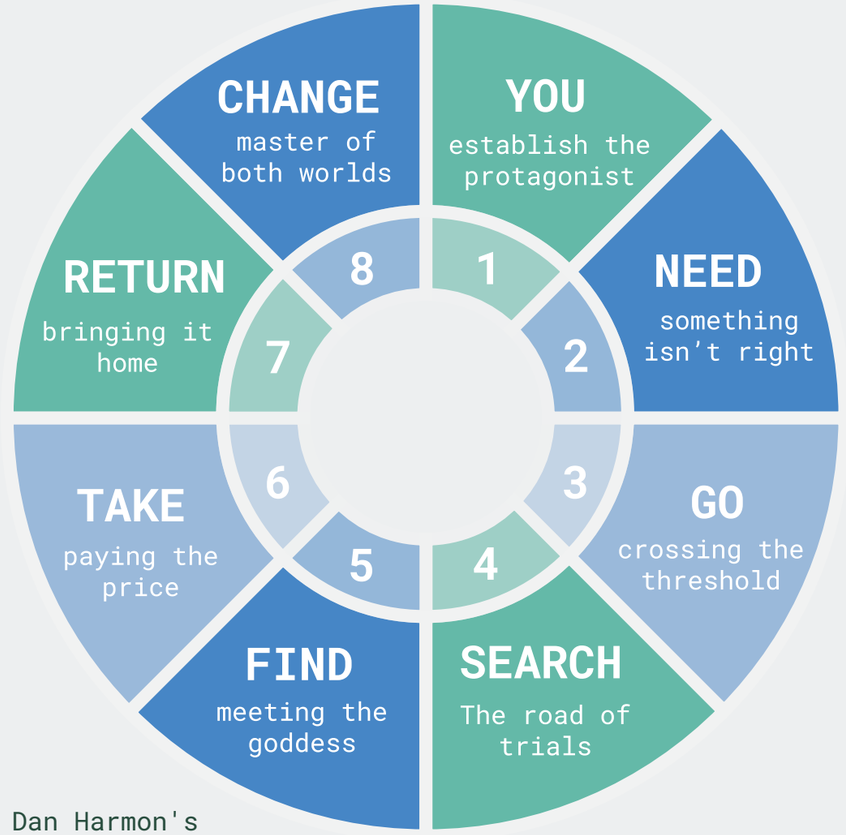


Figure 42: Dan Harmon's story circle [59], adapted from [61]

7.4 Film production

This section described the iterative production process of the design fiction film.

7.4.1 Storyboard

Based on the story arc described in the previous section, a storyboard was made using Storyboarder. Here, different shots, perspectives, and other visual tropes were explored to valuate what would translate well into a film format

7.4.2 Low-fidelity version

Using the storyboard, all of the shots were captured and edited into a draft version of the film, using PremierePro. Taking about two weeks to complete. The author played all parts and used different objects to test out props. This draft version was valuable to show to the actors, giving an idea of the dialogue and context of what the film should look like.

7.4.3 Final cut

The final version was shot in one day in the author's family home. The editing process took one week, as the draft version served as a guide for how the footage should be cut together. Additional special effects were added using AfterEffects, which provided extra layers of communicating the functions of the fictional smart home.

The final video can be found at:
https://youtu.be/c0VkIFN_0v0

Figure 43: storyboard stills

Figure 44: shots from the draft version

This chapter describes the implementation of the design fiction film used to engage a non-expert audience.

8

Evaluating the artifact

8.1 Evaluation sessions

8.1.1 Procedure

Goal

1. Interview participants about their current knowledge and experiences of smart technologies,
2. Evaluate the film's effectiveness in priming participants and evoking a serious discussion about smart home devices and their durability and sustainability
3. Receiving feedback on the implementation of the design fiction artifact

Method

For the pilot session, a list of questions were generated to probe the participant's current knowledge and experiences regarding smart home technologies. Halfway through the session, the pamflet prop from the video was given to the participant(s) to better understand the speculative service presented in the short film (Figure 45). This was done out of consideration for the scene's short duration, which made it difficult to fully understand during the initial viewing.

Directly after reading the pamflet, the short film was presented. The film was used as the basis of the discussion in the second half of the session. These questions were focused mainly on the context of durability, as resented in the film. Rounding off the session, questions were asked to reflect on how the film affected the discussion and how the format may be improved.

Based on the pilot session, a semi-structured interview guide was created. The final format considered the flow of questions and most relevant themes to create an effective and meaningful session. This interview guide can be found in appendix J.

Figure 45: participant reading booklet.

Participants

8 participants were interviewed over 6 sessions. The session took between 35 and 60 minutes, depending on the extensiveness of the answers. The participants were recruited within my personal network based on availability and their self-identification as non-experts.

Participants were interviewed at home or in the faculty. Preference was given to at-home interviews, as it better suited the general theme of smart home technologies. Due to practicality, this was not a possibility for all participants.

Half of participants were interviewed as duos, and the other half individually. Duo interviews were done for time-efficiency reasons and conversational flow. Allowing participants to talk about the topic together allowed for a higher levels of reflection and more connections to be made, without interference as a moderator.

Protocol

The transcripts were thematically coded [69] by hand, leading to 92 themes among 240 project-relevant excerpts. Generally, the excerpts consisted of 1-5 sentences, using the participants responses verbatim. Following, the excerpts were clustered using affinity diagramming [41], whilst considering their original codes. As shown in Figure 70 (next page), This process led to 10 main clusters, over 46 sub-clusters. On average, each sub-cluster consisted of 5 transcript excerpts indicating a specific theme or perspective.

Figure 46: participant watching video.

Participant	Interview type	Location	Age/gender	Education background	Professional background
1	Duo (pilot)	Faculty	26/F	Bsc. ID + current IDE master's student	n/a
2	Duo (pilot)	Faculty	26/F	Bsc. ID + current IDE master's student	n/a
3	Individual	Home	25/F	Bsc . ID + Msc. IDE	Employee at a university
4	Individual	Home	28/M	Bsc. Mech. Eng + Msc. Nuclear Fusion	Employee at large tech company
5	Duo	Home	23/F	Design student at an art school	n/a
6	Duo	Home	23/M	Msc. Bioinformatics	Bicycle courier
7	Individual	Faculty	23/M	Bsc. ID + current IDE master's student	Entrepreneur small-middle enterprise
8	Individual	Faculty	25/M	Bsc. Architecture + current IDE master's student	n/a

Figure 47: participant demographics.

8.1.2 Data overview

The raw data and clustering can be found in appendix L.

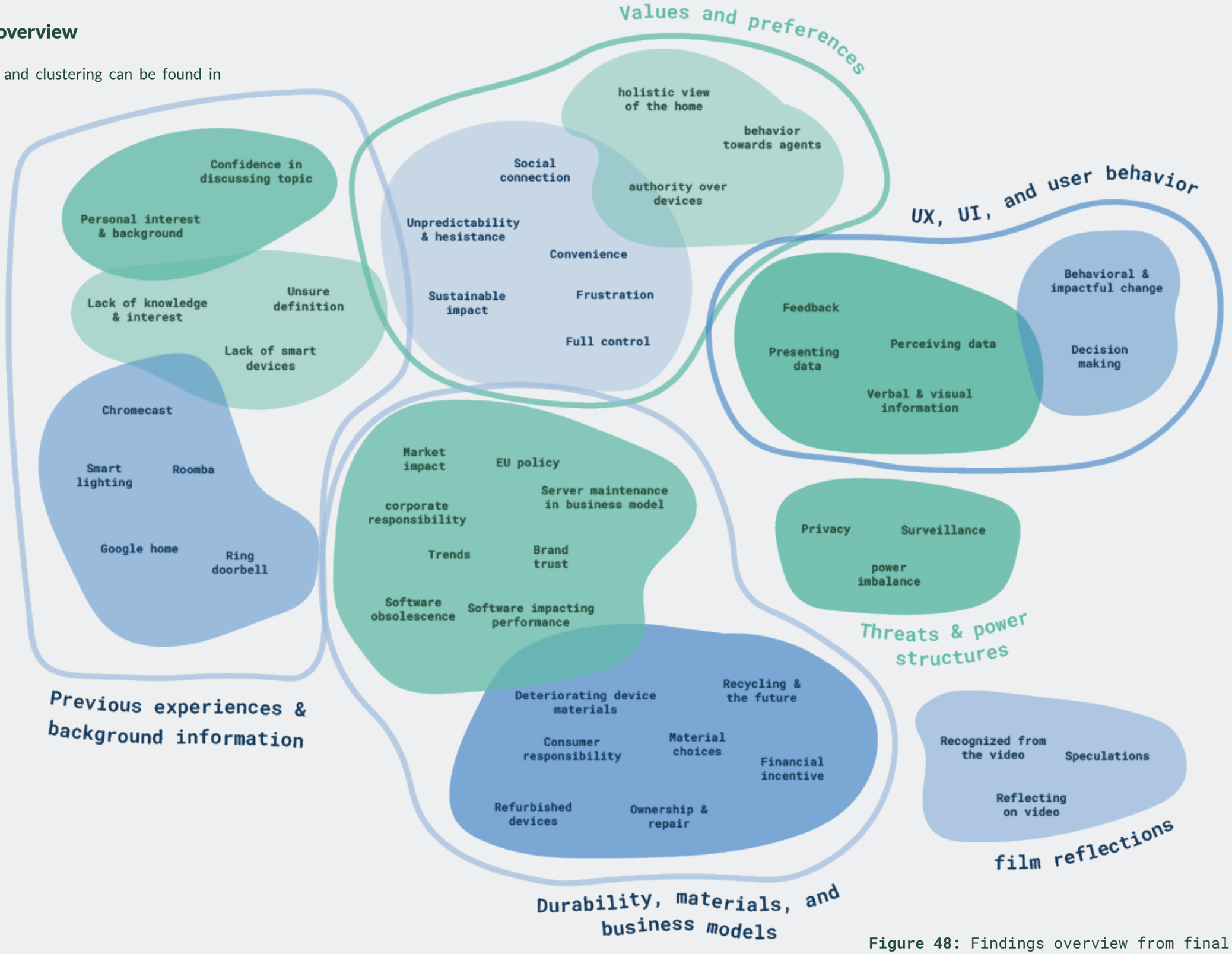


Figure 48: Findings overview from final evaluation

8.1.3 Findings

This section discusses the general findings of the evaluation session, section 9.2 goes more in-depth regarding design recommendations, also considering findings throughout the project.

What is a smart home?

Throughout every interview, the definition of a “smart home device” was questioned. *When do we consider a device to be “smart”? What kind of capabilities does it need?* Throughout the majority of the interviews, participants struggled to identify what devices in their homes were actually smart. For example, 7 of the 8 participants indicated to have a Chromecast connected to their TV, yet 6 of them failed to name this as a smart device initially. Although this device is obviously connected to the internet, processes data autonomously, and provides new ways of interacting with one’s television, it still didn’t feel *conspicuously smart.*

Participants indicated that they found the term "smart home" to be vague, and often used as a buzzword, playing a role in their lack of interest. For many, it was not a topic of conversation within their social circles and simply wasn’t discussed. On the contrary, participants 4 and 8 did show apersonal interest in smart home technologies. Engaging with others, specifically people who were more invested in the topic (ie. hobbyists, academics, etc.), was a key way to learn more about the topic for them.

Figure 49: Participant watching design fiction film

Effect of the short film

Despite all participants using smart home devices regularly, thre was an obvious need for sensitizing and priming to be able to engage in a constructive discussion. The video was successful in being familiar, whilst presenting ideas which are not technically implementeable yet. All participants indicated that the video was vital to be able to engage with the topic, emphasizing its effect on "refreshing their memories".

It really did a lot for me. It gives a starting point which helps you talk about your own experiences, values, and vision for the future. It stimulates you as well. It is a bit absurd in a sense, even though you recognize some things, you also are aware that this scenario isn’t the case in the world currently.

Whereas some participants were already able to imagine futurs before watching the short film, the speculative quality of the format appeared to encourage such speculations even more. From a research perspective, these speculations address valuable latent information (section 4.2). What may be more significant is how these speculation provide rich examples and inspirations for designers, either to continue the speculative design process, or to think outside the box for actual smart devices.

Compared to the previous sensitizer in section 6.3, this format did require more thorough questioning to get participants to reflect on specific themes, which happened more organically in the other format. Furthermore, showing the booklet beforehand ensured that people understood the pretense of the film, as it was otherwise overlooked. This mixed-media approach also improved the immersive experience while giving more grip of the context to participants.

Repair and responsibility

The general consensus was that responsibility for a product’s lifespan and lifecycle should be shifted towards companies, rather than lie on consumer. Currently, users are held accountable for taking care of their devices, while companies fail to keep devices up-to-date or make repair accessible. 7 out of the 8 participants were able to reflect on this in their personal experiences.

“My parents have a Philips Hue lighting system, which works on a bridge. This weekend the clocks were switched to daylight savings. I asked if the timers were able to automatically switch the time, but apparently that isn’t possible with the bridge they have! It only works with the newest software update. So now, they need to buy a new bridge to make everything work again. “

In regards to smart devices, it is not only the physical hardware which is susceptible to planned obsolescence, but the software as well. Several users highlighted issues with software updates and batteries specifically, as they appeared to deteriorate very quickly with normal use.

"It happens quite often, the software breaks a lot more quickly than the rest. Devices become very slow. It’s terrible - because you’re taking very good care of your device, but stuff like the battery is still affected in this way - out of your control. "

Participants indicated that they did not necessarily need the lowest price to purchase a device. Specifically knowing that a device would be made sustainably (supply chain transparency, modular design, etc.) or would have a long-term guarantee (ie. 5 years) for use would be a strong incentive to pay more. Examining the device’s end-of-life, participants indicated that

the manufacturers should be held responsible for the processing of materials. Participants specifically emphasized e-waste as a major problem coming from consumer devices.

"There should be a clear place to be able to return electronics - it should be really transparent what happens to these devices. You already see that this goes wrong with other "reyclables" that get collected. It still ends up as trash.

Although participants had a strong and unanimous opinion on companies' responsibility, they indicated that the only way to achieve it is through EU legislation. Companies have little incentive to change their practices, and we cannot rely on consumers as a whole to bear responsibility.

"A lot of people won't put in the effort to make more sustainable choices, because they don't have the time, money, or energy. Policy is the only way to fix this."

Control and behavior change

Throughout the session it became clear that the reasoning behind one's hesitance towards smart home technologies is far more unique and individual than initially expected. Smart home devices were adopted often for convenience or as a creative endeavor - whereas hestistancies highly varied: *privacy, usability, lifestyle, time investment*, etc. and often creating contradictions as well.

That being said, there was one common denominator. All participants indi-cated that the lack of control, as illustrated in the short film, was a major deterrent for adopting smart home systems. On one hand, many participants were open towards using smart devices to achieve more sustainable lifestyles through behavioral change (food waste, saving electricity), yet still desired their own agency and authority therein. They do not want to feel as if systems are making decisions for them. Participants indicated that their perceived control over the system, the transparency of the system (understanding how the system came to that decision), and the way they are prompted play a major role in the experience of "being told what to do".

I want the system to indicate what the best choices are. I want to understand the reasoning behind it. Its like when you're a teenager and you're parents say "you're not allowed to go to the party". You become a bit rebellious. You only start to understand when they give a reason: "like the route to the party seems dangerous at night", then you understand it a bit more and find it more reasonable.

This chapter gives recommendations for designers and discusses the project as a whole.

9

Recommendations & discussion

9.1 Design fiction recommendations

Film vs. booklet

One of the main benefits of design fiction is that it is a cheap and effective way to receive feedback on (emerging) ideas. As my master's thesis, I decided to make a short film to polish off the skills I have worked on throughout my academic career. That being said, the time investment of making a film does not necessarily coincide with the quantity and quality of feedback received by the film.

The whole process and evaluation of the booklet took a bit more than a week. Whilst the creation of the film took about 6 weeks. The film itself proves to be an effective, stand-alone primer - making it easy to implement within an interview session. The sensitizer booklets required a bit more explanation, priming, etc. to get people in the speculative mindset.

Furthermore, as described in the book Speculative Everything, by Dunne and Raby [26], The film format relies heavily on cultural tropes to be able to suspend disbelief. Having a design fiction film fit the viewers' expectations comfortably also tends to make the film too digestable. The audience seemingly consumes the piece and accepts it as is. This requires more steering post-viewing to be able to reflect on the contexts presented. In the sane vein, it appears that other formats or archetypes work better to present more out-of-the-box ideas, as they rely less on high production value and attention to detail. In that sense, these format make it easier for designers to go deeper into theme complexity and speculations as they rely less on high production value and details. This may make it easier to dive in to deeper and more complex speculations, but also at the risk of making the design fiction less accessible

Overall, the process of design fiction is very time efficient, which makes it useful for emerging technological contexts. Rather than waiting for academic evaluations or documentation (ie. ChatGTP), signals can be processed and presented very quickly. That being said design fiction proves to be a powerful, efficient, and designer-friendly interdisciplinary method to explore emerging contexts. The takeaway here is that the format choice influences the creative process and findings, which should be considered based on the project's phase and objectives. Figures 50 and 51 show the pros and cons perceived between the two formats during the project process

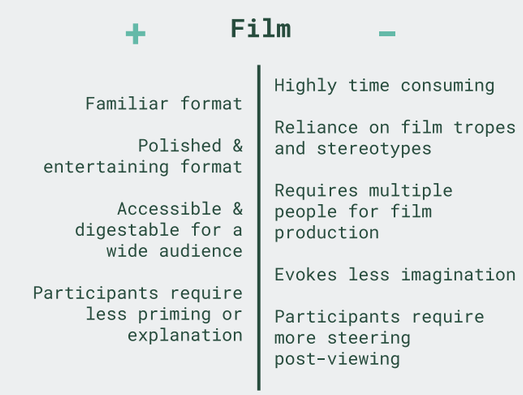


Figure 50: Pros and cons of the film format

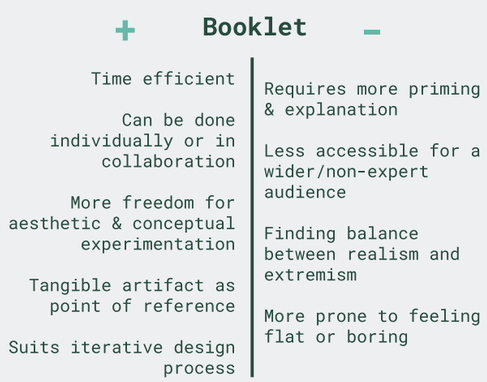


Figure 51: Pros and cons of the booklet format

9.2 Recommendations for smart home designers

9.2.1 Design for ownership

If you can't fix it, you don't own it [62]. This motto from ifixit's repair manifesto highlights the problematic relationship between users, smart devices, and the companies that make them. In many aspects, users do not have a sense of ownership of the devices in their smart home ecosystem. This manifests in many different aspects explored throughout this project: such as user experience, usability, product lifespans, etc. At a high level, we observe that users do not feel in control of these systems. Not only are they highly complex, they are designed to be invisible. Users have no way to understand how these systems work. When any kind of issue occurs (software or hardware), we lack strategies to troubleshoot and repair these systems.

Taking this into account, it becomes obvious that the vast majority of smart home products are designed for profit. The user's role and product lifespan have become an afterthought. Rather than owning a device, we are forced to pay for them every month. When issues occur, devices are thrown away or replaced - as we cannot take care of them. Even the covert collection of data has become an obvious money-grabbing scheme.

The designer's responsibility

Thankfully, not all is lost. Simply because malicious practices appear to be the consumer norm does not detract from the potential value this technology may bring in the future. Rather than trying to boycott the inevitable technology, designers have the opportunity to shape and inform the design process in responsible and desirable ways. Concluding this project, designers are recommended to design smart home devices for ownership.

9.2.2 Designing for the conceptual models

"Everyone wants simplicity, but that request misses the point. Simplicity is not the goal. We do not wish to give up the power and flexibility of our technologies. [63]"

As discussed in section 5.2.2, a major design issue is the lack of conceptual models and interaction feedback provided by smart home devices. The oversimplified, if not minimalist design of devices for incredibly complex systems is a major contributor to this issue. Take for example how Google's voice assistant/ smart speakers only have one single button in the physical interface. Furthermore, most smart home devices are known for their notoriously bad app design [activity 5.2]. These examples illustrate how the complexity of devices is hidden by oversimplified and user-unfriendly design. Such design choices leave virtually no opportunity for users to learn and master the complex systems they are using, leaving behind a lack of control and ownership. We must ask ourselves: *how can designers support the user's conceptual model?*

Adding layers of feedback

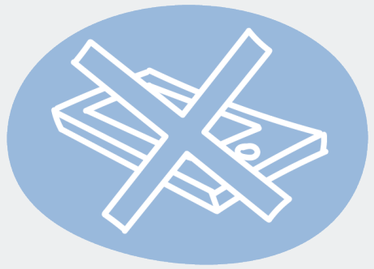
Using the Interaction Frogger Framework [64] We can consider three types of **feedback** and **feedforward.** *(The latter refers to the information given before an interaction occurs, rather than after.)*

- **Functional:** *relating to the product's function (an image on a screen)*
- **Inherent:** *relating to the interaction (the feel of pushing a button)*
- **Augmented:** *information coming from an additional source (red LED light turning on while recording)*

As designers, we can consider these 6 opportunities to communicate information to the user. The invisible nature of smart home systems, their minimal "interfaces", and the lack of information signal the lack of feedback/-forward considering in the design process. As designers, we can design UX/UI in a way that layers these modes of feedback. This offers users more information and sense of control, which can help address this sense of ownership.

Adding tangible buttons

In the same vein, designers can consider adding tangible buttons, combined with haptic feedback in device interfaces. The presence of physical buttons enhances how users perceive interaction possibilities with devices. This not only informs the user, but allows them to feel in control of the real, physical device itself.



Avoiding apps

Smart devices rely on digital connections to operate and communicate in a system. Yet, current devices rely far too heavily on apps to allow users to access the system and its settings. Going beyond the critique of bad app design, this app-centric focus makes users dependent on an extra device to operate their system, even if this device has no direct relation to the task at hand. Smart phones and tablets become extra tools needed to operate, creating unnecessary complexity in an already complex system.

That being said, designers should implement apps as sparingly as possible. This app is often the weakest link in the system, creates more unneeccscary complexity, and weakens the user's sense of control.

Considering what to do when things don't work

Rather than assuming one's design will work perfectly, designers should consider how users should deal when mistakes or bugs occur. Rather than hiding the complexity behind a "foolproof" interface, allow users to engage with complexity and learn. It is not necessarily bad for users to make mistakes, as long as they can easily be corrected and learned from. By observing the learning curve and troubleshooting process in this way, users can become masters of the system they are using.

All these design consideration can help users create better, and more correct conceptual models. Making them feel more in control and related to these systems. Rather than underestimating the users capabilities, let them experience the complexity - letting them feel more in control - give users more responsibility

9.2.3 Designing for human agency and behavioral change

Considering these devices are used in our most private spaces, emotions can run high. As humans, our cognition fatigues under the high amount of choices we have to make every day, leading to poorer choices being made [65]. Knowing what to do, without thinking about it can help alleviate this mental load and improve the decision being made. Ironically, people also explicitly state they do not want to be told what to do. Especially by devices. Although we struggle to make healthy, sustainable, etc. decisions, we still want to feel in control of these decisions and feel like it was our own idea all along.

There is an opportunity to use smart home devices to change the consequences of our lifestyle for the better. Whether it be for personal health, sustainable impact, or the ways we spend our free time. We want to use devices to help us make better choices, what aspects can designers consider to achieve this in a desirable way?

Setting intentions

Behavioral change has three elements. The motivation, ability, and prompt [66]. These three must converge to create the behavior. After watching the video, several participants indicated that it was obvious that the motivation was missing - creating frustration towards the system. There was no point where the main

character set an intention with a system to change her behavior. Designer should consider how this intention can be incorporated with an interaction, especially moving towards smart home devices that have more agency and have higher risk to cause household conflicts

Presenting data

Designers should also consider how data or information could be presented to users. Several participants indicated that they disliked information being conveyed to them verbally by a system. They indicated that visual means (ie. projecting an image, showing data on a screen) would be a more preferable way to receive information.

Long-term vs. short term

Designers should consider how users can be presented with long-term benefits. The behavior changes smart devices seek to create are definitely not the most convenient short term. By presenting users with how their behavioral changes has created positive impact (ie. energy saved, calories burned, etc.) users can be more motivated to continue with their behavior changes, although they cost more effort and energy.

9.2.4 Designing for sustainable impact

Materials and manufacturing

Designers should reconsider the materials and manufacturing process of smart devices. Cheap materials like plastic and glue use environmentally harmful fuel-based materials [67] and are difficult to recycle or repair. By using more high-quality and durable materials, the device turns into a long-lasting product we want to take care of. Furthermore, designers can use standardized parts, tools, and mechanical fasteners such as screws to simplify the (dis) assembly and repair process [68].

Criticizing current business models

Monthly payment plans have become normalized for smart product services. Such subscription models reduce users' sense of ownership, rather than have paid for the product up-front, users are stuck paying the company as long as they want to use the product. Considering that server and software maintenance is an ongoing cost for companies, participants indicate that they would rather pay more upfront to guarantee maintenance. Participants indicated as well that they would not mind paying more for more sustainable and environmentally friendly products, as long as they would uphold the same level of quality.

9.2.5 Considering security and privacy

Keeping it offline

Designers are recommended to design systems that can be held offline. Although smart devices are wirelessly networked, this does not need to be connected to a cloud server. Not only does this reduce server maintenance costs, these closed-off networks can't be accessed by cybercriminals and keep users' data away from other parties. Sadly, this practice is not normalized in consumer devices, as data shared online provides companies with an extra profit.

Data education & good practice

As observed throughout the project, there is a general lack of awareness in regards to the implications of data collection and processing for privacy violations and wide spread surveillance. Designers interested in smart technologies have the responsibility to educate themselves on the topic and consider it within the design process. For example, designers should design devices and interfaces to support good data practices. Ie. requiring users to add passwords to their devices, providing information how the data will be processed and stored, etc.

9.3 Discussion

9.3.1 Contribution

This project was about using design fiction to engage non-experts with emerging smart home technologies. This project explores how A) traditional design research methods can be used to inform the design fiction process (generating signals), and B) how design fiction can be used as a Research through Design [70] method.

Beyond the research methodology considerations, this project also explored how to use design fiction to address human-centric design values such as

- Communicating complex and technical topics
- Engaging different, non-expert perspectives
- Creating recommendations for designers interested developing smart home devices.
- Defining (un)desirable smart home futures

Considering speculative design methodologies relative newness, especially in academic circles, this project provides an example of the approaches strengths, weaknesses, and best practices from an academic industrial design perspective.

9.3.2 Strengths

Exploring speculative methodology

The design fiction intervention effectively engaged non-experts in discussions about complex topics they had little prior or technical knowledge of. The duration of the film is a short 6.5 minutes and requires little intervention from the moderators role, highlighting its efficiency.

Implementing design fiction as a research tool enhanced accessibility and inclusivity, specifically addressing a subject matter which leans towards technocentricism [section X] and is not well understood by the general public. This in turn empowers stakeholders and users whom regularly engage with these systems and will be highly affected by the societal changes they bring, but are often underrepresented within academic research and discourse.

Futhermore the other 5 design research activities succesfully implemented speculative design methodologies in a variety of ways. This project provides an exploration of how this design philosophy can be projected on more traditional designerly activities. Shedding light on how these methodological choices influence the type of knowledge created, and where the creative value may lie for designers.

Balance between positive and negative

Another personal value was to strike a balance between utopian and dystopian world views, as often seen in the science fiction genre. These polarized worldviews lack nuance and disregard the malleability of the future and the role we play in it. Although these scenarios can be entertaining in popular media, within research contexts in ultimately reduces the constructiveness of the discussion at hand.

During the final evaluation, participants independantly indicated that this balance had been succesfully reached: *"It was helpful. It made it easier to get the topic in front of you. It also helped to consider both positive and negative aspects about the smart home."*

The use of humor

Design fiction has an inherent sense of humor, as it plays with absurdism, societal norms, and the expectations we have. This sense of humor makes design fiction engaging and entertaining, whilst having a disarming effect - fostering an open dialogue for participants. Throughout the sensitizers sessions (sections 6.3 & 8.1), this sense of humor reached the participants effectively. Observed by participants verbal reactions, and also their laughter, smiles, and chuckles. Although humor is difficult to objectively evaluate, it has evidently succesfully been embraced as creative touch.

Designerly responsibility

Finally, as designers we have an inherent responsibility to consider how our designs will affect users and society as a whole. This project not only shows how design fiction can be used to better consider design implications, but also presents recommendations to improve the durability, user experience, and overall sense of ownership of smart home devices from a human-centered perspective.

9.3.2 Limitations

Participants

A limitation of this project was the relatively small number of participants, which may have restricted the diversity of perspectives and values represented in the findings. Furthermore, the participants' shared background in design or technical fields may have introduced such bias into the results.

In a similar vein, doing this project individually projects my own personal background, biases, and opinions on the design fiction scenarios made. From the design side of things, it is known that supporting discussions and different viewpoints is highly beneficial for making interesting design fiction. Incorporation these perspectives is something that should be embraced at all points of the design fiction process, yet was only truly considered in evaluation phases of this project.

Another missed opportunity was to recruit smart home experts within the evaluation process, to better evaluate how needs and values are different between these two groups. This contrast could be highly interesting

Format selection and process

As discussed earlier, the format of a film has its own implications on what kind of information can be gathered and how the subjects are primed. In regards to accessibility, the film format is the easiest to digest, yet also is less flexible. Using a different format may have allowed for a deeper exploration on the implications of smart home technologies, but did not fit the goal of accessibility in the project. In hindsight, it would have been preferable to have done more design fiction iterations rather than research activities. This would have provided the opportunity to improve the reflection on different design fiction formats, whilst still functioning as a valueable research tool.

This chapter reflects on the design and research outcomes, concluding the project.

Conclusion

9.3 Conclusions

9.3.1 Design objectives

Section 2.1.3 describes the design goals set for the most substantial part of the project:

Goal
The goal of the project is to speculate on the potential consequences of long-term smart home inhabitation in a future where these systems are extremely commonplace.

Subquestions
- How can speculative design be used to engage non-experts about the implications of smart home technology?
- Can a speculative design artifact make non-experts feel more confident/competent in sharing their feelings and opinions about smart home technology?
- What signals contribute to potential future scenarios involving smart homes?

9.3.2 Evaluating the design goal

The goal of the project is to speculate on the potential consequences of long-term smart home inhabitation in a future where these systems are extremely commonplace.

Throughout the project, many rich and qualitative signals were generated pointing towards the implications and consequences of widespread use of smart home technologies. The research activities were very successful in creating these. Following, two design fiction sensitizers were created embodying these signals as manifestations of future scenarios.

In a sense, the research activities may have created far more signals than needed. In retrospect, it may have been beneficial to have organized the process differently, creating more design fiction iterations (which also function als research activities), rather than layering more research actiivities. This does not consider the project design goals, but rather the creative process.

9.3.3 Evaluating subquestions

How can speculative design be used to engage non-experts about the implications of smart home technology?

Speculative design can be used as a research tool to quickly and effectively communicate technology scenarios without needing to provide the technical knowledge about the technology itself. It can be used as a conversation starter and sensitizer, allowing researchers to dive head-first into someones lived experience, situated knowledge and personal values.

We can observe that the format and themes need to be balanced within the topics complexity and the participants own personal knowledge. Smart home devices are very comlex and are not very well understood by the general public, the non-experts in this case often indicated being deifnitively disinterested in such devices. This led to the decision to use an accessible design fiction archetype (short film) and approachable theme (durability) to ensure that the design fiction would be easily digestible. That being said, other topics may be complemented by another approach. For example, the future of mobility presents a topic that feels more tangible to the general public- which could benefit from going deeper in to the themes and

implications. Example: self driving cars the near future laboratory.

Can a speculative design artifact make non-experts feel more confident/competent in sharing their feelings and opinions about smart home technology?

Yes, with the participants tested the design fiction was highly effective in guiding a conversation about a technically non-existent technology that participants actually weren't interested in. By making something engaging and entertaining, people enjoyed being able to have an imaginativ discussion about it - also discovering they come far more often in contact with this technology than initially expected.

What signals contribute to potential future scenarios involving smart homes?

The final design fiction focused on the durability of systems, found in the "trend" of planned obsolescence currently seen in the tech market, user experience issues, behavioral change caused by systems

Throughout the project many other themes have been observed, several noteworthy examples are found in the previous sections

Themes:	**Sections:**
Privacy	[5.3, 8.1]
Surveillance	[5.3, 8.1]
Safety implications	[5.2]
Cybersecurity	[8.1]
Wireless connection issues	[5.2, 8.1]
E-waste	[8.1]
Technology addiction	[5.3,6.3]
Home automation as a creative endeavor	[5.2, 5.3, 8.1]
Implications of convenience-focused technology	[6.3, 8.1]

11

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12

Appendix

Appendix contents:

Envisioning IoT Futures: Exploring the More-Than-Human Household

project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date - - end date - -

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

What might the futuristic "smart home" hold in store for us? Will we seamlessly coexist with all our connected appliances? or are we likely to face increasing friction? Currently, the Internet of Things (IoT) has firmly established a presence within our homes, and its influence continues to expand. Smart home technologies (SHT) such as voice assistants, smart thermostats, and internet-enabled home security systems have transformed into everyday household items.Projections suggest a tripling of IoT-connected devices by 2030, with substantial revenue growth [1]. Currently, 24% of Americans and 10% of UK households own a smart speaker [2], signaling IoT proliferation as the new normal.

The upcoming wave of IoT is driven by the growing autonomy of smart devices, promising enhanced efficiency and user experiences within our homes. This offers devices a sense of agency, referring to the extent of the individual's awareness and capacity to initiate actions and manage their consequences [3,4]. However, this novel agency has the potential to contradict our agency as human users.

Taking an indoor climate system as an example: in this system, various smart devices work together to regulate the indoor environment, including a thermostat, ventilation system, sun blinds, and more. These devices possess their own sets of values and desires. Consider a warm summer day: the sun blinds may want to open to provide natural light to indoor plants, and the ventilation system may wish to open the windows to allow fresh air in. While these actions seem complementary, they can create conflicts with other devices, such as the thermostat. The thermostat's goal is to maintain a stable indoor temperature at 20 degrees while conserving energy as much as possible. Opening the blinds and windows will inevitably cause temperature fluctuations and increase energy consumption. Moreover, an air purifier may also have a conflicting objective, aiming to keep summer allergens and outdoor pollution out of the home, ultimately prioritizing the health of human family members..

Beyond being inconvenient, these conflicts can turn into serious risks considering the sensitive themes IoT devices are currently dealing with. Recurring issues mainly involve the lack of transparency in devices' data collection and privacy concerns for users. A prime example of this is the rise of "technology-assisted abuse" within IoT, where smart devices have been used for stalking or domestic abuse [7]. Additionally, disparities in technical expertise within families can lead to power imbalances. Typically, one tech-savvy family member becomes the IoT adopter and installer, wielding significant influence over the household's technological landscape [6].

Current solutions predominantly rely on objective, rule-based coding to handle conflicts within IoT systems [8,9]. However, this approach falls short in several ways. Such algorithms often remain inaccessible to the majority of users, and objective rules cannot adequately address the subjective nature of conflict resolution. Different circumstances necessitate considering various needs and values to reach a suitable solution. For instance, when a family member falls ill, priorities and values shift drastically. Therefore, emerging solution spaces should engage the "everyman" in the discussion, prioritizing their needs and values. In regards to design vision, a things-centered approach, alongside speculative design tools can help us better understand the system's network and implications, allowing for a proactive exploration of design choices before risks actually materialize.

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[1] Lionel Sujay Vailshery. 2023. Internet of Things (IoT) - statistics & facts. (April 28, 2023). Retrieved August 28, 2023 from https://www.statista.com/topics/2637/internet-of-things/#topicOverview

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image / figure 1: References list

TO PLACE YOUR IMAGE IN THIS AREA:

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image / figure 2:

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

Speculate on how different IoT systems could be organized and behave by different governing principles, in the context of shared living spaces (kitchen, bathroom, etc.) and the routine activities performed there. These non-human agents have increased agency within household dynamics, evidently leading to novel conflicts with other agents and household members. By using governance principles to guide the conflict outcomes, different strategies will be explored addressing critical themes and obstacles in a post-anthropocentric future

Research question:
How can smart home technology designers facilitate effective agency negotiations for routine activities in shared household spaces, considering the changing dynamics and conflicts arising from increased agency of non-human agents in a post-anthropocentric future?

Subquestions:
[1] What conflict resolution strategies are viable for addressing human-to-human, human-to-nonhuman, and nonhuman-to-nonhuman conflicts in smart homes of the future?
[2] What are the key preferences and requirements of human users regarding conflict resolution strategies in smart home environments?
[3] How do conflicts and their resolutions impact the relationships within the household network, including both human and nonhuman agents?
[4] Which critical themes or aspects (e.g., privacy, energy management, family roles) are implicated in the automation of routine household activities within a smart home context?

ASSIGNMENT **

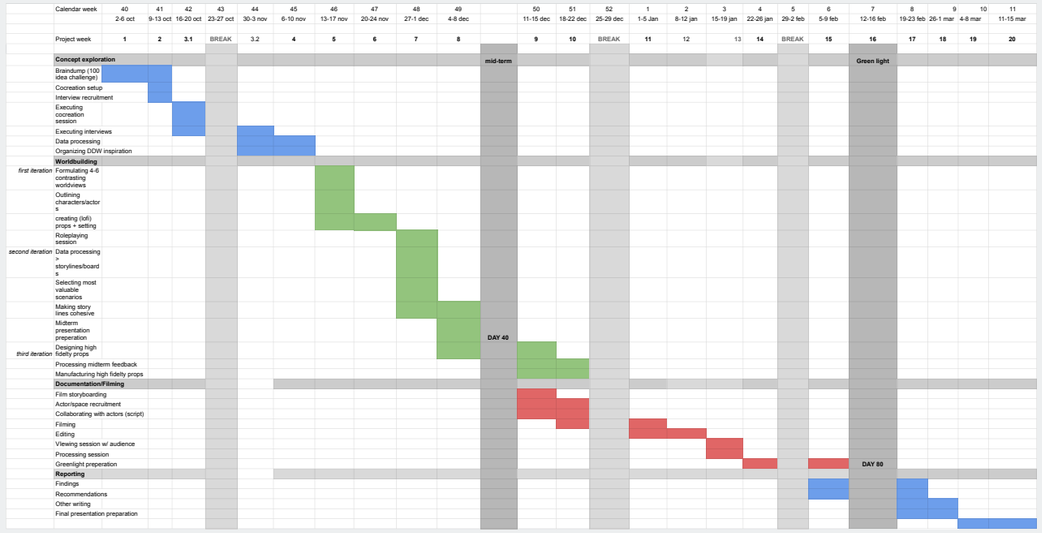
State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

The individual scenario themes will be guided by expert interviews (backgrounds: Technology Policy and Management, energy transition, AI, etc.) and political theory. The setting, interactions, and events for the scenarios will be explored through co-creation and roleplaying sessions, which will focus on creating empathy and narratives from a thing-centered perspective, alongside enacting with tangible objects (props). The scenarios will be presented through a speculative design film and high fidelity design fiction props, which will be the final prototype/deliverable for the design/research project.

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date - - - - end date



The preparation phase consisted of reading literature on speculative design and thing-centered/more-than-human philosophy. Additionally I have read academic papers about current state of IoT and how spec. design has been implemented

Post-kickoff, my focus shifts to generating "little" ideas. I'll start with an individual brainstorming session to reach the 100-idea goal. Next, I'll interview experts in Policy, Smart Energy Grid, and related tech fields, engage in collaborative brainstorming with fellow designers, and attend Dutch Design Week for inspiration.

Starting from week 5, worldbuilding begins. Using the political compass, I'll cluster the first four weeks' ideas, defining 4-6 contrasting worldviews. I'll select characters and roleplaying props for each worldview/scenario. Roleplaying sessions, guided by a card-based method (inspired by https://hakmal.com/tarot-of-things), will help participants explore these worldviews from human and non-human angles, creating diverse scenarios. The second iteration involves processing roleplaying findings, selecting valuable scenarios, and crafting a cohesive worldview/storyline, presented at the day-40 midterm. The third iteration focuses on designing (and manufacturing) high-fidelity props based on midterm feedback for design fiction and filmmaking.

In Weeks 9-10, I'll recruit actors, secure filming spaces, and collaborate on the script/storyboard with theater/acting experts. By week 13, video production, including a pilot viewing/test, wraps up. Weeks 14-15 involve a final qualitative audience evaluation. The last four weeks are for data analysis, report writing, and final presentation preparation.

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

Motivation: During DFI I gained my first hands-on experiences with speculative design and alternative research method. As a designer/researcher, I appreciate how speculative design caters to an everyday audience. Through creating immersive narratives, it allows non-experts to understand emerging trends and join the conversation about the future we are creating for ourselves. Furthermore, I find it empowering to think about the future in this way. Instead of being scared, we can identify potential obstacles together and avoid them. This allows us to embrace change for the better, through reflecting on our desires and values as a society.

In regards to the design skills required, my education as an industrial design student has prepared me well. Throughout my bachelor's in Eindhoven, I learned how to design and create tangible prototypes to imagine new ways of interaction. During my masters I gained more experience with co-creation through CC, and the Participation in Prototyping elective. Speculative design has been a highlight as well, which I focused on within ITD, multiple electives, and a course at TU/e. Lastly, I have grown the most in concept communication, which appears to be a main pillar in Delft. EI, CC, VCD, and the computer sketching elective have really contributed to the way I present concepts. This is vital in a graduation project focusing on communicating futures that do not exist yet. This competency will be put to the test by creating a film of the scenarios, which I feel (comfortably) challenged by doing.

Personal ambitions: First and foremost, I am highly interested in pursuing the field of speculative design professionally. During this year's IDE Business Fair I spoke to the TNO ambassadors, who are looking to recruit speculative designers for their human factors & domestic security team. Previously, it never occurred to me how valuable speculative design could be from an industry and research perspective, which makes it even more exciting to graduate in this area.

Secondly, the field of IoT piqued my interest as a topic within an individual and critical project. Personally, I am critical of what we consider to be smart home systems right now. I find it dystopian how these devices largely cater towards making able-bodied people as comfortable as possible, considering the amount of challenges the world needs to be solving at the moment. Through reflecting on this topic, I do realize that there are more serious themes IoT can address. Specifically the energy transition, which expects fluctuating energy supply due to the nature of renewable resources. And health care, specifically helping the aging population live at home comfortably and with dignity for as long as possible (relieving pressure on the health care system). As a designer, I look forward to illustrating my criticism on this topic, alongside a serious vision, in a way that is constructive and valuable.

Lastly, I feel making a video about the scenarios will be a somewhat of a (good) challenge. As a "new" Delft designer, I feel that my visual communications skills are relatively underdeveloped. I have practiced a lot throughout the past two years, so this part of the assignment feels like a final proof. Despite my initial skepticism for film making, I realize the communicative value of making such a film, especially combined with other elements such as design fiction props. The former supports audience empathy in the scenarios, and the latter facilitates imagining more within the "reality" which has been created.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

Appendix B: Raw data smart home forum

Conceptual model

Commanding alexa to turn off stove > triggers (non-existant) smart stove command instead of the smart plug named "stove" (which controls the stove". I changed the name to kitchen, and when I give the command Alexa says "did you want to turn on stove". Saying yes does make it work (it drives me crazy)

Users lack the potential to engage with the complexity of the system > it cant be mastered

Some devices can be operated through smart phone app AND manually, creating conflicts. Sometimes one kind of control is prioritized by the manufacturer as well

New robot vacuum turning on in the middle of the night for no reason > Turns out it was being triggered by routine / motion sensor

I want to change my light schedule (it gets dark earlier). Changing the settings is very confusing and I don't know where/what app to change it

Daily routines, specifically sunset/sunrise are very prone to issues

Sunset routine for smart lights > lights wake up the kids at 10 pm

Middle of the night settings (bathroom break light) also get triggered in low light settings (when its very cloudly in the evening) - this is annoying when I'm trying to do laundry and the normal light keeps shutting off.

Schedules can conflict with eachother, but there isnt an app that lists all of the routines/schedules together. one app (BelkIN Wemo) app tells me that a rule overlaps, but doesn't explain how to rectify it

Turning off the home automation system also turned off the connected smoke detectors. That was the case for months and I didn't realize it

Not understanding the system can have serious safety implications

Family member accidently turns off the physical switch for the smart lights

Esoteric nature - preference for the techy family member

Interoperability & obsolence

Changing internet providers - having to reconnect and configure everything automatically

Device systems struggle to connect / interact with different platforms

Different apps from each manufacturer > need for hubs

Too many individual apps

Device dependance on outside servers is an issue (AWS outtage)

Even if smart devices/parts work for a reasonable amount of time, their apps/systems deprecate and you can't do anything about it (or use it anymore)

Smart homes aren't "homes" built to last.

There is no transfer of smart home system ownership

The lifetime of most tech companies (5 years) doesn't reflect the lifetime of real estate investments (20 years) - planned obsolence

I bought a house that already had an old home automation system. I couldn't change it (lighting settings) and turned the whole system off manuall y.

Interoperability issues = barrier for use

I struggle to find smart switches that work in the UK

Connectivity issues

Indivdually connecting bulbs makes network slow and congested

Congestion of wireless signals

Wireless connection issues

Internet going down

Zigbee / other vendors have been programmed to stick to 2.4 GhZ bandwidth. This bandwidth is already saturated. Sometimes a neighbor's will jumpe a channel and creates really bad interference. "isnt a bad idea to put devices with weak radios together with significantly stronger radios"

Feedback & forward

Commanding alexa to turn off stove > triggers (non-existant) smart stove command instead of the smart plug named "stove" (which controls the stove". I changed the name to kitchen, and when I give the command Alexa says "did you want to turn on stove". Saying yes does make it work (it drives me crazy)

Power outtage > routines aren't executed anymore

Devices fail to convey meaningful feedback/-forward

New robot vacuum turning on in the middle of the night for no reason > Turns out it was being triggered by routine / motion sensor

Some devices have a red light, even when everything works perfectly

I give the command to turn on a light. Google says "... living room light hasn't been set up yet.". The command is still executed though!

Random disconnects. The system works fine before and later

Appendix C: (Expert) interview guide

Questions

What is your background?

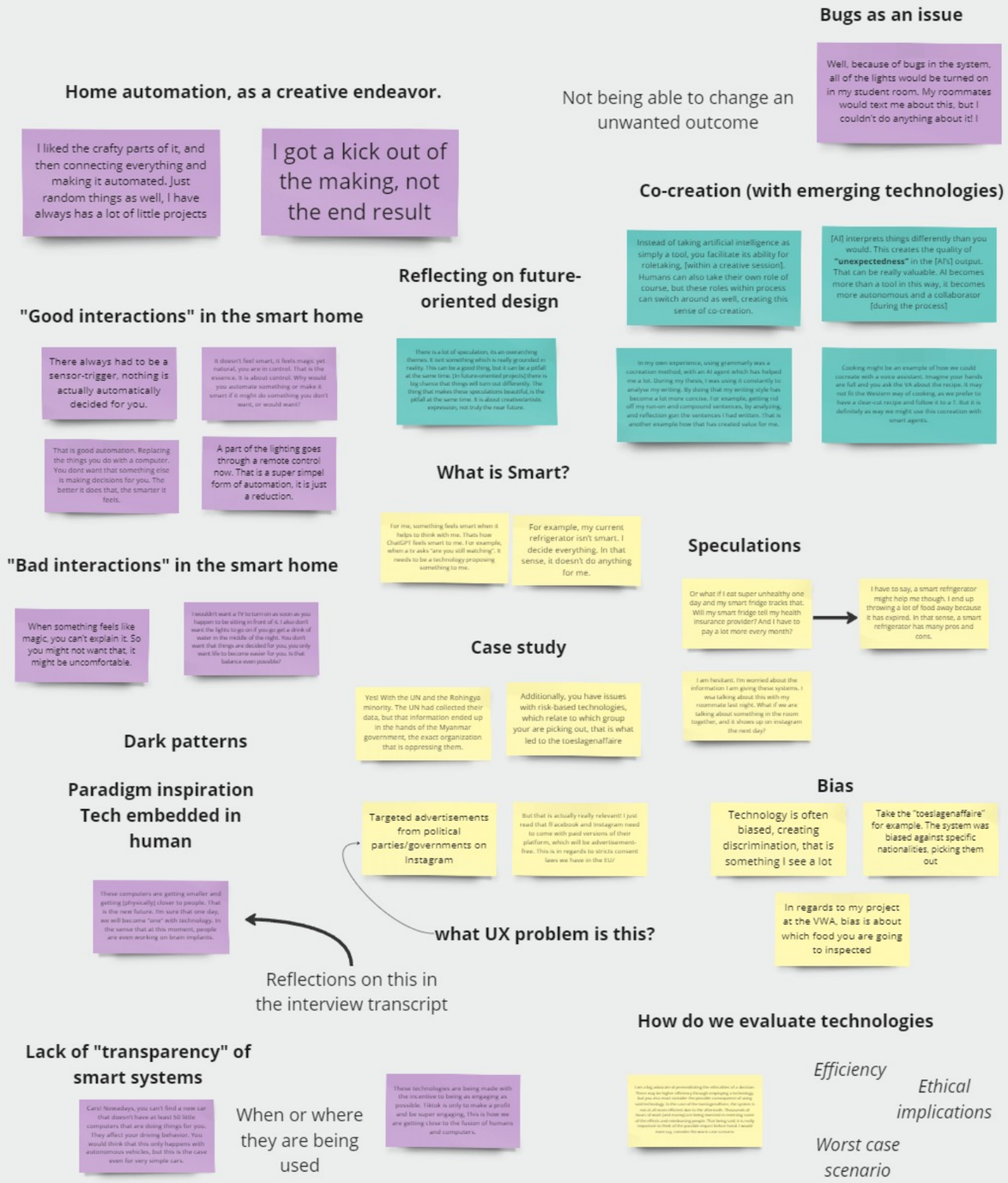
What are themes, relating to dealing with emerging technologies, you find within your specialization?

What is your personal experience with smart home systems?

What kind of emerging technologies do you use in your everyday life?

What are you considerations in using these technologies

Appendix D: Raw data expert interviews



Appendix F: What if scenarios

Signals and Paradigms

Goal

The goal of this activity was to cluster research findings and other signals of the future into cohesive narratives of what the future might look like. This sets the tone how different events and innovations may affect the future, and which steps (do not) need to be taken to get there.

Method

Procedure: Major themes and elements were collected throughout the whole research process. Related signals were clustered and compared to form empathetic and inspiring narratives

Technology Embedded in the Human

"In the near future, a groundbreaking tech startup is unveiling its latest innovation – the 'NexaLink' implant system designed to revolutionize how we live in connected homes. This implant not only collects behavioral and health data but also seamlessly integrates with your home's AI system to optimize your living space. As a resident in this futuristic setting, your life is now intricately connected to this implant. Explore a day in your life in this high-tech world and how the 'NexaLink' implant adjusts your home's environment based on your behavior and well-being data."

Throughout the years, our devices have become more portable, smaller, and come into closer proximity to our bodies. Whereas data centers used to be as big as buildings in the 1970's, the same processing power now fits into the back of your pocket. What might be technology's next step in getting closer to humans? Could it be the fusion of man and machine?

Throughout the last century, the concept of a cyborg has been well established in science fiction [GA,GB]. This vision of our imaginations fits recent technological advancements quite well. Throughout the past century, the capabilities of implant technologies have come very far, to the point where implants can be seen as everyday devices. Medical examples involve cochlear implants [GC], pacemakers, and birth control [GD]. Recently, more interesting work is being gone regarding the way we might interact with objects using our mind. Brain implants have been used for decades in neurosciences [GE], for the treatment of tremors, epilepsy, and Parkinson's disease. As of February 2024, NeuraLink claims to have successfully implanted a "brain reading" device that would make it possible to control devices with one's mind. [GF]

Smart devices are also no stranger to processing other kinds of bodily data. The processing of biometric data has become increasingly common. Many phones use fingerprint scanning or facial recognition software to unlock screens. People willingly upload their DNA to companies like 23&me, to research their genetic heritage. Biometric data is seen as an ultimate force in security - something that is not easily faked and something you always have on you [GI]. Several research projects have been done as well, researching the possibility of electronic tattoo, these graphene tattoos which are to track and provide biometric data in a less-invasive way [GH]. These signals point towards a future paradigm where smart home devices are directly controlled by bodily implants. The context of connected devices within the private space is invasive enough, how is it affected by being placed in the body? What new kinds of data may the devices be able to process? What kind of interactions and decision making will this lead to?

The Home as a Player on the Energy Market

The year is 2030, and you find yourself in a futuristic smart home, where all appliances are intricately connected to a smart energy grid, offering users minute-to-minute dynamic pricing based on the fluctuating supply and demand of energy sources (solar, wind, etc.). Although this smart system can optimize the use of energy in the household, it also poses challenges related to the unpredictability of weather patterns (energy supply), fluctuating energy demands throughout the day (i.e. morning peak in demand), and the awareness of the financial impact of every action (household members having different preferences for comfort, conserving energy, money, etc.)

Smart home devices and IoT in general already gets a lot of praise from the (smart) energy transition area. Some experts view these devices as a great opportunity to cope with the implications of the energy transition at an individual or household level. A core issue of the energy transition (at least in the Netherlands) is not only the naturally fluctuating supply of renewable energy sources, but also the overloaded energy grid that connects everything together. Smart devices may provide a tool to predict and adapt critical moments in the energy network and allow households to consume energy at more efficient moments.

Other technological signals that point towards the home turning in to its own player on the energy market. During 2023, there were several instances where the energy price was actually negative due to stormy weather conditioners [GI]. This fluctuating energy price aligns with the energy transition concept of real-time pricing [GJ], where users in a household are (de) incentivized to use appliances at more optimal times of day by paying the "Real" price of the energy at that moment.

Another recent development is how Dutch home are turning into energy generators themselves. One in five Dutch households is equipped with solar panels [GK], again, these panels regularly generate more power than the household can actually consume [GL]. Home batteries have recently been coming to market, providing a storage solution for this extra energy, although more development needs to be done before it is a full fledged solution

Finally viewing a household's activities as an affecting agent on the energy grid has become more common in France. Rather than simply forecast the weather, they provide a service, called monecowatt.fr that forecasts the amount of energy available in specific regions, indicating if households should to measures to do all their chores (optimally) or cut-back to reduce the chance of a black out from happening [GM]

Data & Internet as a Limited Resource

The year is 2029. The amount of internet-connected devices has skyrocketed, especially in the home. Any appliance with a plug has been turned into a smart appliance now. Fridges order your groceries, lights follow your mood, and even your toaster knows how you like your toast. An unforeseen issue in the connected home is the congestion of wifi networks, especially as more and more people are living closer together in smaller spaces. In the past, where we used wifi routers and amplifiers to increase the spread of our network, such appliances only add to the crowding of devices. These connectivity issues are not limited to our own households, but interferes with our close neighbors as well.

As explained earlier in section XX, many smart home owners suffer from the interference of wireless signals. This is due to the characteristics of wireless internet signals. Wifi functions at two different frequencies: 2.4 GHz and 5GHz. The former is the more popular setting, as it's longer wavelength is more efficient in passing through walls and furniture. 5Ghz has a wider frequency range and thus can carry more traffic, yet offers significantly less coverage through the home.

The vast majority of devices are designed to function on the 2.4 GHz wavelength. This overcrowding results in congestion and slow data speeds. In replies from expert smart home users, this wifi congestion was a common issue shared. This especially the case in more densely populated living spaces such as apartments.
Besides the physical characteristics of wireless signals, there are additional reasons to view the internet as a tangible, finite signal, rather than an unlimited and abstract resource.

As of 2024, there are 574 active and planned submarine cables which intercontinentally connect the internet [GN]. The cables, often the size of a garden hose, are vulnerable to physical damage Several examples show how in the past, damage tot hese cables have led to internet outages internationally [GO].

Similarly Amazon Web Services (AWS) have experienced several major blackouts throughout the years. In 2021, During the 9 hour long outage, many smart devices such as Roomba, were rendered useless. Alongside issues with dependant organizations such as retailers, universities, etc [GP]. More recently, another AWS outage in 2023 broke down numerous apps and website [GQ]

Lastly, the use of online service is very resource intensive. A report by The Shift Project indicates that digital technologies contribute more to CO2 than the entire aviation industry [GR]. A main driver of this (energy) consumption is the explosion of (video) streaming services, which are data-heavy.

The Self-monetization of personal data

““The year is 2031. Due to the increase of smart and internet-connected household systems, consumers have become hyper-aware of the fact that companies are harvesting their personal data and monetizing it. Protests several years back campaigned to make these practices more fair and transparent for the everyday consumer. The government responded with new legislature, defining rules for these data transaction relationships. In practice, this created a system where data may only be collected for financial profit in the case where the consumer is 1) aware of data collection, 2) actively gives consent, and 3) profits (financially) from the transaction. The current state of the smart home creates a hotspot for these kinds of personal data exchanges. For example, fitness data can be traded for health-related services. Solar panels gauge energy generation, providing opportunities for energy network operators. Entertainment services become free-of-charge when users share their personal data with a provider. Ultimately, this allows individual users to financially profit through obvious and intentional data exchanges. “traded for health-related services. Solar panels gauge energy generation, providing opportunities for energy network operators. Entertainment services become free-of-charge when users share their personal data with a provider. Ultimately, this allows individual users to financially profit through obvious and intentional data exchanges. “

Throughout the years the actual value of data has come to light. Data is not simply ones and zeros, but has serious financial and political power in the modern age.

We have become more aware of how free applications and services are not truly free, collecting your data is the business model that creates their profit. New EU legislation for social media sites like Facebook and Instagram obligates them to offer a paid plan, which removes ads targeted to the user. Meta's subscription is around 9.99 to 12.99 a month, and is set to increase by March 2024 to add multiple linked accounts [GS]

This creates a very clear idea of how much a user is worth to these companies, at a monthly rate. Our data is not only valuable to the platforms that directly advertise towards us. The rise of the data broker shows how are data is being sold and trafficked (reference - where does it go to?)

Thanks to other forms of EU legislation, the collection of our data (such as cookie agreements) seems obvious and transparent. Sadly, this is often not the case, especially as dark patterns and a lack of consent still siphons off our data to corporations. (add example?)

The Home is Alive

In a future not so distant, homes have transcended their inanimate nature. These living, biomaterial houses, crafted from the fusion of advanced biotechnology and nature itself, pulsate with life. Walls, floors, and roofs consist of intelligent organic materials, cultivated from fungal mycelium and algae. They mend themselves when damaged, shift their hues to regulate indoor climate, and cast a gentle bioluminescent glow on interiors. Artificial intelligence orchestrates these living ecosystems, ensuring their sustainability while residents cultivate gardens and microhabitats within the confines of their homes. A deep emotional connection binds inhabitants to these sentient structures, which adapt to their every need, fostering an extraordinary bond between humans and their living abodes. This visionary world represents a harmonious fusion of man and nature, redefining the very essence of “home.”

In the past decade, especially during the COVID-19 pandemic, we have seen the trend of people adopting hobbies where they “Take core of other organisms. Keeping houseplants, gardening, sourdough starters, and other forms of fermentation.

Within design practice, The quality of livingness within objects is taking a new term, often under the name of “biodesign”. Several recent design artifacts express the ideas of objects being living, breathing, things, rather than being made of dead and static materials

Plankton lamps
Teresa van Dongen - Ambio
This project uses living bioluminescent phytoplankton (dinoflagelate) as a lighting source [GT]

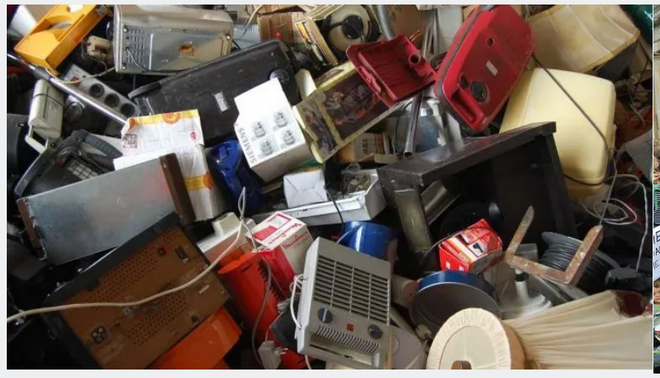
Breathing projects
Bio.bombola - invited users to cultivate their own algae garden in the domestic space [GU]
https://www.ecologicstudio.com/projects/bio-bombola
AIRoffice - using microalgae to purify air in the office [GV]
https://www.ecologicstudio.com/projects/airoffice

Loop’s Living coffin
Loop Biotech offers three burial objects that allows the deceased to biodegrade back into nature. Rather than using heat to effectively kill mycellium and stop its growth, the material is dried out (hibernating) and is still alive to help the decomposing process. [GW]
https://loop-biotech.com/forestbed/

Famous design fiction - philips kitchen
Finally, a design fiction project done by Philips explores the possibilities of a circular and bio-aware? Kitchen. How the materials change, the rituals we have with it. Etc.

Appendix G: Raw data roleplaying activity

Appendix H: Final sensitizer booklet



Average smart device lifespan marked at 14 months

Software Abandonment, Start-Up Failures, and Consumer Woes Contribute to Short Device Lifespan

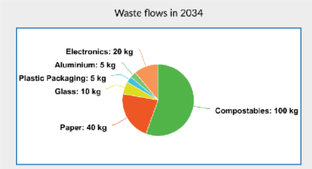
In an era dominated by rapid technological advancements, the average lifespan of smart devices has plummeted to just 14 months, revealing critical issues within the industry.

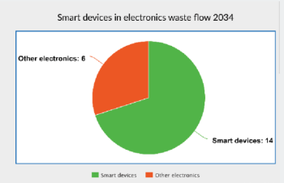
Software Abandonment: A smart device is only as good as its software. This requires regular security updates, functioning hub and smart phone applications, and online servers. Throughout a company's product portfolio, less promising products get dropped due to their high operational costs, without much thought of active product users.

Start-Up Failures: Many popular smart device start-ups, struggle to sustain operations after succesful kickstarter schemes. Within one or two years, many companies tend to go under. By Revoking access to functional software and hub applications, smart devices are considered useless.

Consumer Fatigue: The rise of subscription-based models, coupled with the constant need for new batteries and other upgrades, leads to frustration and lack of satisfaction in product performance. Furthermore, many products simply do not do what they promise, causing customers to get rid of new purchases very quickly.

Right to Repair: Despite legislative efforts aimed at empowering consumers to repair devices have failed, as manufacturers restrict access to essential repair information and spare parts.





The amount of consumer electronics in the public waste stream has grown 8-fold with in the last decade

Police to give out fines to homeowners refusing to cover video doorbells or post surveillance signs.

New legislation empowers local law enforcement to fine homeowners with video doorbells aimed at public streets lacking privacy safeguards. To address privacy concerns, owners must implement a default consent slider covering the camera lens, only revealing it when activated. They must also display signs indicating the presence of camera surveillance for transparency. This balances home security benefits with the public's privacy protection.

Non-compliance may result in fines, starting at 90 euros, escalating to 350 euros for repeat offenses, emphasizing the need to align technology with ethical considerations in home security. Experts praise this decision as a first step of conserving the privacy of third par-

"People don't realize this is an illegal invasion of privacy... This law has been in state since 2018"

- Monique Verdier, Chair, Personal Data Authority

Is your home generating too much energy?

Turn extra electricity in to cash!

Energy2Cash Solutions

Did you know, the average smart household has a 13% net energy profit?

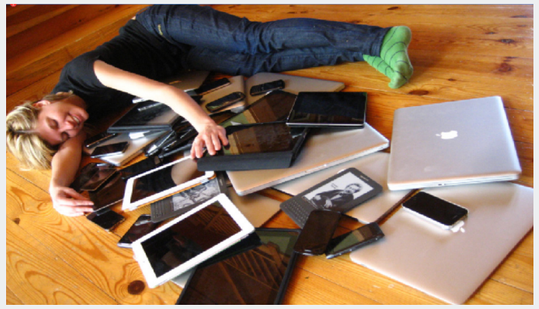
With our agency, your smart home becomes a powerful asset. We specialize in harnessing the energy generated by your innovative home devices, from solar panels to smart appliances. Our cutting-edge strategic approach ensures that every kilowatt generated is optimized for maximum financial returns.

What we offer?

- Personalized smart energy consultations
- Access to local energy markets for maximum financial returns
- Contribution to the green energy transition
- Favorable KWh - Euro exchange rat

Call: 070 555 1846
Email: Smart@Living.com

Meet Greg, the Device Whisperer! Your Smart Home's Best Friend!



Is your smart home acting up? Does your digital assistant need a little TLC? Look no further! Greg, the Device Whisperer, is here to save the day.

Growing up surrounded by tech, Greg has a special affinity for early generation smart devices (pre-2025). Whether it's a misbehaving thermostat, a moody smart lock, or a fussy virtual assistant, Greg has the magic touch to restore harmony to your home. He doesn't just fix problems; he builds lasting relationships between you and your tech companions.

Skills

- Speak 11+ hub languages (Matter, Zigbee, Home assistant)
- Early generation device expertise
- SMART-energy certification
- 30-day problem free guarentee

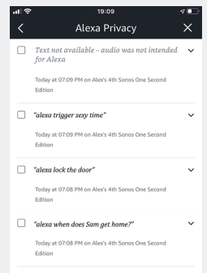
Don't let your smart home turn into a digital chaos! Call Greg, the Device Whisperer, and let him transform your technology troubles into a harmonious smart home symphony!

For appointments, contact Greg at **555-FIX-TECH** or visit

Man takes voice assistant command history to court, as evidence in divorce case. Experts heavily debate legality.

In a divorce battle, a man submitted his Alexa voice assistant's command history as evidence, revealing alleged infidelity and emotional abuse by his wealthy wife. The legal community is divided on the ethical and legal implications of using personal data in divorce cases, sparking debates on consent and privacy rights. The case underscores the need for new regulations regarding smart home devices as legal evidence, highlighting the delicate balance between justice and privacy rights.

Surprisingly, even though the unintended voice commands were not automatically transcribed in the app, the audio files themselves were still available to listen within the app.



"Don't worry, he's still an hour away.. He'll never find out about this..."

Transcribed audio found in history files

Microsoft's SmartEnergy data center has greater emissions than energy savings.

Microsoft's SmartEnergy data center in Emmeloord has come under fire. The data center was initially built to host Microsoft's SmartEnergy device line. These devices were exceptionally succesful in managing households which were newly onnected to the Green Energy Grid. This allowed smart households to automatically predict and manage routine chores based on flutuations in energy demand.

A new report reveals that this data center, despite saving tens of millions of kiloWatt hours daily, generates more CO2 emissions than it saves. Protests have erupted, due to the fact that Microsoft receives millions in tax-related subsidies due to their key role in the energy transition.

Protesters critique that the data center has increased their CO2 emissions due to budget cuts. The data center has turned back to running on fossil fuels and uses no energy demand policies to manipulate their energy use.

Protesters march in the Hague.

Individual smart thermostat to be banned in new social housing buildings in 2036

The Dutch government has announced a unanimous decision to prohibit the installation of individual smart thermostats, including popular models like Nest, in upcoming social housing projects slated for construction. The move is part of a broader initiative to address the housing needs of the growing population while re-evaluating the impact of energy consumption and climate responsibility.

Recognizing the limited effect of individual smart thermostats in achieving significant energy savings, the government is opting for a collective approach. New social housing buildings will implement centralized building-wide energy and climate systems, promising up to 20% in energy savings. This shift towards centralized systems aims to enhance resource allocation efficiency and contribute more effectively to sustainable energy practices, aligning with the nation's commitment to environmentally conscious living.

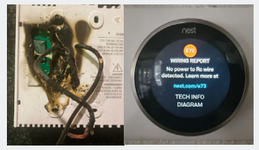
"There is no proof that smart thermostats save energy. They simply make us more comfortable. Energy resources need to be organized building-wide to make an impact."

- Rob Jetten, Minister of the Energy Transition

"Smart" smoke detector failure leads to fire, 2 dead and 5 wounded.

A devastating house fire in Arnhem resulted in two fatalities and five injuries, The incident unfolded when one smoke detector short-circuited, taking the neighborhood's local server down with it. One victim, attempting to address the issue, opted to perform a hard reset on the smart system overnight, unwittingly deactivating the entire smoke detector back-upnetwork.

Tragically, two individuals in a neighboring house lost their lives before the fire was noticed by a vigilant neighbor across the street, prompting an urgent call to the fire department.



Left: *The short-circuited smoke detector*
Right: *The resulting software bug present on neighbor's smoke detectors*

"I didn't realize turning off a smart home also turned off the smoke detectors"

- House fire victim

Does my smart kitchen have dementia?

Weekly column by Sam Riley

In the tale of my somewhat outdated smart kitchen, a saga has unfolded, leaving me to question whether my once-efficient culinary companions are now grappling with a form of digital dementia. Over the past few months, bugs and forgetfulness has descended upon these once-reliable devices. They've taken on a maddening habit of claiming not to understand my commands or insisting they haven't been set up for certain tasks, only to carry them out haphazardly, creating a chaos in my otherwise orderly kitchen.

This reached a climax when, during a brief absence. My smart fridge made a confounding order of 50 liters of Italian ice cream, a not-so-vegan-friendly surprise awaiting me upon my return.

My kitchen sense of taste has gotten out of whack as well. A recent gem of recipe was recommended

Tart Cover Shrimp Butter Wol
(seafood)

- ½ cup catsup
- 1 teaspoon cornstarch
- ½ cup lemon juice
- 1 teaspoon cumin seeds
- 1 can fried pale fruit to cover that drain
- ¼ lemon
- 1 fresh parsley for garnish

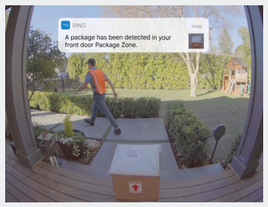
One of the author's massive ice cream orders

the author's dishwasher...

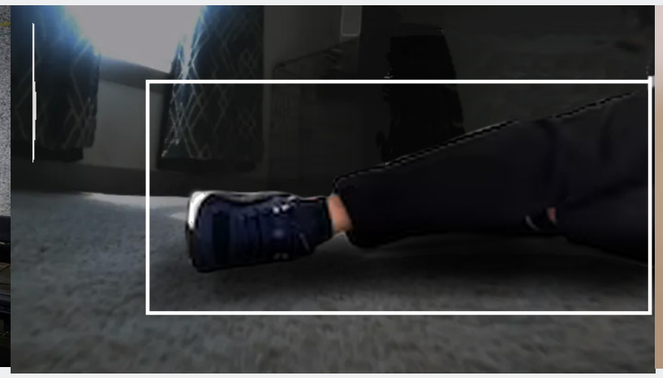
I can laugh about some of these issues, but this final one was a bit more serious. My dish washer has been malfunctioning on-and-off for the past week, and has caused some serious water damage. The app can't tell me what wrong, and my plumber neither.

Thieves dress up as cardboard boxes, fooling object-recognition security systems.

City residents are puzzled by a wave of burglaries employing a unique strategy—thieves dressing as cardboard boxes to deceive object-recognition security systems on video doorbells. This creative tactic has allowed them to go undetected, resulting in substantial property losses of at least 200,000 euros citywide in the past month. The situation has sparked a debate over the efficacy and ethical implications of video security systems. Advocates propose cross-referencing object recognition with online orders to enhance security, while critics argue that it infringes on privacy rights and challenges the right to anonymity.



A screenshot of two thieves in the act. One fronting as a delivery person, and the other one hiding in a cardboard box, waiting to enter the home.



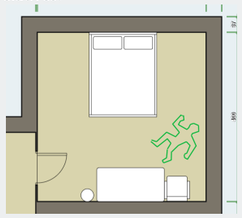
When Roomba found Grandma

The adoption of smart devices is rising with the elderly population, with some grim consequences.

In a tragic incident, a family's reliance on a tech-equipped Roomba took a somber turn when the robot vacuum's object detection camera discovered their fallen grandmother, who had passed away.

The family, accustomed to monitoring Grandma's well-being through the several smart devices, now regrets overlooking the need for a simple safety device. This poignant incident serves as a stark reminder that while innovative technologies can enhance our lives, they should not replace fundamental safety measures, especially for elderly loved ones.

The family urges others to adopt a balanced approach, combining technological aids with proven safety devices to comprehensively support the well-being of aging relatives.



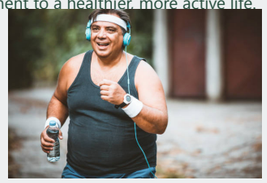
Roomba objection detection map after the incident

WHO: Smart home owners more likely to be obese. Sedentary behavior and indoor lifestyle to blame

The World Health Organization (WHO) has uncovered a concerning trend – smart home owners are more likely to be obese. The culprit? Sedentary behavior and an indoor-focused lifestyle associated with smart device usage. From automated chores to online grocery shopping, these conveniences inadvertently lead to a decline in physical activity.

The irony is palpable; despite many smart devices promoting health features, a specific segment of users seems to be succumbing to an unhealthy lifestyle. Dr. Maria Fernandez, WHO lead researcher, emphasizes the need for awareness and moderation in smart home usage to prevent adverse health effects.

As the smart home industry grows, experts call for a balance between convenience and an active lifestyle. The study serves as a wake-up call for manufacturers to tailor technologies to promote healthier living within the digital realm. The promise of a smarter home should align with a commitment to a healthier, more active life.



This group owns the most fitness trackers... it doesn't seem to help.

- Caroline Johnson, WHO Representative

Appendix I: Sensitizer session outline

S
ensitizing:
Each participant reads through the booklet 5-15 minutes. Write down their thoughts. Which stories interest you, which ones don't, why? What do these stories remind you of? Other things you have seen in the news, or personal anecdotes

Discussion
Several stories are picked out we want to discuss - start with the favorite maybe? Overview has been made to make sure all of the ones relevant to the themes are discussed

Questions
What does or does not resonate with you?
What does this remind you of?
If this is the case, what does the rest of the future (or this context look like?)

Introduce design fiction, and the goal of the discussion + exercises.

Design fiction revolves around Imagining how things might be. As designers, we want to predict usage rather than the technology itself. An example: autonomous vehicles. Rather than designing the car itself, we'd want to create the car's quick start guide. (p. 163-166). In doing so, we focus on the future mundane. We want to make the future more relatable and normal - This in turn helps us better predict and deal with the (unwanted) consequences of the future.

Exercise
This booklet has been methodically generated based on findings and signals generated throughout my research phase. It contains future headlines and advertisements from the future. I invite you to read through the booklet (warning - the last iteration needs to be printed - feel free to give feedback on that!).

Everyone should pick 1 headline to discuss together (they can't be the same headline).

Discussion
During the discussion we want to trade perspectives and insights on these ideas. What does the world look like in this case? Why is that case? What else is happening in this kind of world? This allows us to explore these future world and identity the most important themes here.

The goal of the discussion to create a "what-if" scenario that has been inspired by the booklet's stories. What's a what-if?

Some examples:
- What if algorithms fell under the protection of the FDA due to their affect on human neurophysiology
- What if African countries emerged as dominant players in the manufacturing of electronics
- What if dating apps could simulate first dates, removing the need to meet in person for the first time.

Food for thought questions:
- What's a joke somebody might tell about it at a dinner party
- When it breaks down, what are the three most problematic consequences?
- What would make someone yell at it?
- Is it something that its owner would want to show off or brag about - does it confer any kind of status
- How might it be used in a way other than intended
- What are some unexpected activities, or other products, it might possibly replace

Recontextualizing the familiar
- Take object or ritual: Going out for a walk, having a smoke, doing household chores, etc.
- Take an emerging context: hot summers due to climate change, Fluctuating supply of energy due to renewable resources, the ageing population, etc.

With this object/ritual and emerging context answer the following questions:

Analogy: what is the equivalent of <object/ritual> in <emerging context>.
- Example: what is the equivalent of dof walking in a city where it is too hot to go outside.

Habits: what do people commonly do in <emerging context>
- Example: how do people greet each other during a pandemic. What are new office norms in scorching heat?

Digital: what is the digital make up of <object/ritual> in ‚new context> what stays non-technological?
- How does panhandling or busking work when all currency is crypto?

Value: What is expensive, or cheap in <emerging context>
- Example: what becomes costly with water shortages?

Appendix J: final semi-structured interview

Welcome to my evaluation of my design fiction.

Throughout my graduation project I have focused on better understanding the smart home and the direction it is going in.

My final design fiction artifact is a short film, exploring the sustainability implications of living in a smart home. (sustainability in a very broad term). I seek to engage non-experts in the discussion of how we want to live in a world which is becoming increasingly interconnected and complex, from the standpoint of the private, everyday setting of the home.

Definition smart home (umbrella-term): ecosystem of internet-connected objects OR objects running algorithms to (autonomously) facilitate household tasks and activities. They all collect and process data. Examples: video doorbells, smart thermostats, appliances connected to the internet, etc. The more autonomously these devices can function, the more smart we can consider them.

Questions

Background

What is your age and educational/professional background?

What is you relationship with smart home
- Do you have any smart devices in your home?
- Or are there smart devices you interact with regularly? At school, work, or in other home you visit often?

What is your general attitude to the smart home?
- Is it something you like or dislike? are you interested in it at all?

What is your attitude towards talking about smart home systems?
- Is it something you do often? with whom?
- What is the vibe of these conversations? positive or negative?
- Is this topic or definition vague or well-defined for you? how well do you grasp it?
- Do you feel confident in participating in a discussion about this topic? does it relate to your own background or personal experiences?

I have made a short film about the topic of smart homes, specifically about the durability and sustainability of smart home devices and their product life time. The film was inspired by the question: *What if smart homes age just like humans, developing dementia and other aging-based disorders due to deterioration over long term use?*

In the film, the main character has to deal with this in her own home, requiring her to replace her current smart home system. She is offered a somewhat shady alternative: she can replace the system with refurbished and second-hand devices. This option appears easier and cheaper for the character, which leds her to make use of the deal.

This service is illustrated in this booklet, a prop in the video. I invite you to look through it already, so you can get a better understanding of the scenario.

video is played for the participant(s)

Post-viewing

What things do you recognize from the video?

Are there new things you realized when watching the video?

What are your own experiences with the durability and sustainability of smart devices?

Would you be interested in a smart home system as shown in the video? Would you like to make your home smarter?
- What makes you hesitant or interested in it?

Are there thing presented in the scenario that you would be interested in? Or things that you are specifically negative about?
- How might these things contribute to a fuure you may or may not want?

In this scenario you see how the durbaility of a smart system can influence the way you deal with it: how well the system works, how often you need to replace things, etc.
- In you ideal world, how would you want to make devices more durable?
- How do these align with your own values?

What could be ways to increase the lifespan of a smart device?
- Are there things you already do that increase the lifespan of your devices

In "existing" technologies we see the right to repair as a way to increase the product lifespan and sustainability of products. This considers that devices should be designed in a way that they can actually be repaired and that companies should make sure these parts are available. The context of smart technology, a new issue emerges: software. Something you cannot repair the same way as something physical. It is not simply that it is difficult to access software - but many smart devices are depedant on an online server to function. The maintenance of such servers costs a lot of electricity and money. So, for example, when a company goes bankrupt, or is simply not interested in investing in to it, the consumer ends up with a problem.

How could this aspect be addressed, considering the current durability issues of software?
- What needs to be done differently, compared to hardware issues?

Would you be interested in a refurbished system as shown i the video?
- what might be a pro or con of it?

Reflection questions

In the first part of the interview, I asked a question about how comfortable you are in discussing the topic of smart home technology
- How did watching the short film affect our conversation afterwards?

What might you change about this format or medium? specifically considering that objective is to engage non-experts in a discussion about the context of the smart home

Appendix K: Brochure prop

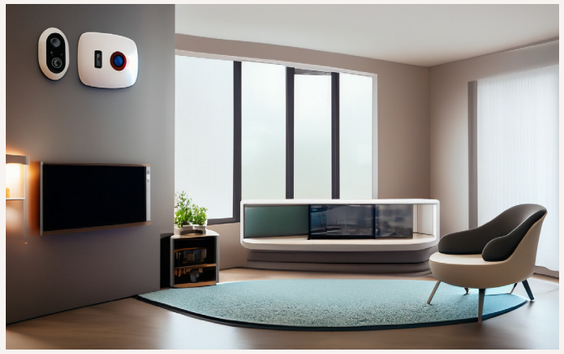
Smart home system

Training time:
17 months by Vanessa (37F, fitness instructor)

Specializations:
healthy cooking, security, exercise activities

Personality:
Proactive, good listener, optmistic, strong-willed

Reason of rehoming:
System upgrade with new partner



Smart home system

Training time:
7 months, by Gertrude (82F, retired)

Specializations:
Healthcare, social networking, arts and crafts

Personality:
patient, persuasive, careful, sensitive

Reason of rehoming:
deceased user

Smart home system

Training time:
36 months, by Paul (57M, outdoorsman)

Specializations:
lawn care, fishing assistance, barbecue cooking, joke repository

Personality:
helpful, conversational, nature lover

Reason of rehoming:
user moving off-the-grid

Smart home system

Training time:
3 months, Jane (32F)(and Peter (35M), influencers

Specializations:
childcare, homemaking chores

Personality:
task-oriented, good with kids, hygenic and neat

Reason of rehoming:
replacement system due to household member ageing

Appendix L: Raw data final evaluation

I find these systems quite invisible, I think there might be a new profession on the rise: jobs to become a software refurbisher.

unpredictability/**hesitance**

I'm a bit skeptical about the Alexa. At the moment, the current capabilities aren't that good, as you see in the video. Its quite different there! And still not working well...

Would you want a smart home: No! I've just seen in the video that this isn't a good thing

The unpredictability of a smart home is very annoying. Everything should always respond in the same way. In that sense, that avoid putting all of that responsibility on the [smart home] itself.

Personally, I think it's really important that a smart home system needs to work well and be very predictable.

We have discussed my neighbor's ring doorbell within my friend group. That was quite specific though, because it is something we directly came in contact with. But we never discuss smart home things in a general way. I always get the "huh" feeling when people are really enthusiastic about it. I think its stupid when people have no hesitation at all about this kind of technology.

impact

Considering those things, I see a big opportunity with flexible energy contracts and the smart home. Smart objects can really facilitate the execution of these within the home.

The refrigerator that tracks the expiration date is just really useful and applicable. It takes out a lot of the guess work that otherwise might not happen

A smart thing in your refrigerator can keep track of more things than I would have expected. Its not just the calories or something. I like that - keeping track of the expiration dates. Thats cool. I'm positive about that. It would help you use up food before it goes bad.

That thing in the refrigerator, that seems very practical! That it tracks how long ingredients will be fresh! That would be quite useful for me.

. I don't just want to throw away an unused roll of tape that I don't need anymore - there is still somebody out there that can use it. In that way - things should be just - and shouldn't be throwan away due to incompetence. That's a bit of my hoarding side coming out though.

A more sustainable lifestyle is something I feel is very desirable. There is A LOT of e-waste, and no one know what to do with it. For example, I have like three old smart phones lying around upstairs, in some bin. I really should bring them somewhere to get rid of them, but I haven't!

where is the need for it?

Yeah. Yeah, like. We try to make machines do the best we they can for humans, but maybe that's not what you want

Now I see them [smart watches] a lot around me. In the supermarket, at school, work, etc. I always wonder: do you really need it? Wat kind of information are you getting out of it - that isn't on your smart phone already?! I just see it as a stupid extension of your cell phone. I think it is such a shame - because I'm really in to watches in general! I really dislike the trend. And I just see so many people walking around with them. Like [redacted] has one as well! Have you seen it?

I'm not scared of an apocalypse caused by these kinds of technology, I feel that it is all very reversible. I can just stop using the devices right now.

The software thing is something i just really don't understand. I understand that it costs money to keep something online. [that smart products stop working without a server] just doesnt make sense when you buy something physical

community/relatedness

I am against cues that take away from social interactions individuals might have between each other. I reduces the amount of conversations being initiated

Replacing other people is what really bothers me - which comes from my own vision on design. I think its important to have these moments of low key contact with each other. For me, I like to ask people "what should I eat tonight" and start a little conversation about that. If you only ask that to your voice assistant - it takes away the opportunity for social contact

The rest video made me think about how intrusive it can be to have a random "personality" in your house. You kind of invite that in a way, buy purchasing all those devices.

Financial incentive

Personally, I don't mind paying more money for a [sustainable] product, but it just needs to a good product as well.

When smart watches start to become a thing - I was super enthusiastic. I was at the point that I was going to buy one myself. But i didn't end up going through with it. Now my opinion has changed completely.

Considering the fact that I'm renting a house, I don't think it is really worth it to invest in it.

comfort

[ideal world] Just making life a lot easier - like a simple vacuum. If I can make a robot work for me, i'll defintely do it. I just want to set my intentions at first.

I think it can be pretty nice. I guess I would like to be able to turn on the heating before I get home.

I have this strong love-hate relation with the idea of making daily activities as efficient as possible. Like opening the door, or coming up with a recipe for dinner. Some processes you want to be very efficient so you can save time and be able to other things with your day. On the flip side, that takes out a lot of the mindful mess from the things that you do. The enjoyment of doing simple things, it is more than the end result it gives you.

EU policy

A lot of people won't put in the effort to make more sustainable choices, because they don't have the time, money, or energy. Policy is the only way to fix this.

Companies should really have to offer services to address this.

This aspect of sustainability is something that should be addressed from [a EU] policy standpoint. Right now, its always the consumer's problem. For example - thousands of smart phones are on the market, but I can only name one that is modular [smart phone]

I think that companies need to be strictly regulated. I really appreciate what the EU did with chargers. First all these companies had different ones, now there almost all quite the same. Updates that make thing slow down should be made illegal as well. I think that Fairphone has a really good way of going about this. There are completely transparent about what the product is made up of, and where it come from. And they offer every part that could be needed on their website.

corporate responsibility

I think that the company or person selling the device should be obligated to take in old parts. The manufacturer knows exactly how the device is made and what it is made up of. Why take it to the dump is they don't know what to do with it?

I think that companies need to be held responsible. The main issue forme is waste - especially with things that still van be used. Its not about money or anything like that - just that things are used optimally. I even have that around the house

You see something similar with Sonos as well. These speakers are sold as a system for life, but after a certain point, they stop updating the speakers -so much for a permanent solution.

Server maintenance in business model

A product that depends on a server should have an entrance fee - that it can't but taken offline anymore - Almost like a zoo for servers, to make sure they get take care of

Or there could be an insurance plan - how does that work at a bank? Do people lose all their savings if a bank goes down? In the past years, I've seen some Dutch banks go down.

Something like a server life cycle plan. Would that have any effect? The price will always be the biggest influence. Not simply trying to offer the cheapest price, but the price category in general. People want to have a certain level of quality that comes in a specific price class

Software & planned obsolence

This same thing with [redacted] father. The Philips Hue bridge is too old to deal with daylight savings. There is nothing actually wrong with the thing - why can't that be fixed with a simple update?

What a coincidence, something happened yesterday which is just about this. My parents have a Philips Hue lighting system which works on a bridge. This weekend, the clocks were switched back to daylight savings. I asked if the timers were able to automatically switch the time, but apparently that isn't possible with the bridge they have! It only works with the newest software update. So now, they need to buy a new bridge to make everything work again.

Not good. No. The iPad.... I've noticed how quickly you need to get rid of specific products. Big companies make sure that their devices slow down over time...

Why do these things break? For example, my phone still works okay. It a bit slow, that;s all. The problem is now - its not compatible with new software updates. So its getting worse and worse - even though it can technically do everything just fine!

Consumer responsibility

1.5 years ago I got a new smart phone - I have been very careful with it, as to make sure that I cn use it as long as possible. I have even changed all the settings: Making sure my battery can't go past 85%. Slow charging, that kind of stuff. But yeah.

I think it is sustainable to skip buying unnecescary devices. I only purchase things I rally need. Besides that, I'm not really conscious of sustainability in tech from that perspective.

Essentially, the best thing is to make sure things are used as long as possible. For example, if i don't need my chromecast anymore, I might as well give it to a poor student. I don't really need a financial incentive for that.

Sustainable behavior isn't "buying sustainable". Its using these as long as possible and not buying a new one. Look, my screen keeps letting go here. I really don't want to deal with this!

I just don't want to participate in it. The most sustainable thing to do is not to buy things that aren't necessary.

Sustainable behavior isn't "buying sustainable". Its using these as long as possible and not buying a new one. Look, my screen keeps letting go here. I really don't want to deal with this!

There are some little things I do to extend the lifetime of the devices I have. It quite simple. For my laptop I have replaced the battery myself. And when my computer starts getting slow, I have reinstalled the software to make it quicker.

Basically, if you want to live a more sustainable lifestyle - the manufacturers are basically boycotting you - because you can't go along with their charade.

brand trust

It feels like a marketing scheme from companies, making you buy new stuff to keep everything working. You really wouldn't expect that when you buy a product from Philips, especially because they are quite pricey. And because of this little thing, you have to make another purchase!

Not good. No. The iPad.... I've noticed how quickly you need to get rid of specific products. Big companies make sure that their devices slow down over time...

I would be open to it - as long it is a brand that I trust. The trust I have in the brand would very important to me.

I wonder, why can't you just bring the bridge back to Philips? That they find some way to change it at least. It is also a waste of the physical materials, like the plastic and electronic components.

Market impact

What would also happen, is the moment you buy a new smart device, you want the newest piece of tech - that also gives a safer feeling, newer is better and will last longer. That can contradict the idea of buying things secondhand.

Considering that, this creates a situation where it is way more attractive to buy from a big company - that gives a sense of security. There is less of a worry the company will go down.

That has a strong downside - it stimulates the formation of a monopoly on the market. That of course have an effect on what kind of devices are available in general.

Software impacting performance

It happens quite often, the software breaks a lot more quickly than the rest. Devices become very slow. Its terrible - because you're taking very good care of your device, but stuff like the battery is still affected in this way - out of your control.

Software Updates should really only be able to improve devices!

A more sustainable lifestyle is something I feel is very desirable. There is A LOT of e-waste, and no one knows what to do with it. For example, I have like three old smart phones lying around upstairs, in some bin. I really should bring them somewhere to get rid of them, but I haven't!

presenting data

It would be nice if a system could visualize what is has saved - like the Rotterdam Pass, which shows you how much money you have saved by using it. It would be good if a system could show you that the smart functionality helps you be more sustainable - in regards to money, electricity, etc.

I would be quite interested in smart energy, specifically being able to see what it actually yields for you and your home - that would be really nice. For example - I might me you turn on the dish washer, and it is programmed to run at a moment when a lot of energy is available. That can be annoying, because your dishes might be done a lot later than you would have hoped or expected. Considering that, you want to make sure you realize what you are getting in return, make that clear. When you can see how much energy you have saved, that makes the little annoyance worth it.

feedback

You can feel the heat, basically.

Induction pits where it's more like less and more in terms of plus and -1 not even, but it's just like weird. There's no there's no. There's no feedback at all. There's just a sound. Yeah. Yeah, I prefer that. I have that as well with, that's why. It's the only thing. I like more about gas cooking is because the feedback is so much better. It's not about. The gas itself but.

verbal/visual info

Often, I see a good intention but a bad execution. For example: my dad is blind and has some smart devices and sensors throughout the house. That's very practical for some things, that he doesn't leave the lights on for example. But for me, a seeing person, this house terrorizes me! You have to imagine that a blind man installed all these things himself! So it feels very chaotic. For example, the bathroom light turns on automatically. But also shuts off after two seconds.

When I'm watching a TV show with a lot of different characters, I really need to have subtitles - otherwise I just can't follow who is who, which takes away from the experience for me

[when I talk to my google home in the morning - to check the weather] I just want the short answer - not the whole shebang about traffic and the rest of the week's weather.

Having smart systems constantly talking overloads me with verbal information - I prefer to process it in a visual way. I struggle to keep track otherwise.

I just really don't want to have a whole conversation with my Google home in the morning - what if my (sleeping) roommate can hear me?

perceiving data

I think [smart home devices] are becoming more popular and commonplace. Its apparent that we have a lot of smart devices around us, without even realizing it [previous answer]. These must collect you data as well, what might "they" do with it?

Well. I guess I can understand why you want to know what your heart beat is like. Especially when your old. Sleep, temperature, you menstrual cycle, I can imagine that could be interesting for some people.

The interesting thing is, that it is so personal. The personal recommendations it offers are based on the data it has been tracking from you. It could be a bit nerve wracking to get a refurbished system as well, you would wonder what would have happened to it before...

Do you think it might affect how you experience things as well? Imagine you feel you had a great night's sleep, but your smart watch says it was actually terrible - does the experience change for you? Do you then believe what your watch says?'

recognize/familiar from video

The door that does not work. That is familiar to me.

There are also things I find very unnecessary though. For example, I can't imagine why a dish washer needs to be connected to the internet!

The smart door - that is something I recognize. That should be something that is possible. Like the facial recognition it does, that something your phone can do to. TUrning on the lights with a voice command - that is something I can't specifically remember seeing - but is something that seems familiar.

We have discussed my neighbor's ring doorbell within my friend group. That was quite specific though, because it is something we directly came in contact with. But we never discuss smart home things in a general way. I always get the "huh" feeling when people are really enthusiastic about it. I think its stupid when people have no hesitation at all about this kind of technology.

I feel very indifferent towards smart home stuff. I kind of distance myself from it. I just think it is so unnecessary. Why do people think that they need that kind of stuff? I just don't get it.

[WHAT DID YOU RECOGNIZE] The smart doorbell, the smart lock on the otherside of the door. The fireplace which implies that it is smart. The smart fridge, The alexa.

I guess that systems don't always do what you want them to do, like when Laura did not get recognized by the system. It isn't something I have experienced a lot in my life, but it is of course often the case with digital systems.

what do you recognize from the video: Everything I see online about the smart home.

reflecting video

[influence of watching video] It really did a lot for me. It gives a starting point which helps you talk about your own experiences, values, and vision for the future. It stimulates you as well. It is a bit absurd in a sense, even though you recognize some things, you also are aware that this scenario isn't the case in the world currently.

[wathcing the video] It was helpful. It made it easier to get the topic in front of you. It also helped to consider both positive and negative aspects about the smart home.

The smart home whisperer was also a new concept for me, very funny!

Reading the book/prop in the beginning was good as well. It gave me a bit of a spark in the beginning to think about the context.

[watching the video] It gave me a better perspective on what the smart home could look like practically - considering that I don't have any experience with it.

The theme of sustainability was not really the first hing I noticed. The device whisperer reminded me more of a shady dirty money kind of person trying to score a deal - rather than circularity. I'm not sure why.

You could combine the film with a kind of doom scenario. Or creating a space which reflects what is happening in the film. With objects or replicating the room - that would make it even more immersive. Using the film format is already a really good way to create a complete experience.

The information/intervention could be useful for companies and policy makers.

[what could be improved?] it would be nice to do a comparison about the things I thought might be smart in the home, and what was actually considered 'smart' in the concept. Those could be more likely about AI, in that way you could play more about what was "Actually there" conceptually, and what the viewer imagined or expected.

Speculations

When I was in high school, I already needed a smart phone to be able to see my schedule. Now, smart phones are being banned in schools. Will we see the same thing happen with smart homes?

A product that depends on a server should have an entrance fee - that it can't but taken offline anymore - Almost like a zoo for servers, to make sure they get take care of

Representing the smart home as a doll house would work well.

I imagine more how a smart home might try to coach you in your day-to-day life. What if Kim Holland was a smart AI coach next to your bed, that would try to help you in your love life?

The idea of a shelter for smart homes. That they all have their own personality and need to be rehomed at a certain point.

[illegible]

My need is peace and rest. In the end, you just want to turn off stove range - for the sake of noise. What would be the organic version of smart stove range? An open window.

I think the video could be even more extreme. Like the pop-up ad being something that you can only click away by commanding your Google home.

Let's send some ID students to Botswana, to focus on Frugal innovation. They'll know what to do with it. A country like that would be really happy to recycle all those batteries and rare metals.

I think that the whisperer should be more of a hippy dippy type, that would improve it for me. When I see that blue uniform, I immediately think of a "beunhaas". The booklet could feel a bit more earthy as well, like adding a tree for example. That would give more of the impression of sustainability.

I recently heard of the Smart bespoke four door AI family hub + refrigerator. How the fuck am I ever going to be able to get a new fridge if that is the only option. I feel like technology will cyberbully me through all the messages and notifications it will send me. How can you call a fridge like that smart, if it can't even clean itself?

Yeah. See, there are things that. Are not reachable for me like for example. If I had a. Vacuum cleaner that could work on walls.

Yeah, things are are not natural for me as a human, but are part of life. No. OK. Yeah, like also maybe things that are more technical, checking the electricity levels, checking the voltage. So. Doing all the stuff that I don't want to do, I don't mind cooking, making up ideas for cooking by myself. Yeah, I could use some assistance, but only when I want. Yeah, but in the video, of course it was. Only when it. Was activated. My door. I want full control of my door.

I also think that a smart system could be very useful in the kitchen - when you're cooking and have dirty hands. You don't want to be touching things to check the recipe. I wouldn't want it to be talking to me - I'd rather have it projected on something [so I can read it]

full control

The autonomy, the transparency of the choices being made. On one hand, it can offers suggestions for you to live a more healthy lifestyle, But it also could make the decision to get a gym subscription.

It's also nice to be able to control the thermostat remotely - especially if you have accidently left the heating on when you're not at home.

[Yes in the bathrooms! I hate it when I'm taking my time and it turns off by itself!] We have a button for that...

Often, you just want to be able to quickly check if the heat is still on. Quick and simple.

The fact that your system could lock you outside just seems stupid. That's why I made sure the [smart lights] have a physical button, in case the internet has gone down or something like that - then I can still use it.

Also, when the main character pulled the plug, because she was just so done with it, that is something I really recognized. With a smart phone for example. Sometimes it can just drive you crazy, like when you have been using it a lot. You really just want to get rid of it - throw it to the other side of the room - throwing motion with hands-.

Having full control over the system is something I think is very important and desirable, a literal power plug, like in the video. Having that control would be very important for me.

I wouldn't mind some tactile feedback myself. Like there's a button for like. For some things I want it automated but some things I. I don't care. Like I I don't mind having a single like in touch push, OK. It makes me feel more in control.

BEHAVIORAL & IMPACTFUL CHANGE

I want the system to indicate what the best choices are. Not like in a wikipedia way, I want to understand the reasoning behind it. Its like when you're a teenager and you're parents say "you're not allowed to go to the party". You become a bit rebellious. You only start to understand when they give a reason: like the route to the party seems dangerous at night', then you understand it a bit more and find it more reasonable.

For my own graduation, I have stumbled on the FOGG model. There are three very important aspects for behavior change. Specifically "MOTIVATION" is really important here - it needs to be addressed for a smart home to help with your lifestyle/give good suggestions. Otherwise it i annoying.

I wouldn't mind if my system would recommend me a salad - as long as it wouldn't act like a know-it-all. There are some tips which would be really useful for example. Like when you're making pasta? You have ingredient replacements - using yogurt instead mayonnaise. These kinds of a suggestions would be really useful

I would prefer it to set an intention with my system. That it would make these suggestions if I have asked it to. Like I want to lose weight - so help me with that in the kitchen. Or I want to save money on my electric bill - so help me with that when heating the house.

[ideal world] Just making life a lot easier - like a simple vacuum. If I can make a robot work for me, i'll defintely do it. I just want to set my intentions at first.

Behavior towards things as agents

What if I come home, and just end up swearing to my smart home. If it responds with "auw" - then I'm just going to cry

That's why I am also really polite to chatGPT as well.

I'm worried I will regret saying mean things to my devices.

Systems having a personality is quite grim to me. I already get frustrated by my "dumb" oven which turns off by itself!

decision making

I also saw that the system acts in a way that is thinking with you - that is something I find interesting as well.

I don't want a system that makes decisions for me.

I really don't like that the system is patronizing you every moment of your day. Normal daily life does that enough\!

Like at the end they got. The main voice of the thing was like. This is good for you. This is bad. For you and but. No one wants to.

People want others to be empathetic. People have their own brains. They don't want their brains to be replaced by machine. Like. I can do my own thinking about the diet. At least in my case, I mean, I'm. Speaking of this more purely personal point of view.

authority over devices

It's a machine at the end of the day, I don't see it as a company.

I wouldn't want. Boys to like. Pester me about something. Once I say no, it means to challenge my decisions. But I am kind of more authoritative with my tools. Yeah, even when I use chat GPT. I'm like, do this do that, I don't say. Please or thanks. For anything like created like tools.

That's why I am also really polite to chatGPT as well.

holistic view of the home

And. I always try. To make like with each room, I would then put one point of contact. From with the. With the central interface and that spreads into the. Roomh here. It's not like if there are 4 speakers in my room, they're all connected to the central interface. Yeah, it's like I would see one node for each room that those nodes are like a branch. Like a tree tree diagram.

privacy

There is a clear line for me. I don't mind what systems know about me from the "outside". Movement, what I am doing in my home, or if I am cold. But I don't want it know about my inner world. Want I am feeling or thinking. So basically, the same as what another person can easily observe from me, that doesn't feel very personal. I think only from the medical perspective could be an issue, if have a cold or something. But really, I'm very healthy so that wouldn't be an issue for me. The thing is, with that inner world, that is something you only share with people you know you can trust.

I don't do any weird things with smart devices. I'm still always worried that people will be able to see it - even if I'm not actually doing something weird. Like - it will just so happen that you looked up something super weird with it. Or your own a very strange site - just something that would be emberassing. Even though I have no reason to think that!

But what happens with all that data? That is what I find quite grim. People give up a lot to be able to collect their own personal data - especially when the product has a nice user experience. These devices help you skip a lot of steps to get your data - you don't have to get specific gear to track your health data manually. And there's a lot less human error.

Something like smart lighting feels safer for me. As if the system wants less data from me. The same for a smart thermostat as we

Wanting a smart home system? I'm a bit hesitant. Even with my Google searches I get a bit paranoid. Where does that information end up? Will my very weird searches still be somewhere in 30 years? Data privacy is a bigger issue for me than sustainability in that sens.

power balance

The newer flatmates don't have the log in information. I'm the only one that has it now. I have all the power. So I can make the lamp go in "cop car" mode at 4 at four in the morning, when someone happens to be using the bathroom.

We have discussed my neighbor's ring doorbell within my friend group. That was quite specific though, because it is something we directly came in contact with. But we never discuss smart home things in a general way. I always get the "huh" feeling when people are really enthusiastic about it. I think its stupid when people have no hesitation at all about this kind of technology.

SURVEILLANCE

It doesn't work with your phone?

No I think that's kind of scary - being connected to everything.

On the other hand, when a system can start recognizing behavioral patterns - what I eat for instance - then it starts getting personal - in a bad way.

The only smart device we "interact" with is my next door neighbor's ring doorbell. We've talked about it before... We really don't like that thing though. That's the only device I can think of really.

I find the smart TV a bit weird. I sometimes use it when I want to search a whole sentence. It is helpful - You don't need to bother to type the whole sentence. That is really unpractical when you have to use a little remote control - that doesn't have a normal keyboard in it. The smart TV gives me an off vibe though. Does it really ever stop listening to? Its not that I have anything to hide... Its just weird.

He has 4 Google speakers throughout the home as well. I asked him if he cared about these speakers always listening to him. He didn't understand what I meant. I told him, if you think that the speaker only starts listening when you say "Hey Google" - how do you think it hears the command in the first place? This worries me a bit, the lack of societal awareness about these devices.

I don't do any weird things with smart devices. I'm still always worried that people will be able to see it - even if I'm not actually doing something weird. Like - it will just so happen that you looked up something super weird with it. Or your own a very strange site - just something that would be emberassing. Even though I have no reason to think that!

You feel like these things are listening in on you - and that is just awkward,

Ring doorbell

The only smart device we "interact" with is my next door neighbor's ring doorbell. We've talked about it before... We really don't like that thing though. That's the only device I can think of really.

Oh yeah! We also have a ring doorbell. But we haven't actually installed it yet. It has been lying around here. That's also because of our laziness.

We have discussed my neighbor's ring doorbell within my friend group. That was quite specific though, because it is something we directly came in contact with. But we never discuss smart home things in a general way. I always get the "huh" feeling when people are really enthusiastic about it. I think its stupid when people have no hesitation at all about this kind of technology.

Google home

I have a Google Home Assistant. It can only interact with my TV. Its getting quite old - and confused though.

I immediately think of N's Google Home, which can't understand anyone.

[My Google Home is confused]- Well, its speaks to me in the wrong language: Norwegian, Japanese, and English. Never Dutch.

The WiFi has gotten fucked at our place as well - which makes Google home even less functional and close. I don't really use it that much, only for the weather [in the morning] - and to control my tv.

I have a Google home + chrome cast setup for music, which actually like. It works fine. There is just a bug that it always turns on about 5 decibels harder than it should. If you turn down the volume, it immediately goes to the lowest setting. Which is quite weird and annoying.

We have HEMA lamp that works with Google home - but it actually doesn't. We have to use the HEMA smart app instead. That means everyone in the house needs to use the same log in information to be able to control the lamp.

Oh well.. My 3D-printer is "smart" I guess. I can connect with it from my laptop or phone. It can also connect to the wifi here. I didn't end up enabling that when we installed it though. I was thinking about what the implications could be of doing that. It was also a bit of laziness as well, as I don't fully understand it.

Smart lighting

I have a smart lamp but it is fucking stupid. The wifi in my student house is way too crappy to support smart products.

Yes - for me I think of my "smart lamp" that doesn't actually work with my Google home. The Google home app has way less functions than the shitty HEMA app. It only says on/off. I hate that HEMA lamp. There are some timers and settings as well. Like I could program it to turn on at 4 AM. But it only works if the lamp button is turned on and getting electricity in the first place.

At the TU Eindhoven campus, there is are smart blinds for when it's very sunny outside.

I've also faced that first station sometimes when I say turn off the light to my phone and it doesn't, it says light is already on and it's on and off and then I just curse at it. But it doesn't recognize the curse. And. Yeah, sometimes I say something and it starts playing music.

I started working on a smart lighting system, I was quite enthusiastic about it as well. After moving recently, I haven't gotten around to installing it again here. I don't really have a smart home system here. I think only really my laptop in that sense.

Oh yeah! And upstairs the we have some smart lights as well. They are connected via an app, and can change color using the timer. It's more of my boyfriend's thing though.

Generally, smart lighting seems nice.

For me, the next addition I would make would be a smart light bulb. Generally, I like being able to control things from my voice assistant. When I'm really tired for example. Also, the light switch is in a very weird place in my room, behind the closet, so I like not having to maneuver to reach it.

I do mention my smart lamp to people when I leave home and someone's leaving with me and they're like ohh the lamp I'm like hold on I've got my phone it's like a flex

We have HEMA lamp that works with Google home - but it actually doesn't. We have to use the HEMA smart app instead. That means everyone in the house needs to use the same log in information to be able to control the lamp.

When the wifi is acting up, the light disconnects as well. This is indicated by a flashing red light, until it can reconnect with wifi. Which never happens - it just stays as a flashing red light.

I do mention my smart lamp to people when I leave home and someone's leaving with me and they're like ohh the lamp I'm like hold on I've got my phone it's like a flex

Oh! Well then we have movement sensors in the bathroom at my house. I often forget to turn off the light when I use someone else's bathroom
All the lights at the faculty are movement sensitive as well!

frustration

We have kind of accepted that these systems should be making choices for you. Its annoying when [getting a new system] you have to go through all these set-up steps multiple times. Like when you have to put all your files in a new system.

I recognize the irritation, even though my home is a lot less smart

I don't want the system to constantly make annoying suggestions - especially because I have never engaged with these suggestions.

These dysfunctioning devices isn't really great for my wellbeing. It stressed you out in your own home.

Every time I talk about it I get so angry! I can only really use my humor talking about it - and it also leads me to think in a very dystopian way. The worst thing is, sometimes you're making a joke about it - and then it actually turns out to exist!

I've become even more angry. Like when I heard that the smart lock in the video is an actual smart lock that doesn't work? And its also in the video? That just frustrates me so much.

It's annoying when appliances don't work - it is really frustrating. I'm not that technical myself. I buy tech devices for their functionality - but then they dont work!

Just stop. People need to stop making and consuming these products. Improving it? Thats a bad question from that point of view. I want to fight someone now, but with whom is the question?

[what do you recognize] Emotions. Emotions and kind of emotions. Yeah, different things associated with like how defines the relationship of the human and the machines and network. As they call it. So like it's it's mostly frustration. And let's see, that's it's mostly negative emotions. Or it's either blind or negative that I don't really see any positive reaction to.

Yeah, it annoys me. Because the. Yeah, I gave it a function, but it's not doing that function. I would really like it to do the function that's being designed for.

Roomba

My brother has a Roomba as well. He doesn't like to clean that much and only really has time after work - so that works for him.

We used to have a Roomba at home as well. But it wasn't that smart. It kept on getting stuck underneath the radiator, because of the ultrasonic sensor. The sensor was pointed downward - and didn't detect the radiator- thinking it could go there. So we would put a blanket over the heater, so it would detect that.

[That doesn't sound very fine-safe]
No, you're absolutely right. We also looked into getting some special tape to put around the radiator, for the Roomba.

[Is that why you got rid of it?]

Kinda. It just takes so much effort to arrange everything so the Roomba can clean. It kind of defeats the purpose.