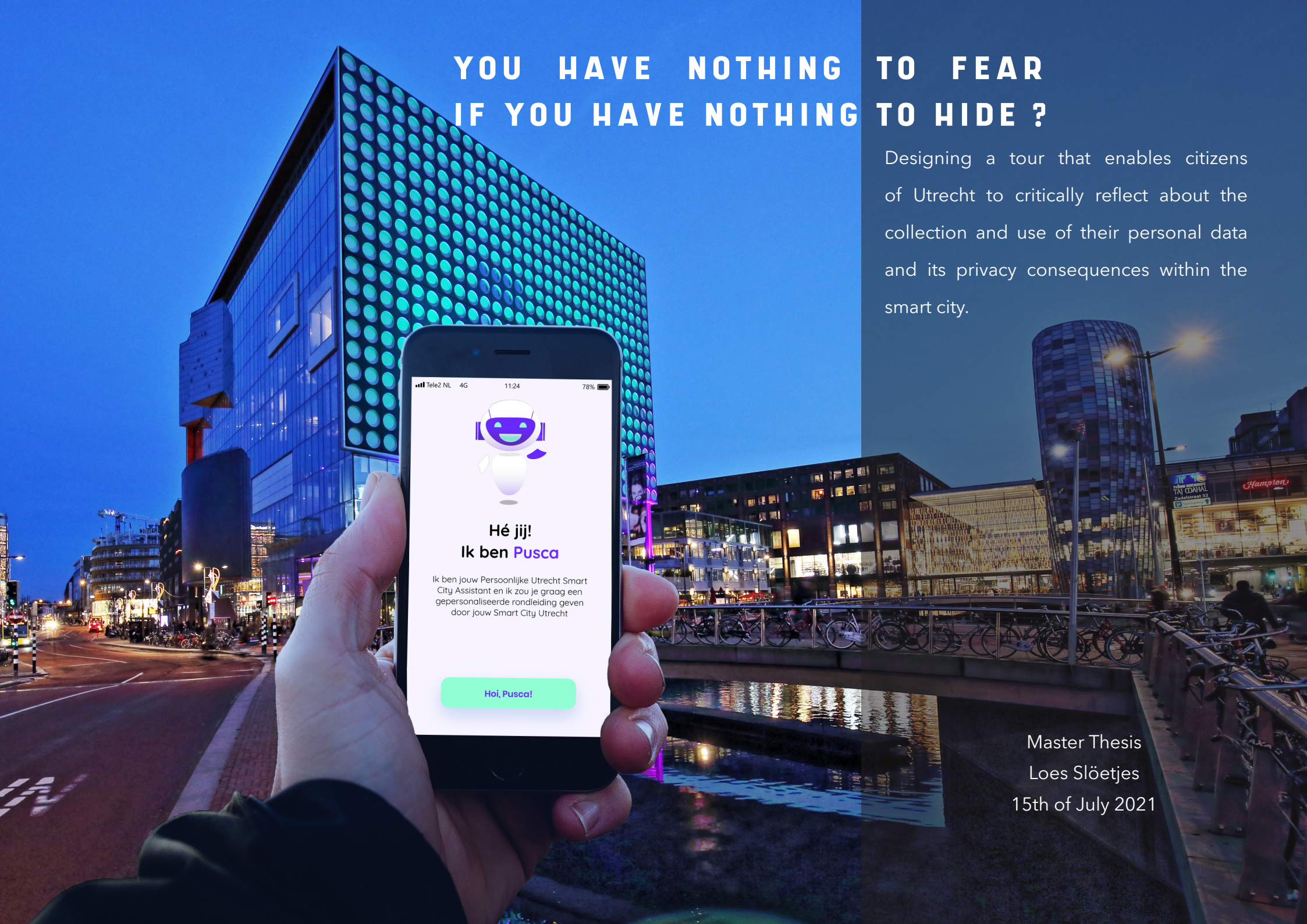
YOU HAVE NOTHING TO FEAR IF YOU HAVE NOTHING TO HIDE ?

Designing a tour that enables citizens of Utrecht to critically reflect about the collection and use of their personal data and its privacy consequences within the smart city.



Master Thesis
Loes Slöetjes
15th of July 2021

"Always eyes watching you and the voice enveloping you. Asleep or awake, indoors or out of doors, in the bath or bed—no escape. Nothing was your own except the few cubic centimeters in your skull."

- George Orwell 1984

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In front of you lies a graduation thesis which is the final deliverable of the Design for Interaction Master and it contains much of what I have learned over the past years at the Industrial Engineering faculty. Looking back I am proud of all the things that I have learned and what I have established.

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Enjoy my master thesis!

Loes

EXECUTIVE SUMMARY

In 2008 more than 50 percent of all people, 3.3 billion people, lived in urban areas according to the United Nations Population Fund (UNFPA - United Nations Population Fund, n.d.). By 2030 this will be approximately 5 billion (Lea, 2017). On the one hand, with fast urban growth also comes excessive burdens to climate, energy, environment and living, challenging the way we build and manage cities. On the other hand, technologies that are discovered in this era of digitization can produce opportunities for the economic and social development of cities. Not only making sure that cities stay safe and livable, but also to improve them, these technologies are indispensable.
Worldwide engineers turn to technology to tackle challenges of fast urban growth that arise on the fields of sustainable development, education, energy, environment, safety and public services (Arroub et al., 2016). Aside from tackling these challenges, technologies provide opportunities for economic and social development of cities keeping the cities safe and livable. Both of these aspects are often gathered under the term: 'Smart City'.

Though there are many definitions, visions or imaginaries of what a smart city is or should be, there are key elements that can be attributed to 'smart cities'. One of the key elements of a smart city is collecting data through sensors embedded in our surroundings to better understand, monitor, regulate and plan the city, with the goal to stimulate and support innovation and economic growth and provide sustainable and efficient urban management and development (Kitchin, 2014).

However, data raises a number of concerns regarding its design, development and deployment for smart cities (Al Nuaimi et al., 2015) as well as other concerns relating to ethical issues (Kitchin, 2014). Privacy certainly proves to be the most prominent issue in digitization technologies and big data (Kool et al., 2017). Several national and international organizations have even identified privacy as a key policy, regulatory and legislation challenges of the 21st century (van Zoonen, 2016). This leads to the following design goal:

"Designing a tour that enables citizens of Utrecht to critically reflect on the collection and use of their personal data and its privacy consequences within the smart city".

Pusca is an application based **P**ersonal **U**trecht **S**mart **C**ity **A**ssistant that takes the user on a one time tour through Utrecht to explore and experience smart city technologies that could improve their quality of life. Each of the stops in the tour presents a service provided by a smart city technology that can be experienced by sharing personal data. The user is asked to make a trade-off between their estimated privacy value of the asked personal data and the benefits of the presented smart city technology. At the end of the tour the user gets confronted with privacy consequences of sharing their personal data that provokes a critical reflection on the trade-offs that the user made during the tour.

This design is a start for knowing how we want our privacy to be protected, by letting people create an opinion about this. I hope that this project can be a first step into creating a society where open and standard policies about safeguarding citizens' privacy within smart city technologies will be secured.

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FOREWORD

0.1 TAKE YOUR RESPONSIBILITY

A while ago I read the book 1984 by George Orwell (Orwell, 1949) and I was fascinated to find out that the book was published in 1949. It seemed unreal that a book written so long ago made such accurate predictions of technologies in our world today. Though I do not have a dystopian view on the world we live in, I do think that technologies can and have big impacts on our lives, in both positive and negative ways. Research states greater attention is demanded to safeguarding private and public values in respect of digitization (Kool et al., 2017) to not let our world become the dystopian world of 1984. This project is about taking the first step into the direction of a higher goal that is seen as a utopian ideal:

"Create a society where open and standard policies about safeguarding citizens' privacy within Smart City technologies will be secured".

By creating awareness about digitization and let people create an opinion about this, the first step is taken into knowing how we want our privacy to be safeguarded. This is the basis to create privacy policies that secure citizens' privacy. I believe that it is everyone's responsibility in, one way or another, to create a world that we want to live in, instead of blindly trusting whatever comes our way.

0.2 PROJECT PARTNER

CLEVER°FRANKE was the project partner for this graduation project. CLEVER°FRANKE is a design company that uses data and to create interactive products and experiences. Their mission is to use their knowledge of design and data to create solutions for complex business challenges, bringing simplicity to our lives and create experiences that inspire change (CLEVER°FRANKE - Data Driven Experiences - A Data Design & Technology Company, n.d.).

CLEVER°FRANKE

DESIGN FOR COMPLEXITY

0.3 PROJECT PROCESS

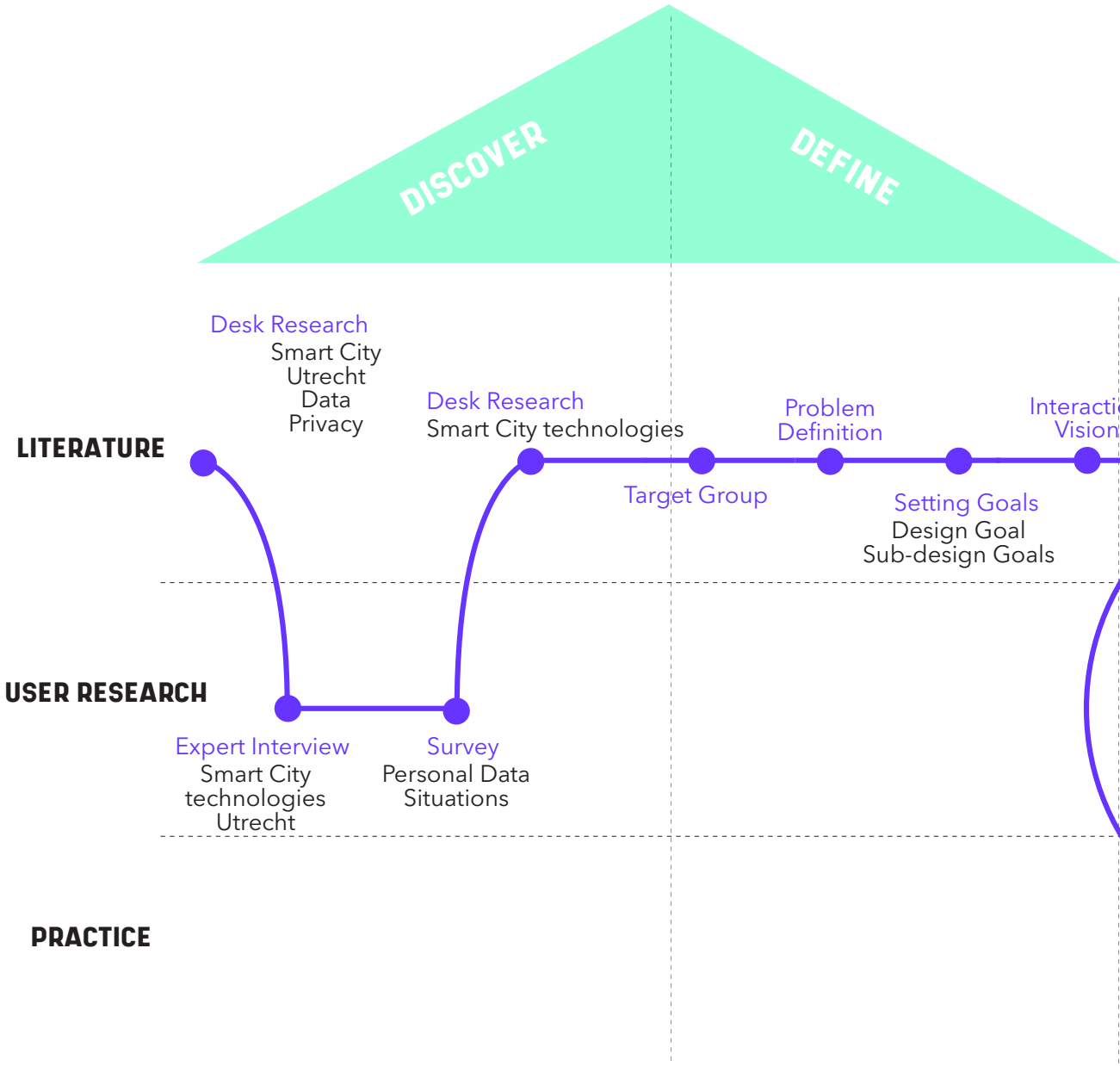
In this project the Double Diamond method by the British Design Council is used (Ball, 2019), consisting out of four main phases: Discover, Define, Develop and Deliver (see fig. 1). The kick-off of the project was October 8, 2019 and the project ended July 15, 2021 (see Appendix A: Project brief).

Discover
The first phase is about understanding, rather than assuming what the problem is by questioning the challenge and identify user needs.

Define
In the second phase insights from the Discover phase are gathered and used to define challenges based on these insights.

Develop
The third phase is about developing, testing and refining multiple solutions to the challenges.

Deliver
The final phase involves selecting a final solution to the challenge and preparing it for launch. the challenge and preparing it for launch.



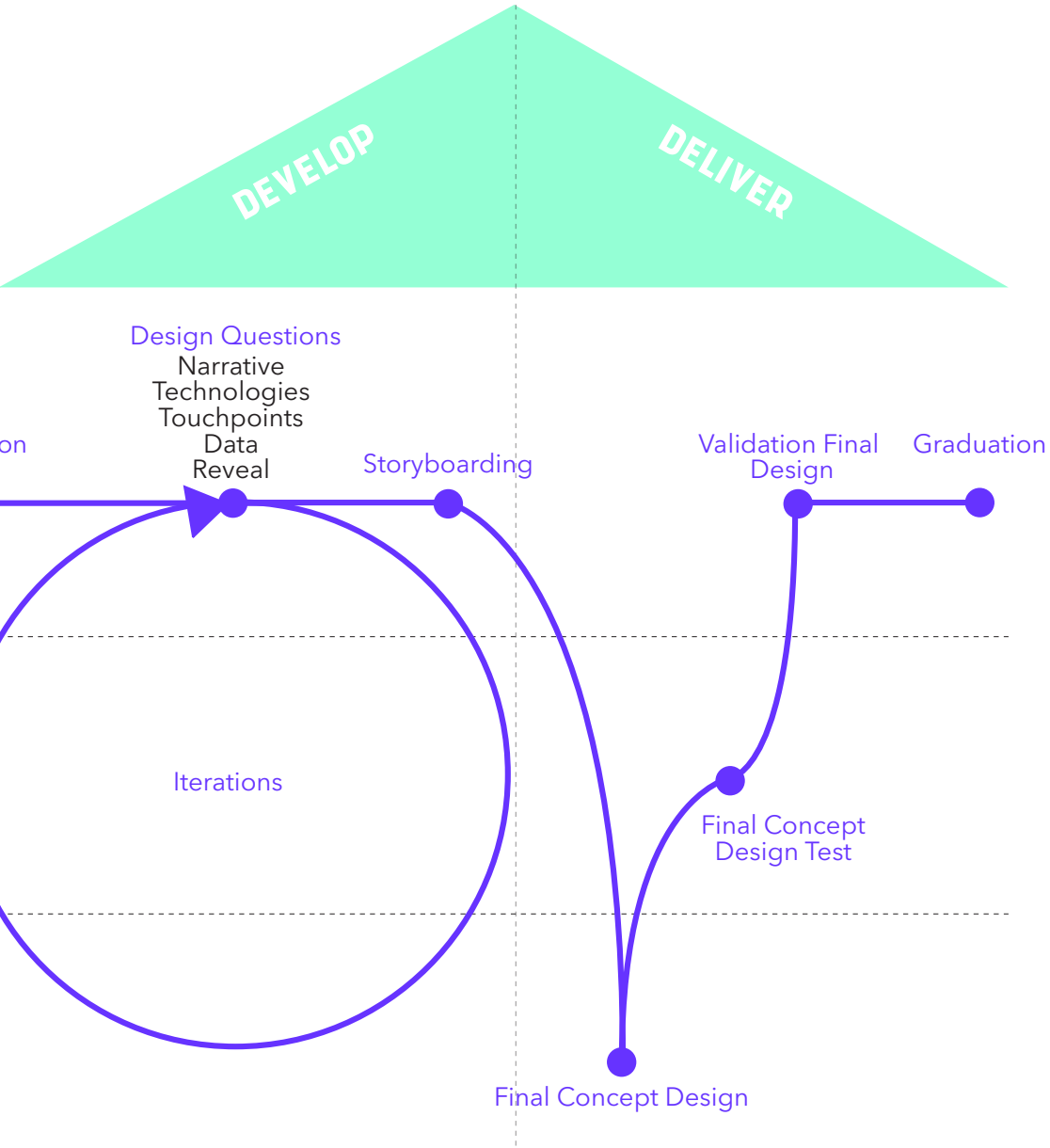


Fig. 1: Graduation process

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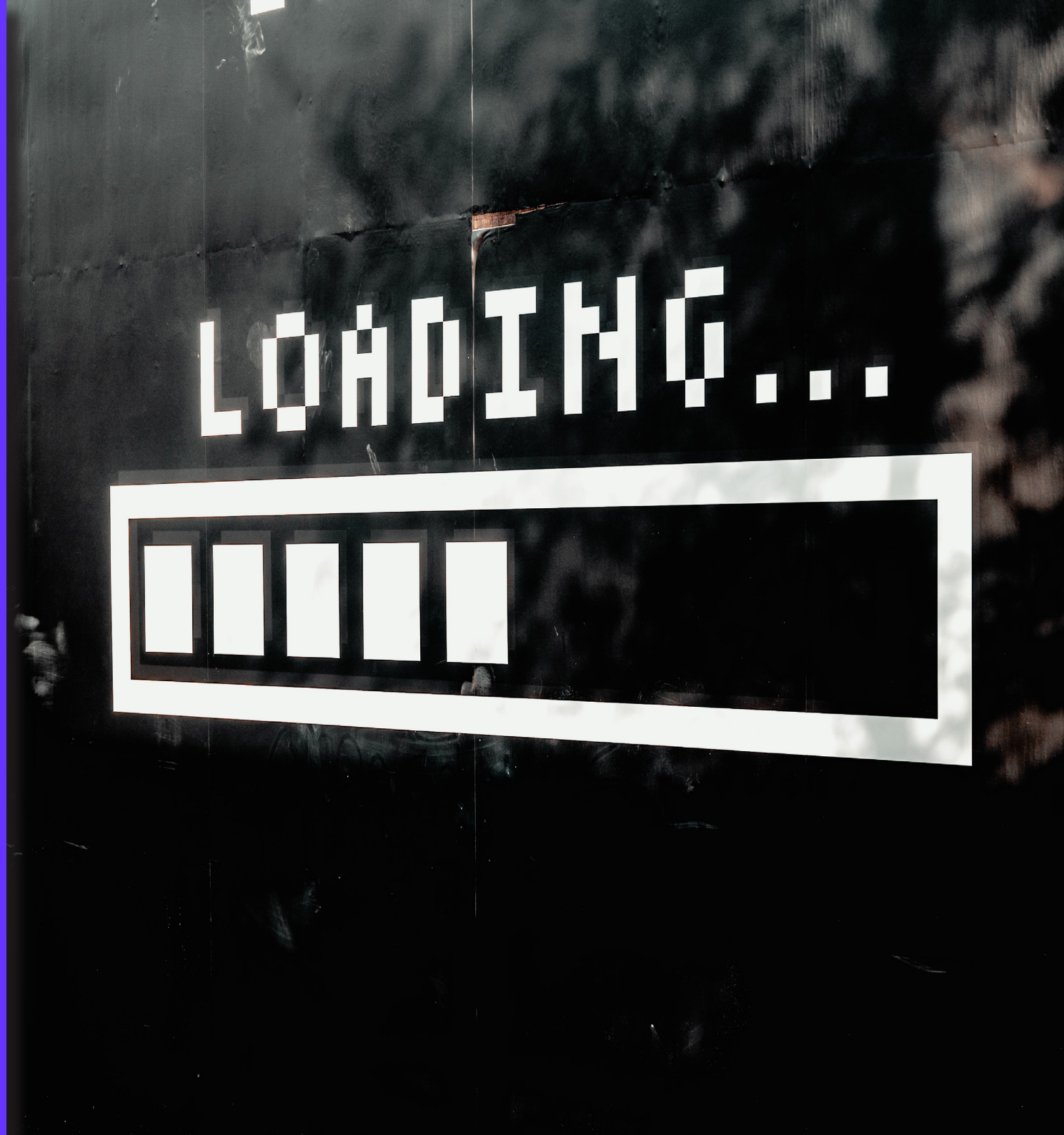
DISCOVER

In the first phase of this graduation project, I conducted a literature review to uncover what a smart city is and why data is so valuable for it. After describing the results of the review, I highlight the value of personal data regarding one's privacy and discuss aspects that influence privacy concerns. This literature review is the basis for the problems and design goal defined in the next chapter.



1.1 DIGITIZATION

1.1.1 The fourth industrial revolution

Mankind has perfected and innovated their ways of living throughout the course of history. Relying on technical evolution and reinventing new technological means brought us the cities as we know them today. Sometimes these technological advancements lifted the industry with such an overwhelming impact that we call them 'revolutions'. The first industrial revolution brought us the steam engine, that accelerated mechanization and replaced agriculture with industry. In 1870 gas, oil and electricity were discovered and this period gave us the combustion engine. The second industrial revolution was born and chemical synthesis, telegraph, telephone, automobiles and planes were invented. In the second half of the 20th century the third industrial revolution appeared. Electronics and information technology were used to automate production and with this came the rise of telecommunications, computers, biotechnology and robots ('The Industrial Revolution', 2019).

Looking back, we can see that the previous revolutions were based on a new type of energy that was found. Today the fourth revolution has been occurring since the middle of the last century and still is happening, right before our eyes (see fig. 2). However, this is not because a new type of energy has been discovered. The fourth revolution is building on the third and combines technologies that blur the lines between the physical and digital world: digitization (Schwab, 2016).

1.1.2 Urban challenges and opportunities

The rising economy caused social transformation: people move from the country to cities, resulting in the biggest urbanization wave in history (Zhang et al., 2017). In 2008, more than 50 percent of all people, 3.3 billion people, lived in urban areas according to the United Nations Population Fund (UNFPA - United Nations Population Fund, n.d.). By 2030 this will be approximately 5 billion (Lea, 2017). On the one hand, with fast urban growth also comes excessive burdens to climate, energy, environment and living, challenging the way we build and manage cities. On the other hand, technologies that are discovered in this era of digitization can produce opportunities for the economic and social development of cities not only making sure that cities stay safe and livable, but also improving them.

Fig. 2: An overview of digitization resources (based on Kool et al., 2017)

1.2 THE SMART CITY

Worldwide engineers turn to technology to tackle challenges of fast urban growth that arise on the fields of sustainable development, education, energy, environment, safety and public services (Arroub et al., 2016). Aside from tackling these challenges, technologies provide opportunities for economic and social development of cities keeping the cities safe and livable. Both of these aspects are often gathered under the term: 'smart city'.

1.2.1 Smart city examples

An example on making the city smarter is Amsterdam Smart City (Home - Amsterdam Smart City, n.d.), that describe their platform as: "an unique partnership between companies, knowledge institutions, governments and active residents". These parties come together to contribute to a cleaner, greener and happier Amsterdam Metropolitan Area and turn it into a smart city. It is presented as an 'urban living lab', where smart city initiatives can be tested and demonstrated on the fields of living, working, mobility, public facilities and open data. This example emphasizes how the relations between the knowledge economy and urban development are thought to make a city smarter. By monitoring, understanding, analyzing and sharing knowledge on this platform, Amsterdam Smart City aims to improve quality of life for its citizens in real time (Meijer & Bolívar, 2016).

Another completely different example of a smart city is currently being built from scratch. At the foot of Mount Fuji in Japan, Toyota is building the ultimate smart city of the future: Toyota Woven City (see fig. 3). In this city everything will become 'smart': citizens, buildings and vehicles will all be connected and will communicate through data and sensors (Toyota Woven City, n.d.). This fully connected ecosystem will be powered by hydrogen fuel cells and will function as a 'living lab' to test robots, smart homes and AI. This smart city example focuses on technology used by the government in combination with Toyota.

These are two completely different perspectives of what a smart city is and these correspond with the two most commonly found diverging smart city perspectives in literature (Goodspeed, 2015; Kitchin, 2015). One perspective is focused on the use of information technologies to stimulate urban development and the other perspective highlights the extensive embedding of software-enabled technologies into the fabric of cities (Kitchin, 2014).

Fig. 3: Toyota Woven City (Toyota Woven City, n.d.)

1.2.2 No one-size-fits-all

There is no one-size-fits-all definition of the term 'smart city' and it is used in ways that are not always consistent. Definitions of a 'smart city' range from simply using information and communication technologies (ICTs) to optimize the management of urban infrastructures, to complete visions of cities as integrated systems to improve quality of life, working towards 'smart' economic growth and even 'circular' cities (de Waal & Dignum, 2017).

The usage of 'smart' in the label of 'smart city' is employed in a variety of ways (Hollands, 2008). 'Smartness' sometimes refers to the so-called intelligence of technology, where smart systems act autonomously, appropriately, and promptly to respond in real time to complex and dynamic situations (Kitchin, 2014). Another interpretation of 'smart' when placed in the context of the city as a whole, becomes a vision that incorporates ideas and beliefs about the future of urban areas (Sadowski & Bendor, 2019). The smart city is identified with its technical infrastructure, but it can't be described by any single technology or a particular collection of technologies.

Also, the term 'smart' has by its nature a positive and uncritical stance towards urban development and this can therefore result in an 'urban labelling' phenomenon, where it is difficult to separate the hype and use of the term 'smart' that are placed because of marketing purposes (Hollands, 2008).
Many researchers have pointed out that smart city approaches have mostly been top-down, techno-centric and serve the interests of corporations and governments instead of improving the life of citizens (de Waal & Dignum, 2017). These approaches and visions have mostly been shaped by big technology providers, that sell this vision in need for suppliers. Some critics of the smart city imaginary point to it as a kind of universal, rational and depoliticized project that focuses on profit-maximizing (Hollands, 2008; Kitchin, 2015; Sadowski & Bendor, 2019).

Not only is the term criticized as being top-down and techno-centric, it is also accused of lacking the most important dimension that drives cities: its citizens (de Waal & Dignum, 2017; Hemment & Townsend, 2013; Meijer & Bolívar, 2016; Oliveira & Campolargo, 2015). The definition can't be limited to the use of information technologies to stimulate urban development or implementing software-enabled technologies into the cities' fabric, because a city will only be smart if citizens play a leading role in conceiving, designing, building and maintaining our cities of the future (Hemment & Townsend, 2013).

1.2.3 Smart city pillars

Though there are many definitions, visions or imaginaries of what a smart city is or should be, there are key elements that can be attributed to 'smart cities'. One of the key elements of a smart city is the use of ICTs. The idea that ICTs are central to the operation of the future city is at the core of all smart city perspectives (Meijer & Bolívar, 2016). However, social factors other than technological smartness are essential to smart cities, and a socio-technical view is needed, rather than blindly believing technology itself can automatically transform and improve cities (Goodspeed, 2015; Hollands, 2008; Nam & Pardo, 2011). Research has focused on common grounds within these 'smart cities' perspectives and found that a smart city enables social, cultural and urban development and improves economic and political efficiency (Hollands, 2008). Research has also found that the majority of smart city models have overlapping components or "pillars": Smart Economy, Smart Governance, Smart Mobility, Smart Environment, Smart Living and Smart People (Arroub et al., 2016; Griffinger et al., 2007).

Smart Economy

Smart Economy can be described by industries that produce innovative ideas and employ knowledge to increase the productivity and reduce cost. Especially by using ICTs focusing on sustainable and green resources and being socially responsible to promote the welfare of individuals.

Smart Governance

Smart Governance represent a collection of technologies, people, policies, practices, resources, social norms and information that interact to support city governing activities. Where the term "smart" refers to the relation between the city government, administration and its citizens.

Smart Mobility

Smart Mobility can be described by modern transport technologies that improve urban traffic control, traffic management systems and the inhabitants' mobility.

Smart Environment

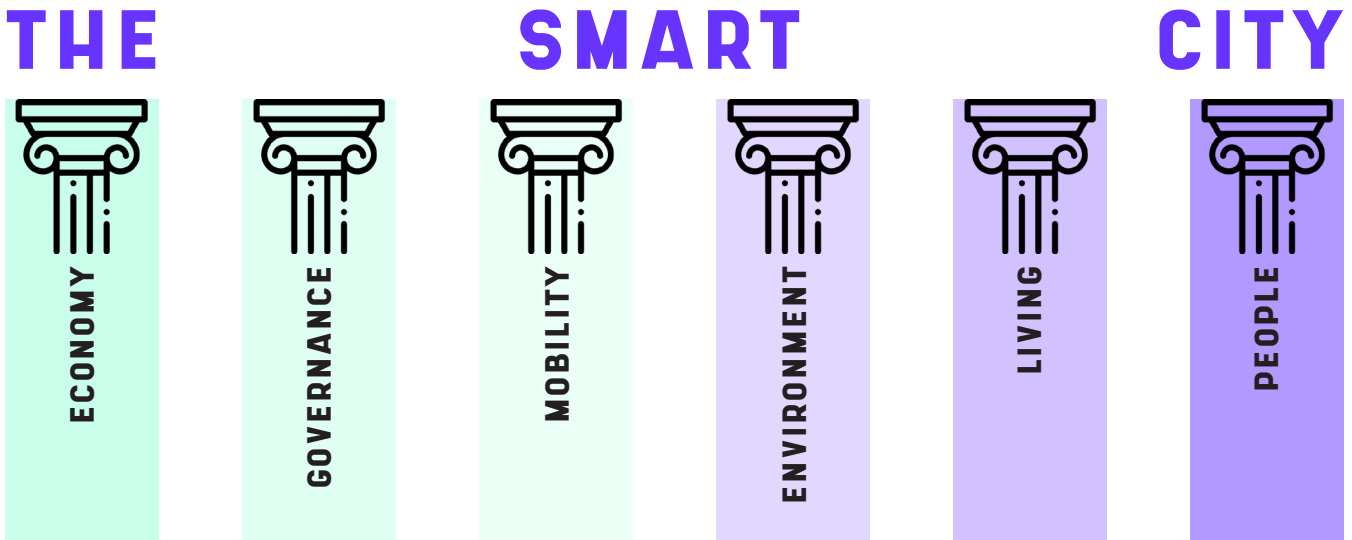
Smart Environment contains the actions involving environmental infrastructures such as: waterways, sewers and greenspaces and is also focused on using natural and green energy sources.

Smart Living

Smart Living is about connected devices to make a lot of tasks easier, safer and cheaper. It makes the life of individuals more productive, sustainable and efficient.

Smart People

Smart people is about the creativity, education, knowledge and learning of citizens that make the city smart. This is an essential factor within the smart city dimension.



1.3 DATA

1.3.1 Data is the smart city's lifeblood

For a long time, the most valuable resource has been oil, those who controlled oil, controlled the economy. However, in today's economy there is another resource that is said to be more valuable: data, the oil of the digital era ('The World's Most Valuable Resource Is No Longer Oil, but Data', 2017). In recent years the ability to collect data has increased dramatically (Fan & Bifet, 2013). Data can be described as facts or numbers that are collected and later analyzed to be processed into information. This information is then to be examined and used to help with making decisions (DATA | Meaning in the Cambridge English Dictionary, n.d.). Sensors that collect data are embedded in our surroundings everywhere, from cameras in public spaces to smartphones in our pockets and the volume of produced data has grown exponentially. Data is analyzed for understanding, monitoring, regulating and planning the city, with the goal to stimulate and support innovation and economic growth and provide sustainable and efficient urban management and development (Kitchin, 2014).

1.3.2 For whom is data valuable?

Data can be valuable for different reasons to citizens, governments and companies (van Zoonen, 2016):

For citizens, the value of data lies in making life easier. Data and its analysis offers insights into city life and aids everyday living and decision-making (Kitchin, 2014)

For governments, data and integrated analysis and control centers offer more efficient and effective city management and regulations (Kitchin, 2014)

For companies, data analytics offer new, long term business opportunities (Kitchin, 2014). These so-called 'panspectric' techniques of predicting consumer choices and customer desires are proving crucial for the control of markets (Palmås, 2010). By capturing, storing and analyzing customers' data, companies can affect the value of advertising, improve specific activities such as customer relationship management, or produce new business models predicated on data analytics and social media (Constantiou & Kallinikos, 2015).

1.3.3 Data collection in the smart city

The concept of digitization is shaped by a number of trends: robotics, the internet of things (IoT), artificial intelligence (AI), algorithms, big data, digital platforms, biometrics, persuasive technology, augmented reality (AR) and virtual reality (VR) (Kool et al., 2017). Digitization makes the physical and the digital world more and more intertwined on three levels: the material world (our streets, buildings and homes), the biological world (our bodies and minds), and the socio-cultural world (our social surroundings) (see fig. 4) (Kool et al., 2017). People, objects and processes in the physical world are being sensed and measured. Data collected by sensing components is transmitted into the communication layer of the digital world by using heterogenous network infrastructures (see appendix B: Smart city infrastructure). Networks enable the data that is collected in different ways to be transmitted seamlessly to the information layer in the digital world. In the information layer, processing units exploit and analyze the collected data into information for decision making (Zhang et al., 2017).

This information is then accessed by municipalities who use control and operating components to modify and steer the physical world, creating continuous feedback loops between the digital and material worlds. This two-way flow of sensing and control is an essential part of what is called a smart city.

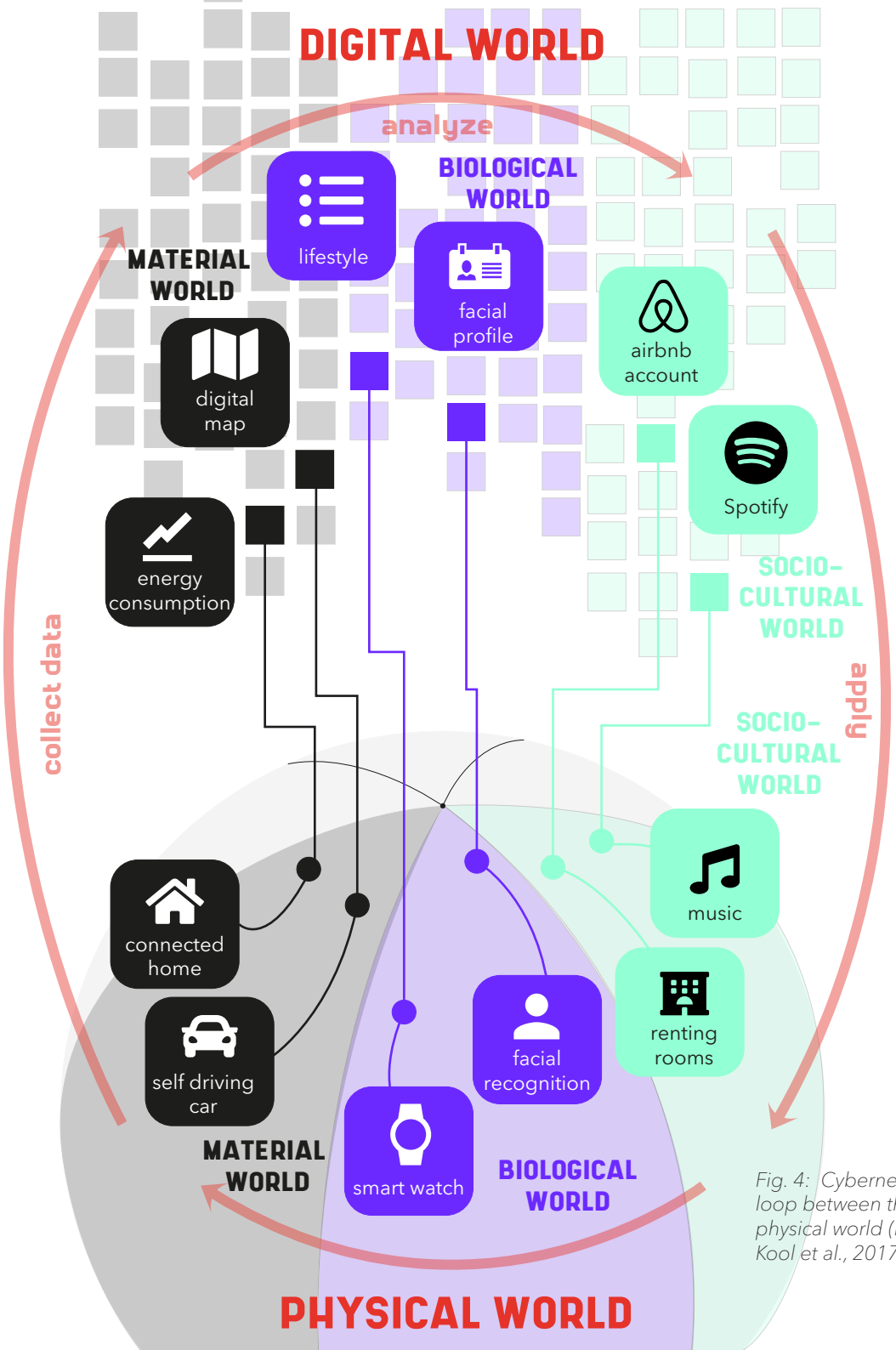


Fig. 4: Cybernetic feedback loop between the digital and physical world (based on Kool et al., 2017).

1.3.4 From data to big data

The ability to collect and analyze data from sensors and sensing components has dramatically increased, with over 90% of the world's digitized data was collected in the past 7 years (Al Nuaimi et al., 2015). Developments in the field of big data, smart algorithms and AI are indispensable elements in the digitization of society and together they create the digital world (Kool et al., 2017). Big data is key in the continuous feedback-loop because without collected data there is nothing that can be analyzed by algorithms or be used by AI to understand, monitor, regulate and plan the city (Kitchin, 2014).

1.3.4.1 The three V's

A reasonable definition of 'big data' has not yet been achieved, because it is seen alternately as a technological object, effect or capability. However, research has found characteristics that can be attributed to big data. These characteristics can also be described as: the three V's (Al Nuaimi et al., 2015; Fan & Bifet, 2013).

Volume

High in volume: refers to the size of data that has been created from all the resources.

Velocity

High in velocity: refers to the speed at which data is generated, stored, analyzed and processed.

Variety

Diverse in variety: refers to the different types of data being generated.

Other characteristics that can be attributed to big data are that the structure and meaning of data constantly changes (Al Nuaimi et al., 2015) and that it is relational in nature by conjoining different datasets (Kitchin, 2014). To sum it up:

big data consists of massive, dynamic, varied, detailed, inter-related datasets that can be connected and utilized in different ways.

1.3.4.2 Benefits and opportunities

Big data can make a contribution in creating the 'smart city' to be economically, environmentally and socially thriving. Big data analytics can achieve enhanced levels of sustainability, resilience, governance and improving the citizen's quality of life. Some of the benefits that can be achieved are the following (Al Nuaimi et al., 2015):

- Efficient resource utilization: many resources are becoming scarce or very expensive. Integrating solutions that give more control over how these resources are used is important.
- Better quality of life: with better and directed services, more citizens will have more efficient working and living methods that enhances their quality of life.
- Higher levels of transparency and openness: better management and control over all the smart city aspects is needed and sharing data will be the standard. The links in a heterogeneous information network can uncover surprisingly rich knowledge from interconnected data (Fan & Bifet, 2013). In this way more knowledge could be gathered and sharing data and open data is key for this.

Apart from the opportunities that big data brings, challenges and ethical issues can also be found. These will be explained in the next section.

1.3.4.3 Challenges and ethical issues

Data raises a number of concerns regarding its design, development and deployment for smart cities (Al Nuaimi et al., 2015) as well as other concerns relating to ethical issues (Kitchin, 2014). Key challenges of big data are identified and explained below.

CHALLENGES

Data sources and characteristics

Data is collected from many different sources and exists in many different formats. Most of the formats are unstructured and have to be managed and classified into a structured format to be analyzed and used (Al Nuaimi et al., 2015). Big data's characteristics such as volume, velocity and variety (Fan & Bifet, 2013) generate very complex models and approaches and make it hard to manage. It is difficult to analyze this data in an accessible way for applications to use.

Data and information sharing

Each government and corporation can have multiple departments that have their own data storage. Some of the data may be privacy sensitive and it is difficult not to cross the fine line between collecting and using big data and ensuring citizens' right of privacy (Al Nuaimi et al., 2015).

Data Quality

Several data quality challenges arise in the field of data collection. Data is collected by different entities and is rarely stored in standard formats and there is no universal way to retrieve and transform data into unified data that can undergo a useful analysis. Information gathered from analyzing data may therefore be untrustworthy or uncertain.

Cost

The implementation of data applications requires new systems, components or features to monitor and record information can be very expensive. If the project is not implemented correctly, it could negatively affect the city and replacing the hardware and software could be required to make the project work.

Smart city population

People affect and are affected by smart technologies and as the population grows, the size of collected data also grows. Smart technologies and big data need to evolve and adapt quickly to the systems in the city to generate better results.

Security and Privacy

Another challenge of using big data in a smart city is security and privacy issues. Databases may include confidential or sensitive information related to the government or citizens. They need high levels of security policies to protect this data from falling into the wrong hands. In the section below the main ethical issues that evolve around big data are explained.

ETHICAL ISSUES

Privacy

The potential combinations of different datasets and the re-use of data brings new challenges regarding privacy (Kool et al., 2017). It is often not clear beforehand which insights can be found from the collected data. These characteristics seem at odds with central pillars of the data protection regime, namely permission and purpose binding (Kool et al., 2015). If it is not clear what the goal of the collected data is and how this data can be combined to gather new insights, it is impossible to give a specific purpose and permission to use this data upfront. Another privacy challenge of big data is that when it is out there, it is practically forever. Sharing data is often irreversible.

Autonomy

Issues about autonomy start playing a part in the analysis and application of data. Online platforms play an increasingly greater role in determining what kind of information people get to see and don't see, based on the data collected from them (Kool et al., 2017).

Control

Algorithms and AI are used to automate the process of analyzing massive amounts of data. With the increasing speed and complexity of algorithms and computers it is difficult to understand what is really going on. This process is also described as a "black box", where it is hard to look into and understand how a decision has been reached, or to check for errors and correct these. Discussions have emerged

about the accountability and control over these automated systems and the choices that they make (Kool et al., 2017)

Justice

The automated systems that make choices are not flawless. Not only accountability is an issue here, but also discrimination and unjust exclusion can happen because of erroneous analysis. Self-learning systems, algorithms and AI can expand their knowledge based on biased assumptions and therefore profile people to put them in certain categories. Based on these categories an individual can be discriminated or excluded. Because of the black box process mentioned above it is hard to check for these judgements and also for an individual to object to the system (Kool et al., 2017). Combining this with the logic behind a system that is not transparent, it is hard to assert whether the system is wrong.

Balance of Power

The lines between government and business have blurred, which results in a shifting balance of power between businesses, governments and citizens. Governments are collecting more and more data about citizens and using this to steer and nudge them. Much of the online data that is collected is in the 'private hands' of companies and this information can be sold and resold (Kool et al., 2017). Also, corporate actors and technical experts from the private sector have been working to meet governments' demands by offering them a range of new surveillance technologies (Liang et al., 2018). This makes it more challenging to identify who is responsible for surveillance expansions and who has access to the collected data.

All of these values are closely related to fundamental human rights, but privacy certainly proves to be the most prominent issue in digitization technologies and big data (Kool et al., 2017). Several national and international organizations have even identified privacy as a key policy, regulatory and legislation challenges of the 21st century (van Zoonen, 2016).

1.4 PRIVACY

1.4.1 What does privacy mean?

Privacy is defined by Meriam Webster Dictionary as "the quality or state of being apart from company or observation" (Privacy | Definition of Privacy by Merriam-Webster, n.d.). In the 15th century this was probably a good definition, but nowadays it is a little bit more complicated than that (Raider, 2019).

Since the rise of the internet and global digitization technologies, many definitions to cover all the aspects of privacy have emerged. However, we are still lacking a widely recognized definition. Koops et al. (2017) proposes a typology of privacy that is more systematic and comprehensive than any model (see fig. 5). It can serve as an analytic and evaluative tool to help assess the impact of new technologies, social practices and legal measures on broader privacy interests (Koops et al., 2017). In this typology privacy is broken down into a two-dimensional model, consisting of eight basic types of privacy and one overarching privacy aspect: bodily (the integrity of the physical person), intellectual (typified by a person's interest in privacy of thought and mind, and the development of opinions and beliefs), spatial (individuals' interest in the privacy of their physical body), decisional (typified by intimate decisions, primarily of a sexual or procreative nature, but also including other decision-making on sensitive topics within the context of intimate relationships), communicational (a person's interest in restricting access to communications or controlling the use of information communicated to third-parties), associational (individual's interest in being free to choose who they want to interact with), proprietary (referring to property-based interests), behavioral (typified by the privacy interests a person has while conducting publicly visible activities) and informational privacy (overarching aspect of each underlying type, typified by the interest in preventing information about one-self to be collected and in controlling information about one-self that others have legitimate access to). The horizontal axis moves from the personal or completely private to intimate, semi-private, and public. The vertical axis is divided into two categories: negative freedom (being let alone) and positive freedom (self-development), according to which bodily, spatial, communicational and proprietary can be associated with negative freedom (being able to exclude others from these aspects), and intellectual, decisional, associational and behavioral privacy can be associated with positive freedom (self-development).

The overlay of informational privacy can be found in each of the eight ideal types of privacy, because a privacy interest exists in restricting access or controlling the use of information about that aspect of human life (Koops et al., 2017). So:

access to any information or data of an individual's life can harm that individual's privacy. That is why any type of personal data should be protected.

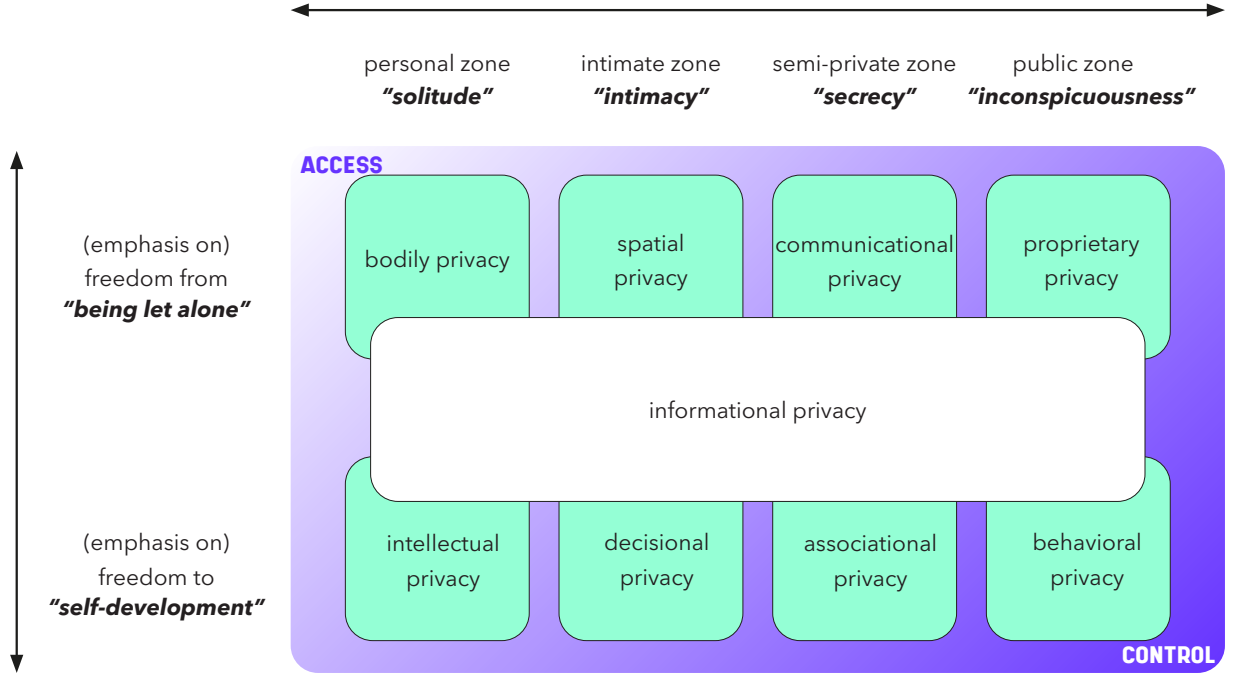


Fig. 5: A typology of privacy by Koops et al., 2017

1.4.2 Privacy concerns

Previous research on privacy by CLEVERºFRANKE found that the major concerns about data privacy are: discrimination (unfair treatment and exclusion), loss of autonomy (in the research it is described as deindividualization) and confrontation with unwanted information (PRIVACY LABEL — Part I: The Privacy Illusion | by Jeremy Raider | Sensor Lab | Medium, n.d.). The concerns are that, based on personal data, the individual can be treated unfairly or be excluded (for example: not being invited for a job interview because they have a different skin color), is not able to make his or her own choices (for example: targeted advertisements determine what the individual sees) and is confronted with information that he or she did not even know or wanted to know (for example: a women gets advertisements about babies, because the combination of different datasets of her give a clear indication that she could be pregnant).

1.4.3 Aspects that influence privacy concerns

There are three aspects about data that influence people's concerns about privacy: the type of data collected, the purpose and use of that data collection, and the identity of the organization or persons collecting and using that data (van Zoonen, 2016).

Personal data

The definition of personal data described by the GDPR is as follows: any information relating to an identified or identifiable natural person ('data subject'); an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person (What Is Considered Personal Data under the EU GDPR?, 2019). Impersonal data is information that does not directly or indirectly relate to a specific individual, such as the counting of passengers. Personal data touches more on the privacy aspect of big data than impersonal data does. For example, when your health insurance provider collects information about your medical files it can be considered an invasion of your privacy. However, if your health insurance provider would get information about major health issues with the general population in your city it cannot be directly linked to you or any of the individuals that are part of that data. However, both contain valuable information for health care insurance providers to improve or adapt their offers to customers (van Zoonen, 2016).

Service or surveillance as a purpose

When data is collected, people assess for which purpose this data is used and weigh the benefits that providing their data may offer them (van Zoonen, 2016). A trade-off is made between the amount of data asked for and the benefits that are received by providing it. When too much data is asked it can feel more like being surveilled rather than being serviced. A complication of this trade-off is that the data that an individual provides can be used for other purposes than they were originally collected for or that their data is shared with third parties. This makes it harder to assess the benefits and disadvantages that providing this data would bring.

Who collects data?

Another aspect that influences people's privacy concerns depends on who is collecting and using their personal data. For example, banks and medical organizations are trusted the most across Europe with their data, while internet companies including social media are on the lowest end of the spectrum(van Zoonen, 2016).

1.4.4 No such thing as a privacy paradox

Every person may have a different opinion about what privacy means to them and when it is violated. That said, every person has concerns about their privacy (Waldman, 2020) even if people's actions may not always cohere with their concerns. Some services offer good data protection and provide the option that consumers' data will not be used for commercial goals, but this is often not viable to put on the market just for free. Consumers have to pay to secure their data from being sold for commercial purposes, but it turns out that only a small number of consumers is willing to do so (Hoogeveen et al., 2018). Research shows that the more personal information people share on social media, the more privacy they said was desired (Chaudhry et al., 2015). Despite people clearly expressed concerns about their privacy, there is a lack of appropriate secure behavior. This phenomenon is called "the informational privacy paradox" or "privacy paradox" in short (van Zoonen, 2016). The paradox implies that people are dissatisfied about what they receive in return for sharing so much of their information online, but they continue to share personal information about themselves because they are afraid of being left out or judged by others (Chaudhry et al., 2015). It is not considered a true choice to withhold or withdraw completely from all online activity to protect one's privacy.

However, according to research the Privacy Paradox is a complex phenomenon (Kokolakis, 2017) and may even be described as a myth (Waldman, 2020). The paradox is based on rational disclosure and many assumptions of human decision-making which are based on the rational-actor disclosure model are debunked by behavioral economists (Waldman, 2020). Privacy behavior is a phenomenon that is highly context dependent and therefore we should not expect individuals to have the same behavior in different contexts (Kokolakis, 2017). More recent studies identified that individuals do not make rational disclosure decisions online and that a rational choice model triggers bigger cognitive processes that encourage individuals to give up and give away control over their privacy (Waldman, 2020).

Even if these biases did not exist, there are still the limitations imposed on individuals by design (Waldman, 2020). It is long recognized that design of the built environment constraints human behavior and the same goes for online behavior. Technology companies use manipulation in the form of 'dark patterns' in interface design. These can be described as "instances where designers use their knowledge of human behavior (e.g., psychology) and the desires of end users to implement deceptive functionality that is not in the user's best interest" (Gray et al., 2018). These are used to not only constrain users, but also to coerce personal information disclosure and trigger cognitive and behavioral biases that let the user give up control over their own privacy (Waldman, 2020).

CONCLUSION CHAPTER

The goal of the literature research in this chapter was to understand the scope of a smart city and the privacy consequences that data collection can bring to an individual's privacy because of the emerging smart technologies. I discovered that the smart city, data, big data and privacy are difficult terms that do not have a widely recognized definition. However, I found common grounds for these terms: a smart city can be described by six pillars, data and big data have different values and concerns for citizens, companies and governments and are situational dependent, and access to any information or data of an individual's life can harm that individual's privacy. Therefore, any type of personal data should be protected.

2

DEFINE

In this chapter the main problems of data privacy in the smart city found in previous literature are highlighted. A more individual view on these problems is expressed through a survey, leading to a problem definition. After that the design goal and sub-design goals are presented as a solution to the problem and the approach and Interaction Vision (IV) help to set the boundaries of the design.

2.1 MAIN PROBLEMS OF DATA PRIVACY

Everything we do in our lives leaves, or will soon leave, a digital trace, which can be analyzed. This mass of data collection can help us to analyze all sort of things, including peoples' behavior and needs. This analysis can be used for positive ends, but it can also be used against people. It is clear that data collection, analysis and application can have serious impacts on the privacy and liberty of an individual with infringing consequences. In the next section the 7 main problems found in data privacy in the smart city will be explained.

2.1.1 Privacy policies are not keeping up

Rapid digitization is happening all around us. Concerns about digitization for essential public and private values are justified and policies are not keeping up (Kool et al., 2017). There is wide agreement that government policies play a critical role in fostering smart cities (Meijer & Bolívar, 2016), but there is little attention to 'politics of city data' (Kitchin, 2014). To safeguard essential public values, the governance landscape needs to be substantially strengthened at several societal and ethical aspects of digitization (Kool et al., 2017).

2.1.2 Invisible technologies

The physical and digital world are becoming more and more intertwined. It is difficult to be aware of the data that is collected during our everyday life, because of the invisibility of sensors and sensing technologies. The technologies used to collect data in the physical world are physically invisible, because they are intangible or hidden in the city landscape and people no longer notice their relationships and interactions with them (Sadowski & Pasquale, 2015). The processing unit and authorized entities in the information world also steer the physical world in ways that are functionally and/or physically invisible. Few people know about surveillance technologies, data collection and data brokers for instance. However, most of us 'consent' by default for most technologies, because not using Google Maps, your smartphone or living in a populated area are hardly even considered real choices to most citizens. The invisibility of the technologies contributes to invisible data collection and the consequences that can harm citizens' privacy.

2.1.3 The right to be forgotten is lost

Sometimes an individual shares information online to make use of a service such as getting directions based on their personal information, preferences and driving history. It is logical to think that some individuals might change their mind about sharing this data with that service provider and they want to have their data deleted form the provider's database. An individual's request of deletion of their personal data or account may be in conflict with a data collector's interest, thus it is important to have legal or regulatory means to grant individuals' control over their personal data. The GDPR is a regulation adopted in 2016 by the EU, that aims at protecting the data and privacy of individuals in the EU (Garg et al., 2020). The GDPR states that "the data subject shall have the right to withdraw his or her consent at any time". And article 17 states that, "The data subject shall have the right to obtain from the controller the erasure of personal data concerning him or her without undue delay and the controller shall have the obligation to erase personal data without undue delay" (Garg et al., 2020). It seems that the individual has the right to be forgotten, but this is not as straightforward as it sounds. Deleting your own personal data from a provider's database can be described as a scavenger hunt, where privacy choices and data deletion are often difficult for users to find and use (Habib et al., 2020). Next to this, the regulation does not precisely define what it means to delete something and it suggests that it is sometimes reasonable to preserve the result of processed versions of that personal data, that often contain all or most of the original data, even if that personal data is requested to be deleted (Garg et al., 2020). Another problem can be that the personal data collected is shared with or sold to third parties. This would make deleting or retrieving that personal data very tricky and almost impossible. Although, an individual has the right to be forgotten, in reality this is not as easy as it looks and sharing personal data is often irreversible.

2.1.4 Blurred lines

Data collection, analysis and use in the smart city is not done by one institution, but it is rather complex. Technical companies from the private sector are working together with governments to provide them with a range of new technologies (Liang et al., 2018). Data collected by these technologies are then available for both the government and the private corporation, and this data can also be sold and resold again to other companies or institutions (Kool et al., 2017). This raises questions about who collects, who owns and who is responsible for what data. The same applies to local governments making data available to the wider public to be more transparent in its data collection (van Zoonen, 2016). Who can be held accountable for what happens with that data or what effects the usage of that data bring? The lines have blurred between private and public sectors on the fields of data collection, usage and responsibility, and this raises issues about who has legitimate access. This makes it difficult to create laws and legislation for protecting data privacy of individuals and hold someone accountable if privacy violations do happen (van Zoonen, 2016).

2.1.5 Data is opaque

Data differ in size, purpose, complexity, ownership, visibility and other aspects. In cities an overview of these different data collection and streams is missing (Meijer & Bolívar, 2016) and it is not always clear for what goal certain data is collected. Databases can be mined to discover previously unknown facts and patterns that hold valuable information. Data mining relies on correlations that arise from the application of algorithms to large collections of data (Rubinstein, 2013). The extracted information can be used as horsepower to fuel profiling techniques to make interesting predictions, some of which may benefit society or individuals, but others may be more problematic on the fields of privacy (Rubinstein, 2013). The outcomes are not only unpredictable, the entire process is a black box. It is hard to look into the process and understand how a decision is being reached, or to find errors and correct these (Kool et al., 2017). The accountability and control over these automated systems is difficult and therefore it is hard to oversee the consequences that it has for data privacy.

2.1.6 Cognitive biases and dark design

Some argue privacy is the primary concern in digitization (Kool et al., 2017) and it is something that many people care about (Waldman, 2020). Although privacy paradox research provides contradictory results (Kokolakis, 2017) and to some it is considered a myth, cognitive and behavioral biases to rational privacy and disclosure decision-making have been identified (Waldman, 2020). These biases limit the individual's ability to acquire all relevant information and translate it into an evidence-based decision. What makes it even more difficult is that technology companies make design decisions that are not only built to constrain users, but to make it difficult to realize their privacy preferences. The design forces the user to disclose personal information and trigger these cognitive biases that ultimately encourages users to give up and give away control over their privacy (Waldman, 2020).

2.1.7 Citizens are unaware, uninformed and uninterested.

As stated before a more socio-technical view on smart cities is needed, where citizens play a bigger role in designing and creating the smart city (de Waal & Dignum, 2017; Hemment & Townsend, 2013; Meijer & Bolívar, 2016; Oliveira & Campolargo, 2015). However, actually engaging citizens in smart urban governance is immensely challenging (Hemment & Townsend, 2013). Smart cities are not really understood outside the circle of specialists, but without engaging citizens with the role that technologies in their cities play in their lives the smart city will fail (Hemment & Townsend, 2013). Previous research of CLEVER°FRANKE found that citizens have a lack of interest in smart city technologies and are not well informed or interested to engage in these processes. If cities truly want to benefit from the smart city technologies, they need to start a discussion with their citizens on how this could influence their lives in a positive and negative way (Hemment & Townsend, 2013).

2.2 SURVEY

It is interesting to know what citizens consider data privacy to be able to start a discussion on the influence of smart city technologies. Therefore, an online survey is conducted to generate more individual views of citizens on data privacy and aspects that influence privacy concerns in the smart city. This survey provides insights in what citizens consider personal data and in what situations they are willing to share personal data, despite not being well informed or engaged in smart city technologies and their impact. In this survey respondents are questioned about what type of personal data they consider private and in what situations they would agree to share their personal data.

2.2.1 Setup

For 10 days an online survey was released. The survey is written in Dutch to lower the threshold for Dutch people to fill it in. On the first page of the survey I stated that it takes approximately 8 minutes to complete the survey and that the results will only be used for research purposes (see appendix C: Survey questions English).

2.2.2 Content

The questions in the survey are based on the literature research in chapter 2. The first question is about what kind of data is considered personal and how important it is for the respondent that they and only they give permission to have access to that specific personal data (Q1) The second question is about what kind of situations respondents would accept or not accept to share their personal data and to see if the purpose and the actors have an influence on that (Q2). For readability of this thesis the survey is translated into English, the Dutch version can be found in the appendix (see appendix D: Survey questions Dutch).

Q1: How important is it to you that only you and the one you give permission to have access to your … [personal data]…

This question is about what data is considered personal for individuals. The GDPR makes a distinction between 'personal data' and 'sensitive personal data' (see fig. 6). According to the GDPR 'sensitive personal data' should be handled with more security, because this data can be more harmful to an individual's privacy (GDPR Personal Data – What Information Does This Cover?, 2020). This distinction is used in a brainstorm to identify a list of personal datapoints (see appendix E: GDPR personal data study) and the outcome is used in this survey (see below). A total of 34 different sorts of personal data (online and offline) have been identified. The answers are given based on a five point Likert Scale (Boone & Boone, 2012), 1 being least important and 5 being most important.

'Personal data' definition under the GDPR:

> ***The basic definition of personal data is any information relating to an identified or identifiable natural person (data subject).***

'Sensitive personal data' definition under the GDPR:

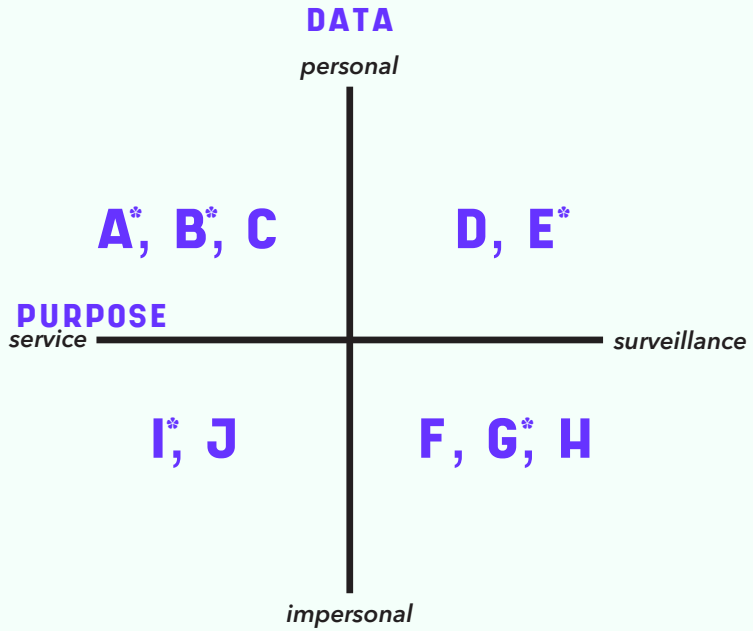
> ***data consisting of racial or ethnic origin, political opinions, religious or philosophical beliefs, or trade union membership, genetic data, biometric data, data concerning health or data concerning a natural person's sex life or sexual orientation.***

Fig. 6: Definitions for personal and sensitive personal data according the GDPR

Q2: In which situations would you accept that your (personal data) would be used?

This question is based on the aspects that influence privacy concerns (section 2.4.5) of personal vs. impersonal data, service vs. surveillance as a purpose and government vs. companies as actors (see fig. 7) (van Zoonen, 2016). Respondents are asked if they accept, not accept or are not sure if they accept to use their data in the presented situation. Everyone of the 10 situations can be placed within the framework presented by van Zoonen et al. (2016). The framework consists of four quadrants, where the bottom left hardly any concern is raised about privacy (impersonal data and service as a purpose) and in the upper right controversy about privacy is raised (personal data and surveillance purpose). The other two quadrants (upper left: personal data and service as a purpose and bottom right: impersonal data and surveillance) are the two that are interesting to look at. These two quadrants are where most participants make trade-offs between the benefits they get out of providing data or not (van Zoonen, 2016). Each of these two quadrants therefore has one more situation in the survey to better compare results.

For each of the situations an actor (government or company) is added to compare this aspect influences privacy concerns. Each quadrant has at least one government actor and one company actor. Only the bottom left quadrant has no actors attributed to the situation, because hardly any privacy concerns are raised. The goal is to get insights into what kind of data (personal or impersonal) respondents are willing to share in different situations and to see if that relates to the purpose (service or surveillance) of that collected data.



* *Governmental actor*

Accept:
The respondent agrees with sharing that type of data for that purpose.

Not sure:
The respondent does not agree or disagree with sharing that type of data for that purpose.

Not accept:
The respondent does not agree with sharing that type of data for that purpose.

Fig. 7: Framework survey Q2, based on van Zoonen et al., 2016

SITUATIONS

A. Fitness tracking app makers sharing user data with medical researchers to better understand the link between exercise and heart disease

B. Google Maps sharing users' locations with companies so they can offer more personalised advertisements

C. Government monitoring and responding to posts on social media platforms to communicate with their citizens and improve quality of life in the city

D. The government collecting CCTV data about citizens to use facial recognition to assess potential terrorist threats

E. DNA testing companies sharing customers' genetic data with law enforcement to help solve crimes

F. Government using WiFi beacons to count passengers in order to control crowds during big events

G. Companies that use person tracking on customers to see how they behave in stores

H. Government gathering data from neighbourhoods about income, households and vacation days to predict burglaries

I. Companies measuring air quality with sensors on shared bikes to map out the more polluted places in cities

J. Government placed interactive signs that direct bikers towards available places in bike parkings where sensors are used to count the empty spots.

2.2.3 Results

Over the course of 10 days, 111 people responded (see appendix F: Survey results). The results for Q1 and Q2 are explained below.

Q1: How important is it to you that only you and the one you give permission to have access to your … [personal data]…

Out of all the datapoints respondents' 'bankaccount' and 'medical files' are considered to be the most important personal data to keep private (see fig. 8). Datapoints from 'online shopping behavior' to 'bankaccount' are labelled as important to very important and will probably be shared less easily by individuals. 'Apps and programs used' to 'date of birth' are deemed neutral to important when it comes to sharing that data. Whereas 'marital status' to 'gender' are considered not so important to neutral personal datapoints to keep private. It is interesting to see that the datapoints that are labelled 'sensitive' by the GDPR (see fig. 6) are mostly seen as less important than other datapoints according to the respondents. The reason for this could be that 'sensitive' datapoints are shared regularly by individuals to identify themselves at institutions or platforms for example, and that could make them less aware of the sensitivity of these datapoints.

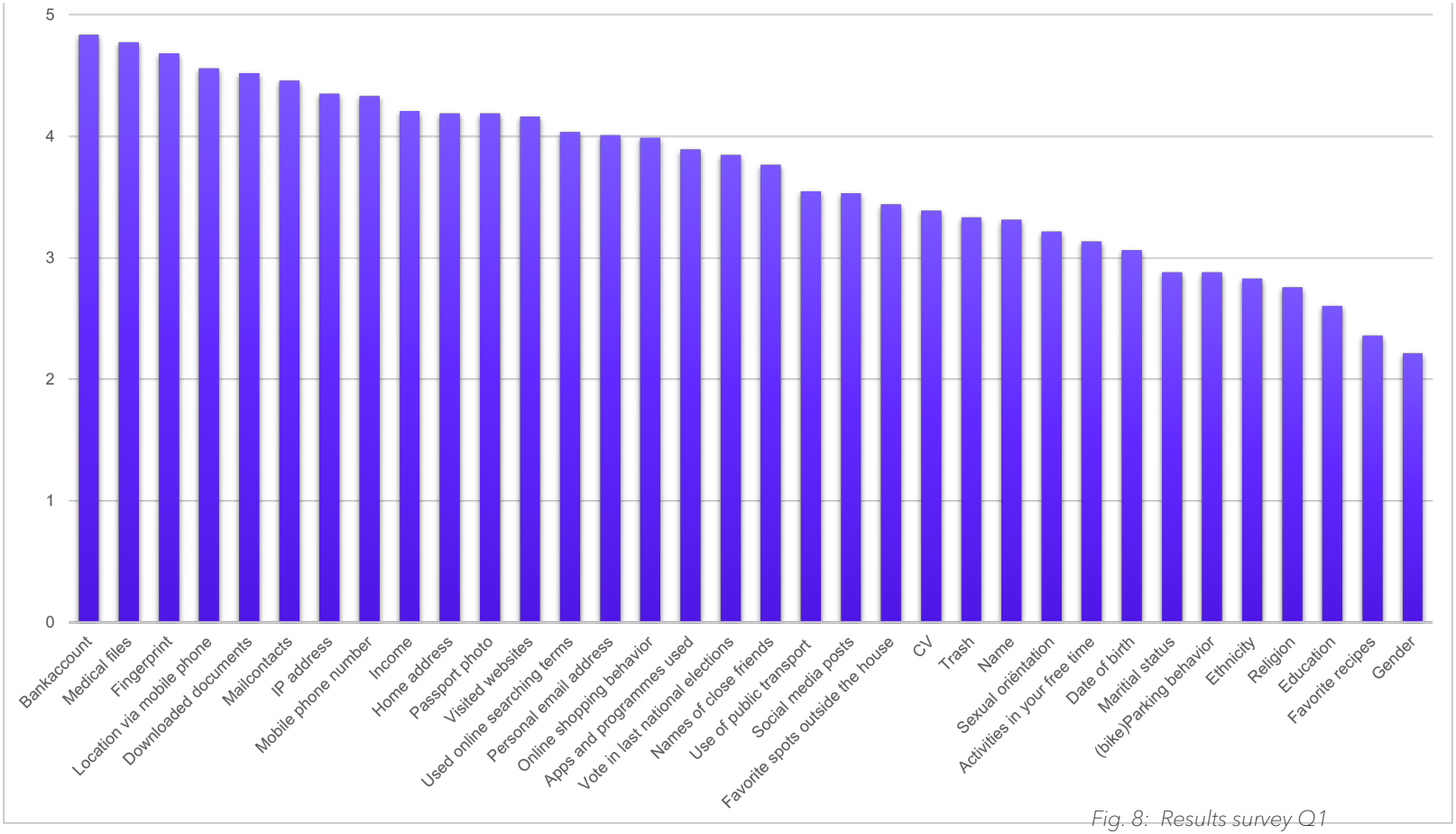


Fig. 8: Results survey Q1

Q2: In which situations would you accept that your (personal data) would be used?

As expected, the situations in the bottom left quadrant (impersonal data for a service) were accepted the most to use respondents' data (Situation I and Situation J) (see fig. 9 & 10). A result that was not expected was that the top right quadrant situations (personal data for surveillance) were acceptable to use respondents' data (Situation D and Situation E). According to van Zoonen et al. (2016) this is where concerns about privacy are raised most and therefore it was expected that the situations would not be accepted by the respondents. The reason for this could be that the presented situations are not solely for surveillance as a purpose, but have a greater purpose of providing safety and security for citizens. The respondent also benefits indirectly from this greater purpose and therefore respondents accept that their personal data is used for surveillance. When

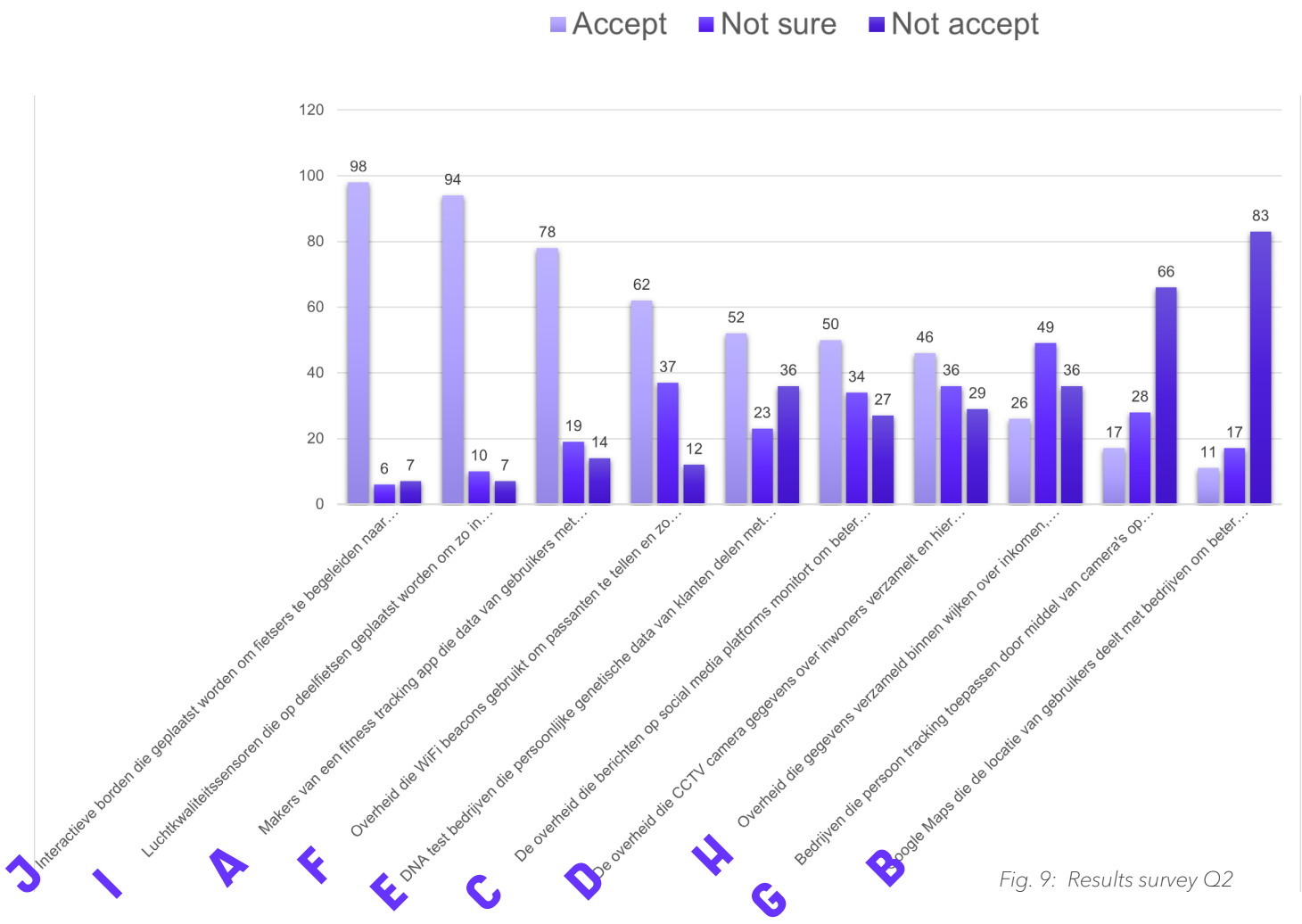


Fig. 9: Results survey Q2

we look at the bottom right quadrant (impersonal data for surveillance), two of the three situations are not accepted to use respondents' data. For the top left quadrant (personal data for service), two out of the three situates were accepted. It is interesting to see that these two quadrants have more diverse outcomes than the other two quadrants. This shows that the relation between the two aspects of that quadrant (personal data for a service & impersonal data for surveillance) do not have the same acceptance in every situation. Results show that three of the four situations where the government is actor are accepted and one of the four situations is not accepted. As for two out of the four situations are accepted for companies as actor and two out of the four are not accepted. This shows that data used by the government as actor are slightly more accepted than data used by companies as actor. However, these results have such a small significant difference that they are not taken into account for further design.

2.2.4 Conclusions

It is less important to citizens that only they and the one they give permission to have access to their sensitive personal data than personal data, while the GDPR states that sensitive personal data should be handled with more security because it could be more harmful for an individual's privacy. Another conclusion is that citizens have the most diverging opinions for situations where personal data is shared for a service and aspects that influence their privacy concerns are have more impact in these situations. These insights are the basis for the problem definition in the next section.

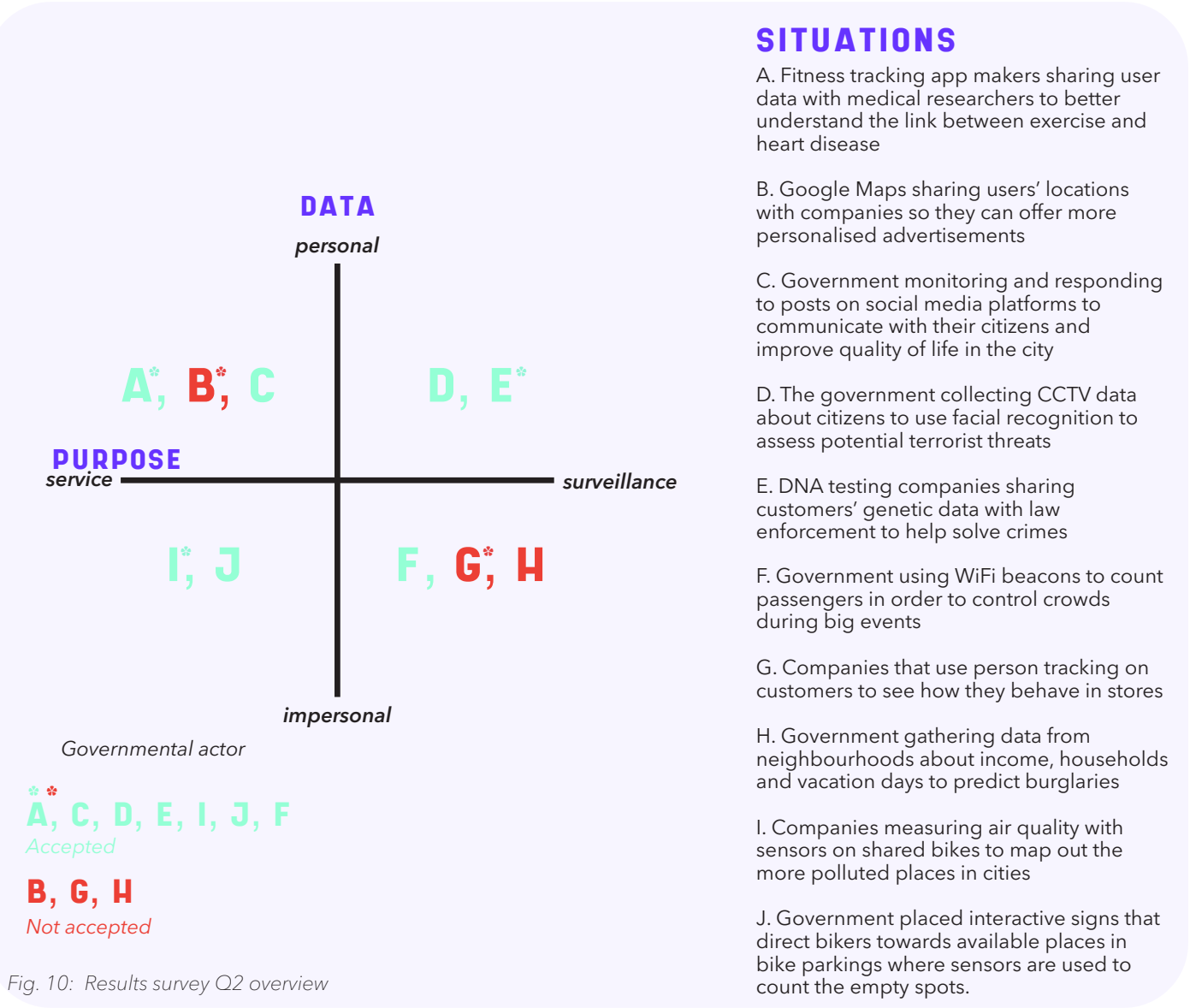


Fig. 10: Results survey Q2 overview

2.3 PROBLEM DEFINITION

The following problem definition attempts to capture the main problems found in the research above:

"Citizens are insufficiently aware of how personal data collected by smart city technologies could affect their privacy."

The problem starts with citizens being not aware of their data privacy and the negative consequences that it may bring. With them being more aware and making deliberate choices about sharing their data, the first step in secured privacy policy making is taken. Because, secured privacy policies cannot be made without knowing how citizens want to be protected.

2.4 DESIGN GOAL

From the conducted literature the design goal was set. The design goal will be the starting point for idea generation in the next chapter.

"Designing a tour that enables citizens of Utrecht to critically reflect on the collection and use of their personal data and its privacy consequences within the smart city."

This research addresses this lack of awareness by enabling citizens of Utrecht to explore, on the one hand, the benefits of Smart City technologies and, on the other hand, experience the consequences of sharing their personal data in terms of privacy. The design goal was formulated to hold on to while designing and to address the effect that the final concept design must achieve.

The design goal can be divided into three sub-design goals that each highlight a different aspect of critical reflection on personal data and privacy:

A. "Designing a tour that enables citizens of Utrecht to critically reflect on *personal data collection within the smart city and its technologies*".

B. "Designing a tour that enables citizens of Utrecht to critically reflect on *the use of personal data and its privacy consequences*".

C. "Designing a tour that enables citizens of Utrecht to critically reflect on *their own behavior of sharing their personal data*".

2.4.1 Why Utrecht?

Utrecht was chosen as the site for the design. The first reason is because CLEVER°FRANKE is situated in Utrecht and one of the design requirements that they set was to make a design for citizens of Utrecht. The second reason is that Utrecht is one of the fastest growing cities in the Netherlands and many smart city technologies from all smart city pillars are implemented to manage and improve the city (see appendix interview and smart city technologies Utrecht list).

2.4.2 Why a tour?

Another design requirement from CLEVER°FRANKE was to design a physical tour through Utrecht. Next to that requirement, a tour was chosen as a may to help citizens better explore the smart city technologies for themselves in the context that it takes place in. This helps the citizen to better understand and experience the highlighted problem.

2.4.3 Why an app?

Most personal data is collected by people using screens, and especially their smartphone (Personal Data Collection: The Complete WIRED Guide | WIRED, n.d.). Software of the device itself or apps installed on it collect, analyse, use and sell this data and most of the time users are not even aware of this happening. I have chosen to design an app because almost all citizens of Utrecht have smartphones and this is a benign way of collecting data from an individual.

2.4.4 Target group

With Utrecht being the focus point, the target group is all citizens of Utrecht. The highlighted problem concerns all citizens equally, thus no smaller selection is chosen as a target group.

2.5 APPROACH

In this research the critical design approach developed by Tony Dunne and Fiona Raby (Dunne & Raby, 2013) will be used, whose goal is to push design beyond strengthening values of consumer culture and instead implement cultural critique in designed objects (Sengers et al., 2005) (see fig.11). The Critical Design approach is not focused on serving needs, but on provocation (Bardzell et al., 2012), and its goal is to challenge what is normal in a society and to provoke public debate (Johannessen, 2017). Within this design practice, the design will act as a form of critique on the social and political problem that will be experienced by questioning technology (Malpass, 2015).

2.5.1 Problem finding rather than problem solving

Critical design is used because this approach focuses more on problem finding than problem solving. The problem stated in the problem definition will be communicated through the design to citizens of Utrecht and they are provoked to think critically about it. The goal is not to give them a solution, but to alert them to the presence of the problem and let them form their opinion on the matter.

2.5.2 Critical reflection

In this project critical reflection is seen as: "bringing unconscious aspects of experience to conscious awareness, thereby making them available for conscious choice" (Sengers et al., 2005), which may lead to changes in personal understandings and potentially behavior (Lucas, 2012). Critical reflection provides means to gain awareness and raise concern about the collection and use of personal data and its privacy consequences in the smart city. This will lead to the desire to know more about the social implications of the technologies we build and finally find a way in changing behavior by imagining alternatives of how to manage data privacy in the smart city.

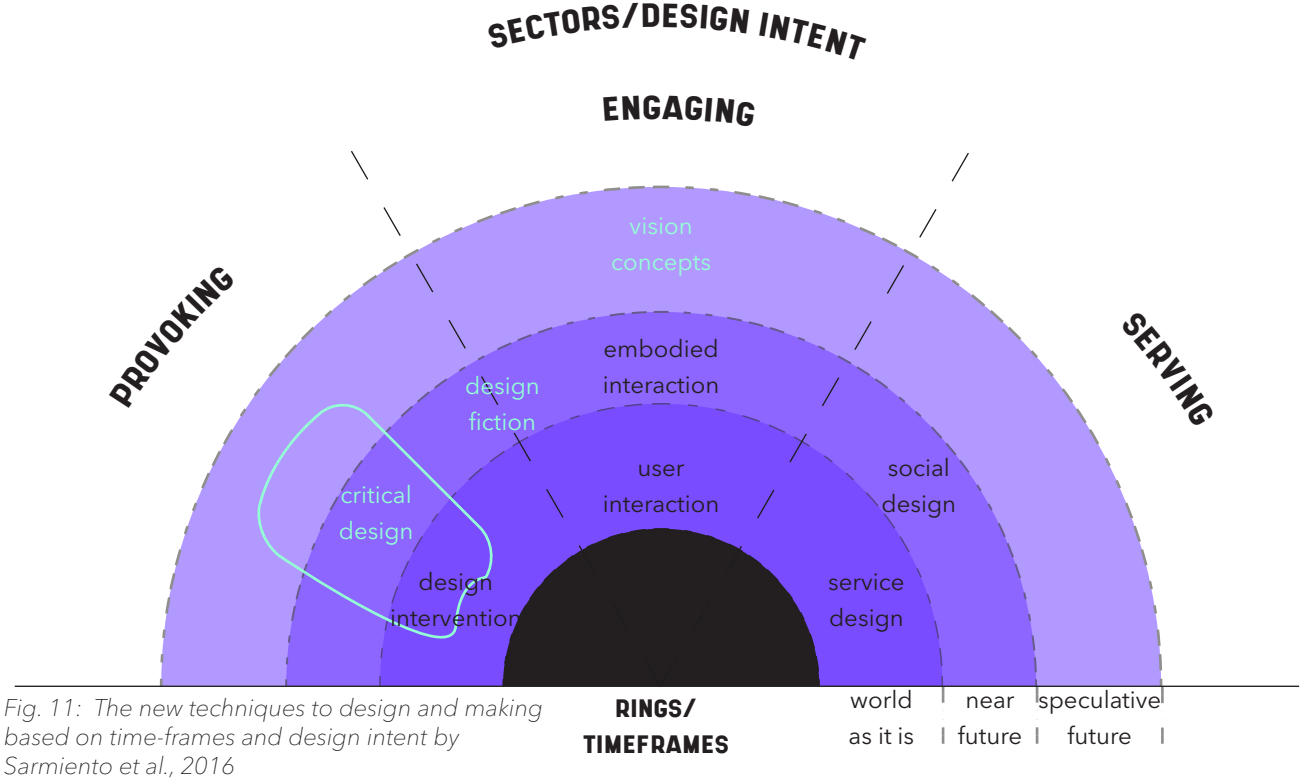


Fig. 11: The new techniques to design and making based on time-frames and design intent by Sarmiento et al., 2016

2.6 INTERACTION VISION

To help with designing an interaction vision (IV) is created. This vision is borrowed from the Vision in Product (ViP) approach and it suggests using a metaphor of an alternative situation to describes the desired interaction of the user with the product (van Boeijen et al., 2014). This metaphor enables the designer to guide the design in the right directions by using interaction qualities. These qualities describe what the desired interaction should be like and help to see what choices should be made and what ideas to leave out.

I conducted a brainstorm on thinking of a metaphor that describes the desired interaction based on the design goal (see appendix G: Interaction Visions). One of these metaphors is selected based on the criteria of encompassing a benign experience at first that later leads to a reflection moment at the end:

> ***"Getting help from the Microsoft Office Assistant 'Clippy' to make it easier to use the program Word"***

'Clippy' is the unofficial name for the world-famous paperclip introduced by Microsoft Word in 1996. It is a virtual Office assistant that was designed to help Office users with different projects and their word processing skills. He would pop up unsolicited when its algorithm determined that the user needed help (see fig. 12). The first time this happened, users may have been amused and agreed to be helped. However, when time progressed Clippy would increasingly interrupt by offering his help that led to the user getting irritated and de-installing the word assistant (The Tragic Life of Clippy, the World's Most Hated Virtual Assistant | Mental Floss, n.d.).

ATTRACTIVE

Clippy seems most helpful and that could benefit the process of writing the thesis.

ENGAGING

The tips that Clippy gives are helpful and desired and make the thesis better.

CONFRONTING

Clippy keeps popping up unwanted and at inconvenient moments.

THOUGHT-PROVOKING

Clippy is interrupting too often and it does not benefit the thesis writing at all. I am questioning if I would agree with him helping me next time.

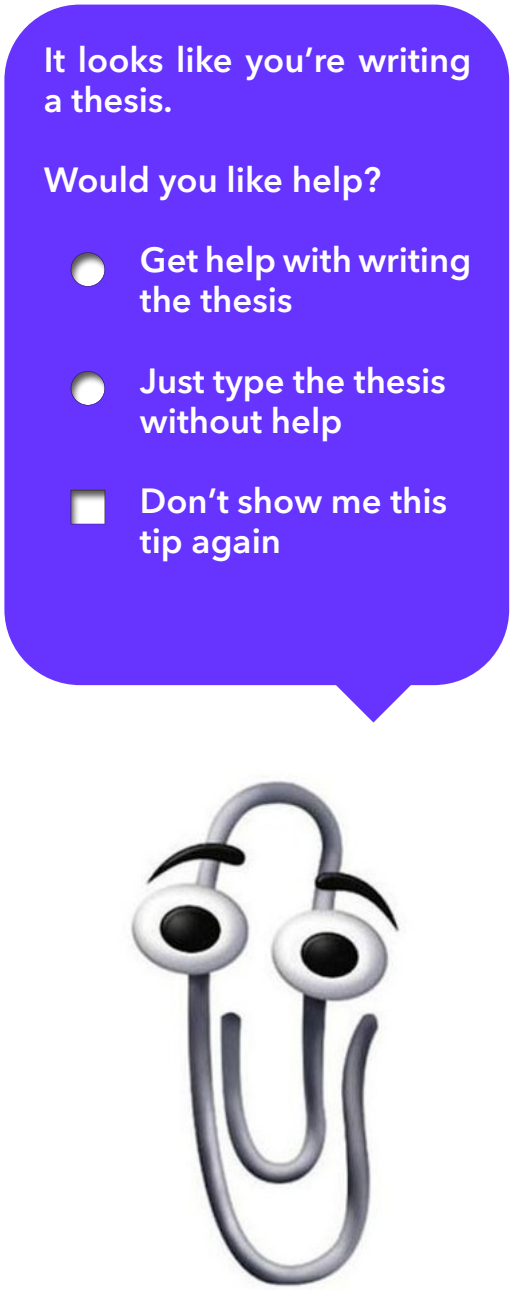


Fig. 12: An example of a pop-up from Clippy

The interaction designed in this project should feel like the experience that Clippy brings. At first, a positive and personal introduction should help attract the user. When the user is getting information about smart city technologies and shares his personal data, he becomes more engaged with Utrecht as a smart city and the benefits that these technologies could bring for him. Secondly, at the end of the tour a big reveal that shows the other side of these smart city technologies and confronts the user with privacy consequences. This confrontation should, just like Clippy, be intrusive. At the end of the experience the user should criticise what had happened and form his opinion about the situation. Then the user is able to critically reflect on the interaction and learn from it in next likewise situations where data is asked in exchange for a service. This design shows the two sides of smart city technologies and data collection. It is not the goal to create a utopian or dystopian view on the topic, but rather to let the user experience both sides to let them critically reflect on it and use this in next likewise situations.

ATTRACTIVE

At the beginning the smart city technologies should attract the user to want to do the tour and explore the technologies.

ENGAGING

During the tour the user should feel engaged by the benefits that the smart city technologies bring for him so he shares his personal data.

CONFRONTING

At the end of the tour the user should be confronted with the possible privacy consequences of sharing his personal data.

THOUGHT-PROVOKING

After the tour the user should be provoked to think about the choices he made between sharing personal data for a service and the possible privacy consequences.

CONCLUSION CHAPTER

The goal of this chapter was to define the main problems of data privacy in the smart city. The results of the survey gave a more individual view on these main problems and showed that sensitive personal data as stated by the GDPR are not considered as important by individuals. It can also be concluded that personal data collected for a service has a different acceptance rate in different situations. These findings and the findings from chapter 1 formed the basis for the problem definition, the design goal and sub-design goals. Together with the critical design approach and Clippy as the interaction vision the design in the next chapter can be guided in the right direction.

3

DEVELOP

The develop stage starts by determining the design space. From this design space it will be more clear what design decisions need to be made and design questions can be formulated. Next, knowledge and insights from the literature study are used to generate ideas to answer these design questions, using the design goal and IV qualities as guidelines. After that, the ideations are then developed further and are tested through iterations to validate the design decisions for each design question. Finally, results of the design questions are combined into the final design concept which will be presented in the next chapter.

3.1 DESIGN SPACE

The design goal and IV qualities help to guide the design process. All of the decisions that were already made that help to frame the design space can be seen in this overview. From this overview it will become clear where design decisions have to be made and design questions can then be formulated (see fig. 13).

Tour with intro, midsection and reveal
Attracting the participant to want to explore the smart city technologies. Let the user engage with the technologies and get him to share his personal data. And finally confront the user with the possible privacy consequences of his personal data.

Tour
It was already established that the tour would take place in the context of the city to help the user better understand the highlighted problem (see section 2.4.2).

App based
The choice of designing an app has also been established already, to make the connection with digitization in the smart city (see section 2.4.3).

6 pillars, 6 stops
To cover all of the smart city and its technologies 6 stops will stand for the 6 smart city pillars that are defined in the literature review. Each of these stops will highlight one of the smart city pillars and a technology in that field.

Service
Personal data is collected during the tour and a service is offered to the user. (see section 2.2.4).

Dutch
The tour will be created in Dutch, because that is the language that most people of the target group speak (see section 2.4.4).

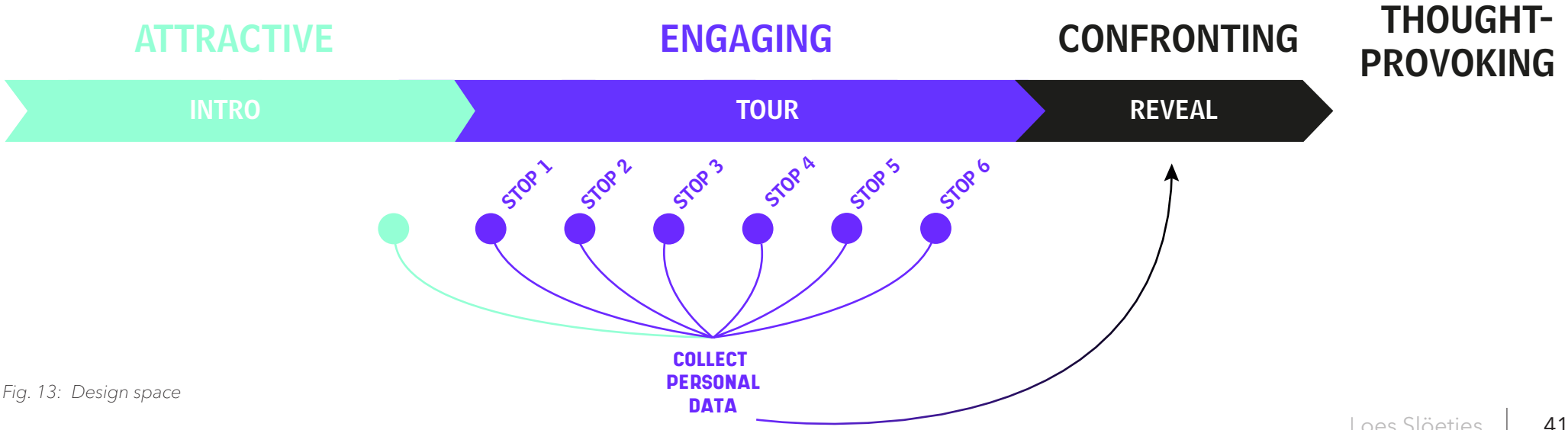


Fig. 13: Design space

3.2 DESIGN QUESTIONS

The design space allows us to see what still needs to be designed. In the overview five areas are highlighted where design decisions still have to be made. These areas have been translated into design questions (see fig. 14).

In the next section these design questions will be answered by ideations and iterations to validate the outcomes of the design questions.

1 What is the ***narrative***?

2 What ***smart city technologies*** are explored?

3 What are the ***geographical touchpoints***?

4 What ***personal data*** is collected and when?

5 What is the moment of ***reveal***?

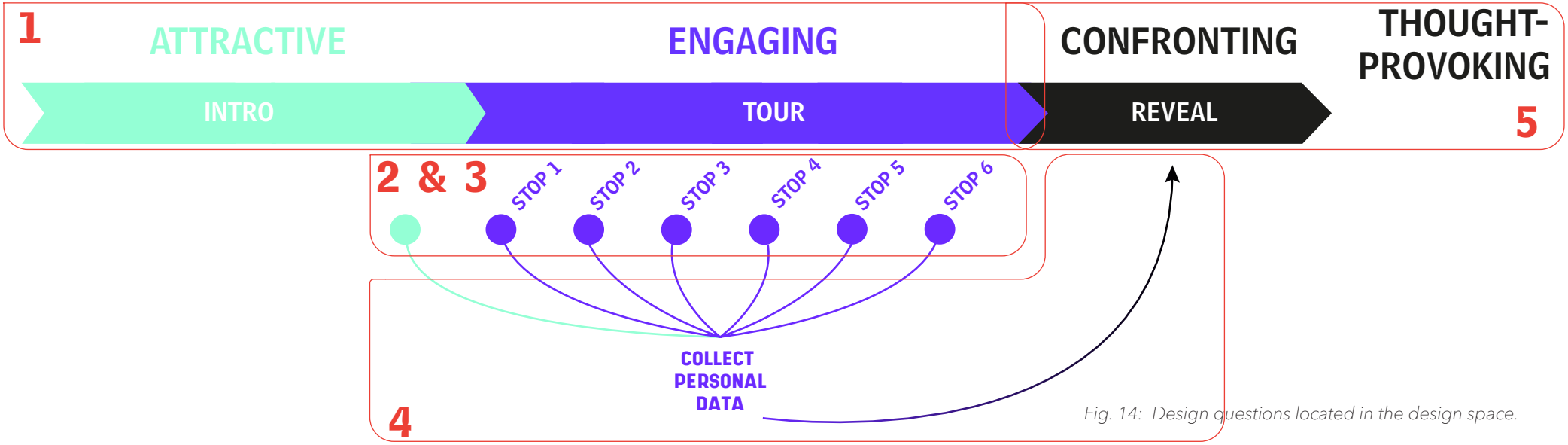


Fig. 14: Design questions located in the design space.

3.2.1 What is the narrative?

The narrative should be the introduction of the tour with a promise of what the tour entails, as decided in the design space. This should attract the user to start the tour and to have the feeling that this tour could benefit them. In the following section three narrative ideas are tested to see which is most attractive and one will be chosen for the final concept design.

3.2.1.1 Iteration Narrative concept

A brainstorm was conducted to discover what narrative creates an attractive situation for Utrecht's citizens (see appendix H: Brainstorm narrative ideas). Three narrative ideas were selected from this brainstorm and made into prototype designs (see below). The criteria for this selection is based on choosing three different narratives that are suitable for all citizens of Utrecht: an informative narrative, an interactive narrative and a gamified narrative. Narrative number 7 is translated into version A: 'Utrecht van de toekomst', and focuses on Utrecht as a smart city and to make life easier for the citizens by expanding their own knowledge (see fig. 15). Version A is the informative narrative. Version B is based on narrative number 10: 'Stop cyber criminaliteit'. This version is a game based tour that focuses on catching criminals with their own personal data and is chosen as the gamified narrative (see fig 16.). The last version C is the interactive narrative and derived from narrative number 8: 'Ontdek jouw Utrecht'. This version is more about giving discounts to the user and testing the user's greediness (see fig. 17). An iteration was done to see which of these three narratives is the most attractive for citizens to start the tour.

Fig. 15: Narrative version A.

Fig. 16: Narrative version B.

Fig. 17: Narrative version C.

Setup

In total five participants were presented with the three narrative versions A, B and C on paper sheets (see fig. 18). After each narrative they were asked what narrative the user found most and least appealing. Two extra questions were asked about the timespan of each version of the tour and distance to be walked, to get some insight in what the user prefers. At the end, a few more questions were asked about ranking the three narratives based on how willingly the user is to do the tour and which ending they find most attractive (see below). The test is done in Dutch, because that is the language of the target group. The English translation is written below for readability.

A1, B1, C1: Wat spreekt je aan in deze tour?
What do you like about this tour?

A2, B2, C2: Wat spreekt je niet aan in deze tour??
What don't you like about this tour?

Q1 Welke tour zou jij het liefst willen doen? (rank A, B en C en motiveer je antwoorden)
Which tour would you like to do the most? (rank A, B and C and motivate your answers)

Q2 Welk einde van de tour trekt jou het meest?
Which ending of the tour is most appealing to you?

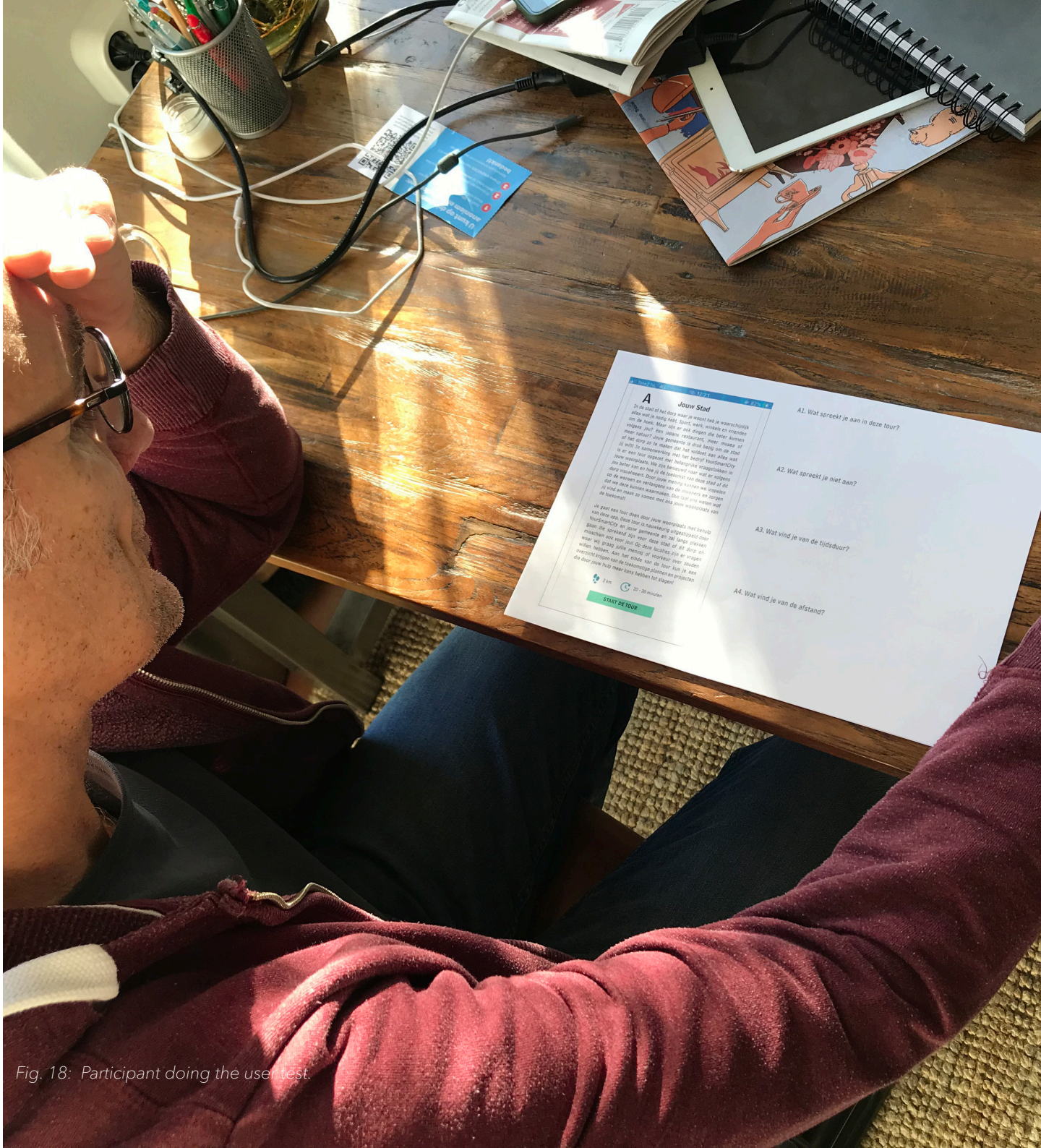


Fig. 18: Participant doing the user test.

Results

Version A 'Utrecht van de toekomst' was appealing to four of the five participants, because they liked that they were able to contribute to a better Utrecht (see appendix I: Narrative iteration results). However, some of the participants were concerned about whether their input would really be used to improve parts of Utrecht at all. The time of 20 to 30 minutes was perceived as very short and the distance of 2,0 km was considered too short to see enough of Utrecht. Version B 'Stop cybercriminaliteit' was considered a current and interesting theme and very exciting to do. However, the narrative of a terrorist attack seemed a bit too extreme for most of the participants. For a game like this the time of 30-40 minutes was too short but the distance was doable. Version C 'Ontdek jouw Utrecht' was very appealing to all of the participants. They all liked to explore new places and getting personal offerings. One of the downsides was that most participants were sceptical about actually getting to know new spots or that it would just be the regular spots that they would sese. The time of 40-50 minutes was considered as too long for just a tour, but very good if you are able to stop and walk around at these 'newly discovered spots'. The distance was for most participants something that they are willing to walk for the goal of the tour.

Q1: Welke tour zou jij het liefst willen doen? (rank A, B en C en motiveer je antwoorden)

Which tour would you like to do the most? (rank A, B and C and motivate your answers)

The participants were asked to rank the versions A, B and C on how which tour they would like to do the most (see fig. 19). When a version is put on the first place it gets 3 points, second place 2 points and third place just 1 point. Version A 'Utrecht van de toekomst' was most interesting for the participants and Version C 'Ontdek jouw Utrecht' was the least interesting.

Q2: Welk einde van de tour trekt jou het meest?

Which ending of the tour is most appealing to you?

Version C 'Ontdek jouw Utrecht' was considered to have the most appealing ending of the tour (see fig. 20). After that Version A 'Utrecht van de toekomst' was ranked second and version B 'Stop cybercriminaliteit' had no points at all.

Conclusions

Version A 'Utrecht van de toekomst' has the most interesting narrative for the participants, but version C 'Ontdek jouw Utrecht' has the most interesting ending of the tour. Though version B 'Stop cybercriminaliteit' seemed exciting to the participants, it was not considered attractive at all. With these results it is concluded that a combination of the story of version A and the end of version C will be the most attractive narrative for the tour. The focus will lie on discovering Utrecht's smart city technologies that have personal benefits for the user and improve their life.

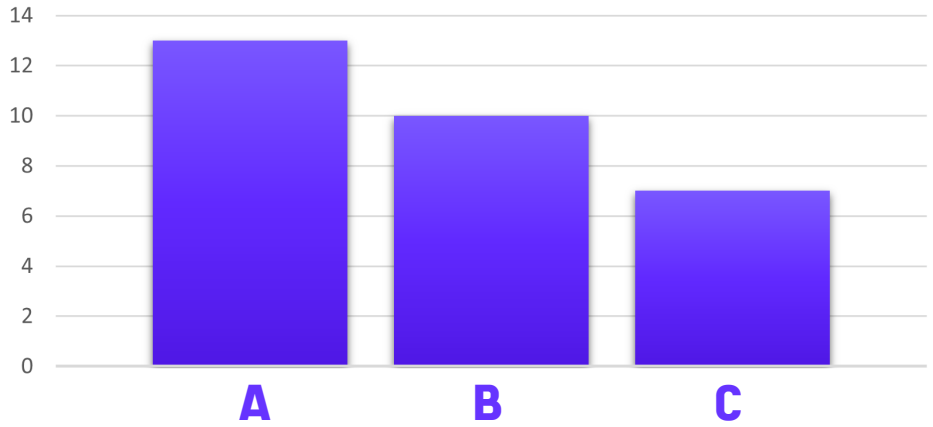


Fig. 19: Result narrative design Q1: Which tour would you like to do the most?

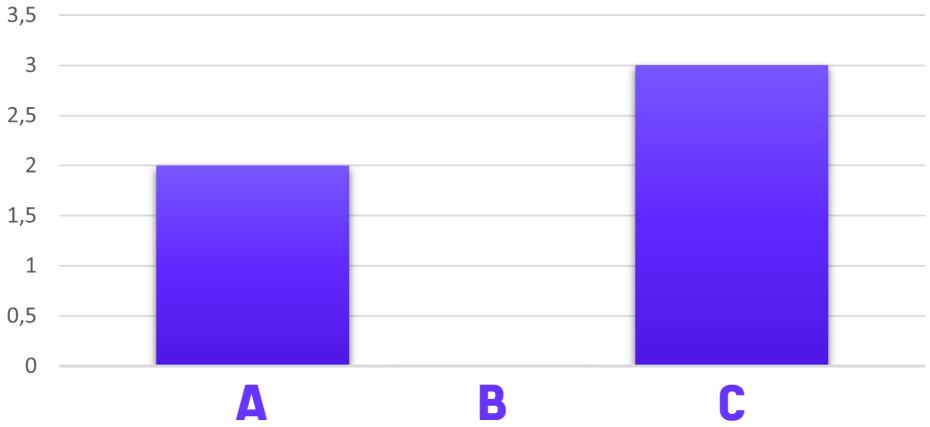


Fig. 20: Result narrative design Q2: Which ending of the tour is most appealing to you?

3.2.2 What smart city technologies are explored?

Previous research of CLEVER°FRANKE states that 66% of Utrecht's citizens have never heard of the term 'smart city' before. That research has also found that the majority of Utrecht's citizens feel like they are not informed enough about technological changes in their neighborhoods and they would like to know more about the role digital technologies play in their city. In order to find out what kind of technologies should be presented to citizens it is important to find out what Smart City technologies can be found in Utrecht.

3.2.2.1 Iteration Utrecht smart city technologies

To collect information about smart city technologies in Utrecht an interview with a member of the municipality of Utrecht was done (see appendix J: Interview member of municipality Utrecht). Together with desk research an overview of smart city technologies in Utrecht was created (see appendix K: Overview smart city technologies Utrecht). From this list, six smart city technologies were selected, each of them matching one of the smart city pillars (see section 2.2.3) to let the user explore the diversity of a smart city (see fig. 20). A more detailed description of each selected smart city technology can be found in chapter 4.3.

Setup

A total of six participants helped to test the tour's framework. They were presented with a prototype of the stops in Adobe XD on an iPhone. For each stop a problem is presented and a smart city technology is provided as a solution to the problem. On the laptop the participant can explore websites that explain and demonstrate the selected smart city technologies. After exploring each technology the participant is asked two questions:

Q1: Did you know about this technology?

Q2: Did you find this technology interesting?

Results will demonstrate if the selected smart city technology is interesting and engaging to use for the tour.

Results

All of the participants stated that they did not know about the following smart city technologies: Druktemonitor, DENKMEE, Inbraakvoorspeller, Talking Traffic and Snuffelfiets (see fig. 21). Three of the participants said that they had knowledge about the smart city technologies presented at the Huis&Energy platform, and three of the participants said to have no knowledge of these technologies.

The majority of the participants said that all smart city technologies are interesting, apart from the Druktemonitor (see fig. 22). This technology was considered not interesting to three of the six participants. Two of that gave the reason that they do not live in Utrecht and that the crowdedness does not bother them.

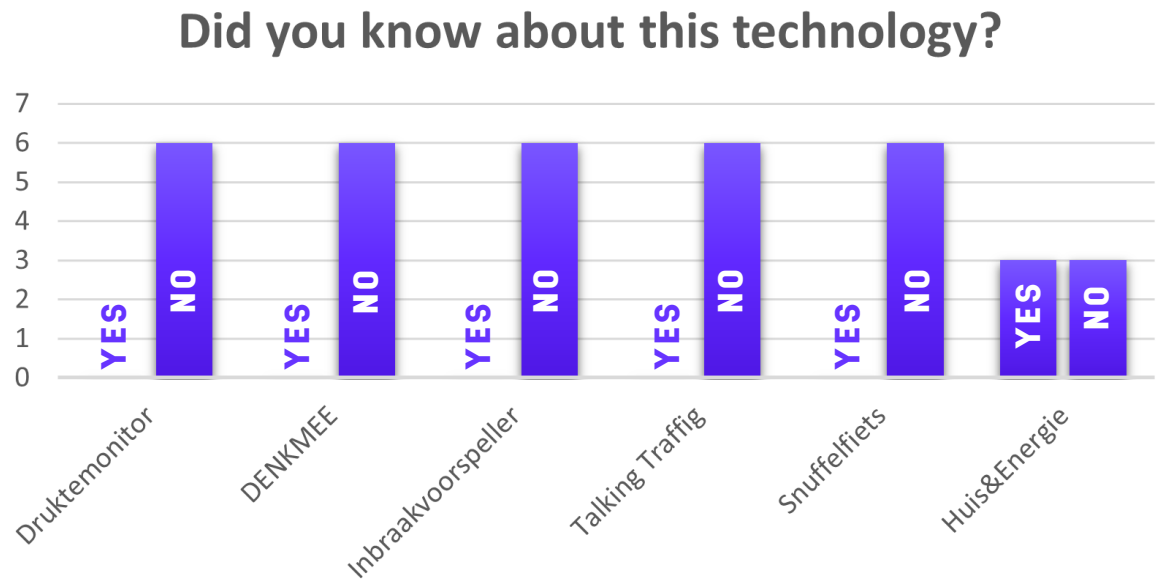


Fig. 21: Result knowledge of smart technologies

Conclusions

From an interview with the municipality and additional desk research into Utrecht's smart city technologies, 6 technologies have been selected to be implemented into the tour (see fig. 23). All of the selected smart city technologies are unknown to most participants and are considered interesting. Therefore, the 6 smart city technologies are validated for the final concept design. These 6 technologies each represent one of the 6 smart city pillars to let the user explore the broadness and possibilities of a smart city. These will be translated into 6 stops of the tour that the user will discover.

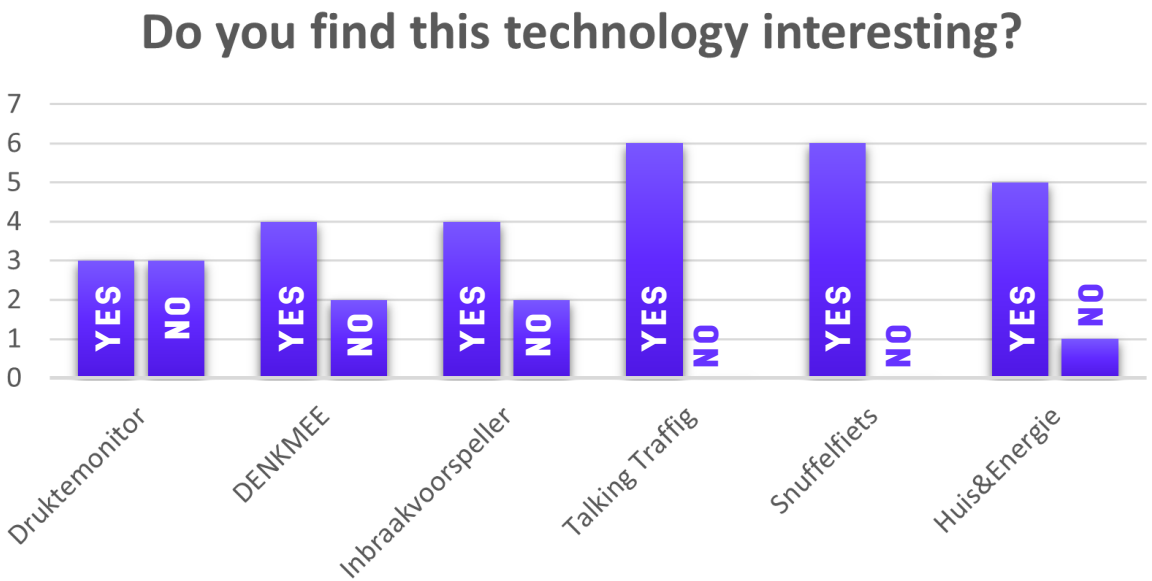


Fig. 22: Result interesting smart technologies

Pillar: Smart Economy
Technology: Druktemonitor

Pillar: Smart Citizen
Technology: DENKMEE Platform

Pillar: Smart Governance
Technology: Inbraakbarometer

Pillar: Smart Mobility
Technology: Talking Traffic

Pillar: Smart Environment
Technology: Snuffelfiets

Pillar: Smart Living
Technology: Huis&Energie Platform

Fig. 23: Final smart technology for each stop

3.2.3 What are the geographical touchpoints?

For this design question the exact location for each of the technologies will be determined to define the locations of each of the 6 stops. Possible locations that match with that particular smart city pillar and with that technology are identified. A walk around the city was done to see the possible locations in context and the final geographical touchpoints for each stop are selected.

3.2.3.1 Walking around the city

To identify the locations of the smart city pillars it is important that these locations have a connection with the smart city pillar and the matching technology. These locations are called the geographical touchpoints of the smart city technology and its matching pillar. Only locations within and around the city center were explored to make sure that the final locations would not be too far apart for a walking distance for the tour. Desk research identified a list of possible locations for the geographical touchpoint of each stop (see appendix L: Possible geographical touchpoints). After that a walk through Utrecht helped to select the final six geographical touchpoints (see appendix M: Walking around the city)(see fig. 25). In my opinion these geographical touchpoints fit best with the corresponding smart city pillar and technology, and are not too far apart for walking distance. The final geographical touchpoints for each stop are presented below (see fig. 24). In the next section the order of the stops will be determined based on the collected personal data. A more detailed description of each selected location can be found in section 4.3.

Pillar:	Smart Economy
Technology:	Druktemonitor
Location:	Hoog Catharijne
Pillar:	Smart Citizen
Technology:	DENKMEE Platform
Location:	City hall
Pillar:	Smart Governance
Technology:	Inbraakbarometer
Location:	de Neude
Pillar:	Smart Mobility
Technology:	Talking Traffic
Location:	Nijntje traffic light
Pillar:	Smart Environment
Technology:	Snuffelfiets
Location:	Jaarbeurs skatepark
Pillar:	Smart Living
Technology:	Huis&Energie Platform
Location:	The Greenhouse

Fig. 24: Final geographical touchpoints for each stop

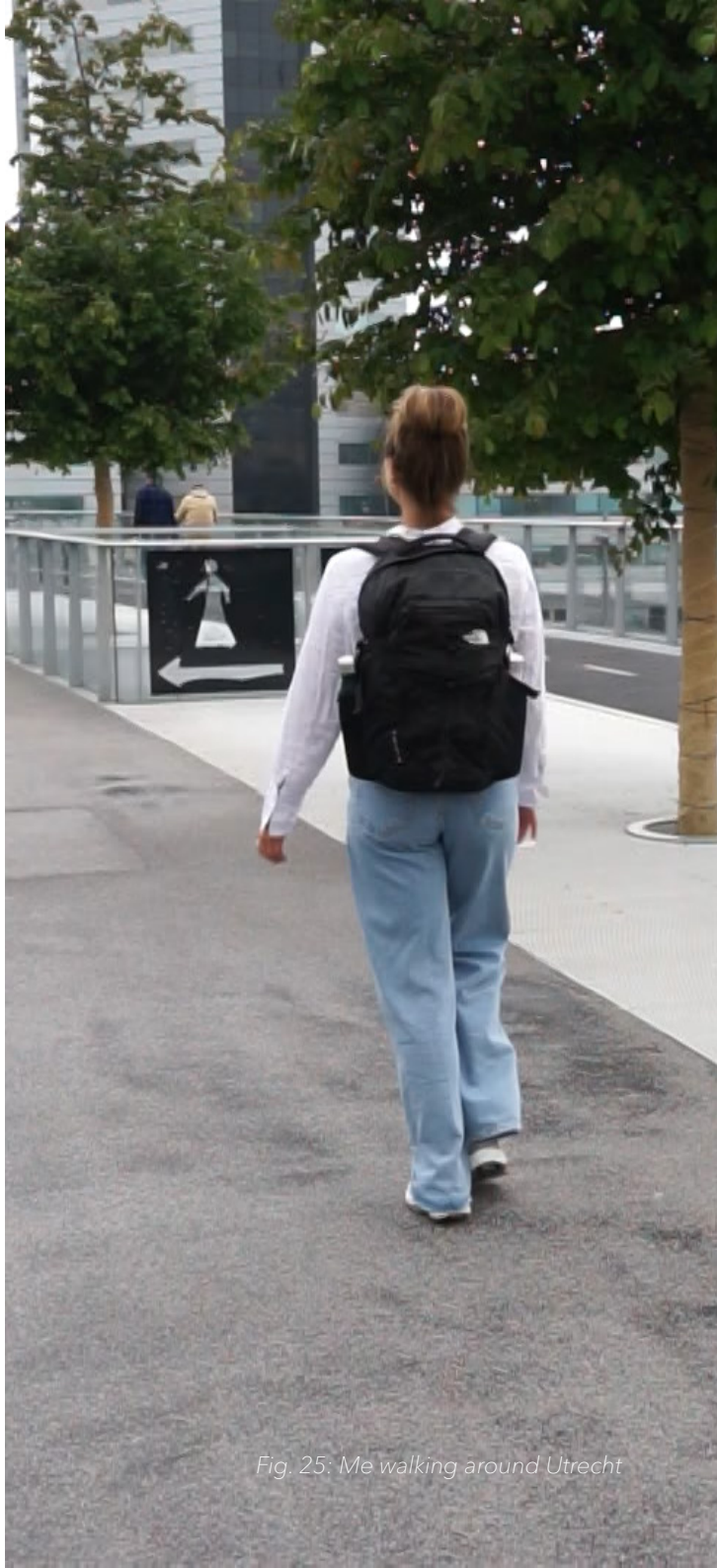


Fig. 25: Me walking around Utrecht

3.2.4 What personal data is collected and when?

During the introduction the user is asked for a few personal data points to create the personalized tour and at each stop the user gets presented with a smart city technology that could benefit their life, but they have to share their personal data to make use of this technology. To find out what kind of data should be collected to confront the user at the end of the tour, I did an iteration to find out what data points users are willing to share to generate the personalized tour and I created a datatable that shows what data points are collected at what stop.

3.2.4.1 Iteration

I did an iteration to discover what kind of data points the user is willing to share at the beginning of the tour to create the personalized tour.

Setup

The participant was first presented with the narrative of the tour on a piece of paper (see appendix N: Iteration data points at introduction) and after they are asked to rank the willingness of sharing the following personal data points:

First name
Date of birth
Gender
Postal code
Email address
Phone number

These data points are based on commonly asked personal data that individuals share when creating an account online. In total five participants were tested.

Question

The participant was then asked to answer the following question:

Q1: How willing are you to share the following personal data to create your personalized tour?

Results

The results show that participants are willing to share all personal data points except the phone number in order to create the personalised tour in the introduction (see fig. 26). The postal code and email addres are not selected to ask for in the beginning of the tour, because I think that these data points have a better fit for one of the stops. I selected the following datapoints to use for the introduction:

First name
Date of birth
Gender

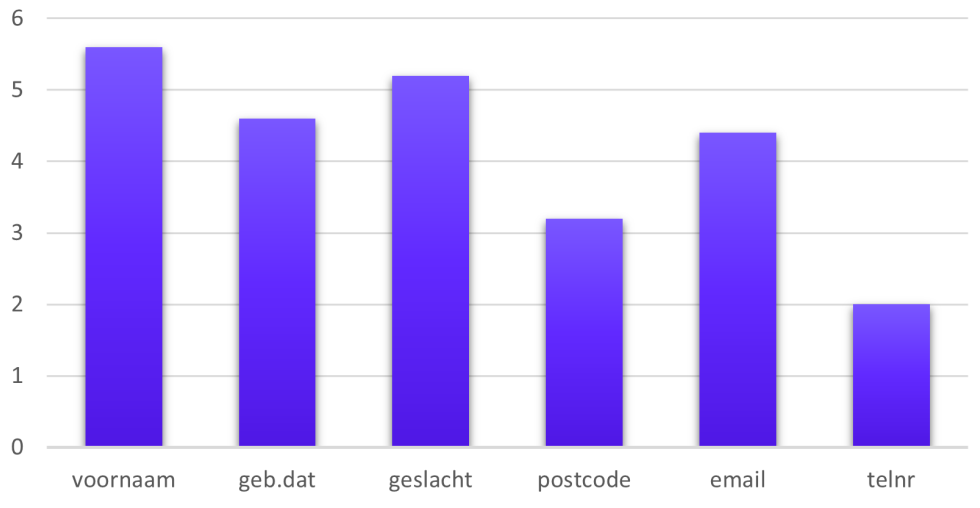


Fig. 26: Result willing to share personal data points at the introduction

3.2.4.1 Data table

The data points selected for the data table match the smart city pillars and the smart city technologies that are presented during that stop. A data table (see fig. 30) was created from a selection of the datapoints that were asked about in the survey (section 2.2). The datapoints that were mostly focused on online behavior are left out, because it is considered more interesting for the reveal to collect personal data that is not based on online behavior. The datapoints are ranked from least important (top) to most important (bottom) according to the results of the survey. For each stop and technology datapoints were selected that are most logical to ask for at that exact stop and match the smart city pillar, technology and location. Some stops have more 'important' data points than others. To create a build-up to the reveal at the end of the tour, the stops are ranked from least important to important. The order of the stops will be based on the 'importance' of each of the datapoints. The one exception is the first two stops (Smart Environment and Smart Living), which could not be ranked from least important to important, because that would guide the participant from Smart Environment to Smart Economy through the area of Utrecht Central station. This area is confusing for Google Maps and will result in confusing directions for the next stop. For that reason I chose to guide the participant around Utrecht Central station to make sure that the directions provided by Google Maps get the user to the next stop. In figure 28 and 29 the sequence of the stops of the tour are presented.

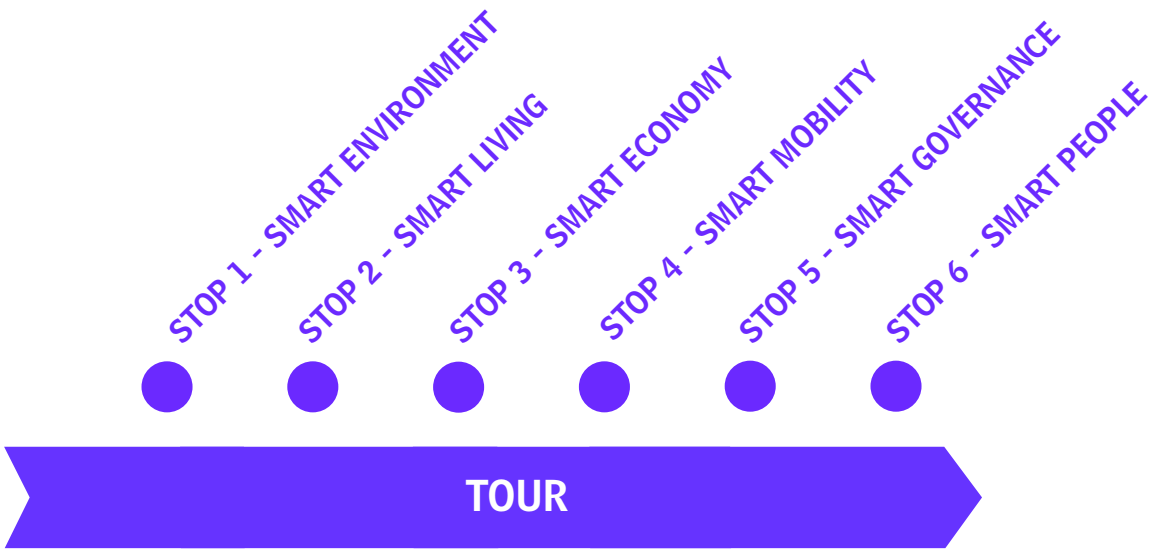


Fig. 28: Sequence of the stops

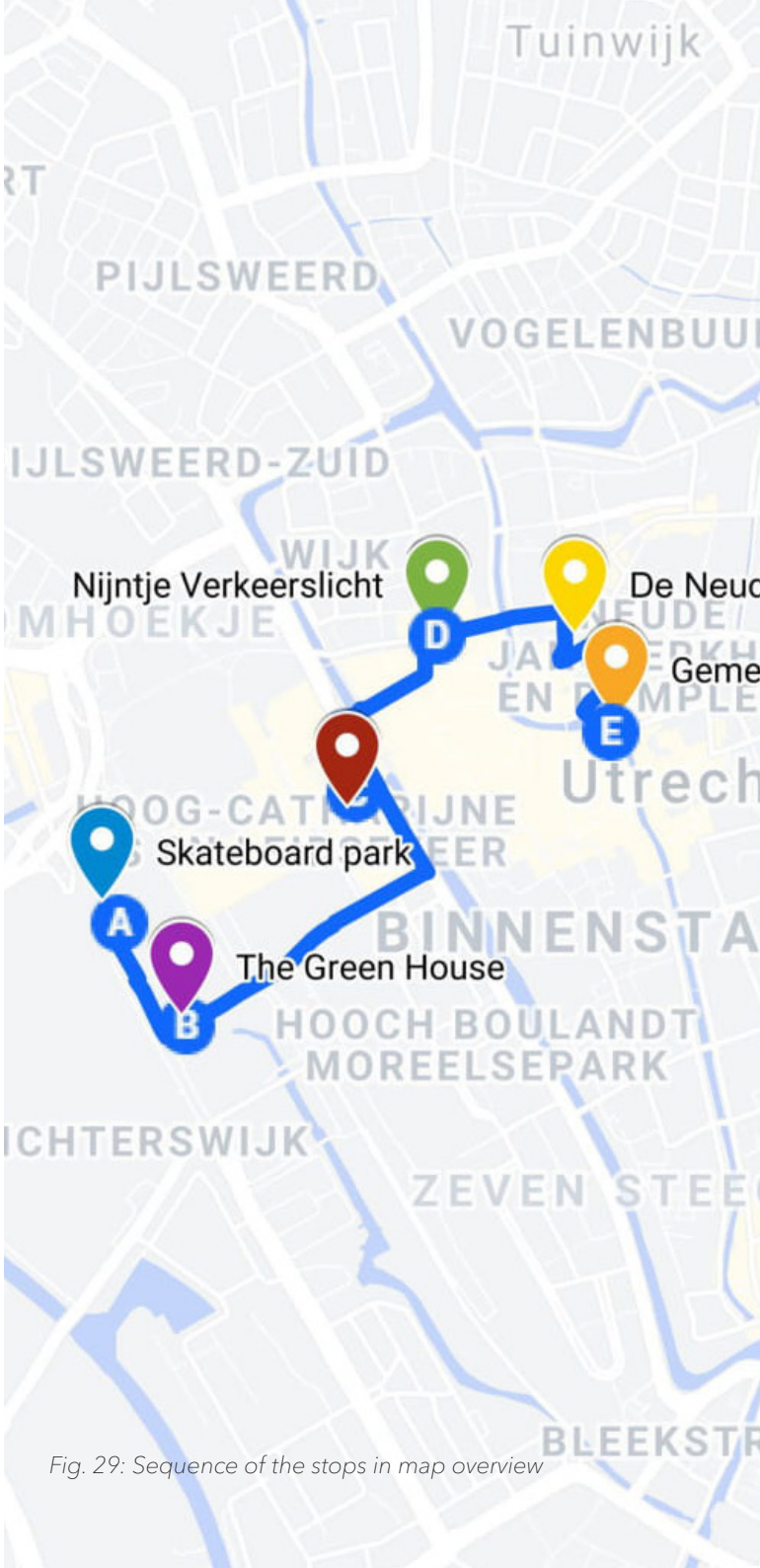


Fig. 29: Sequence of the stops in map overview

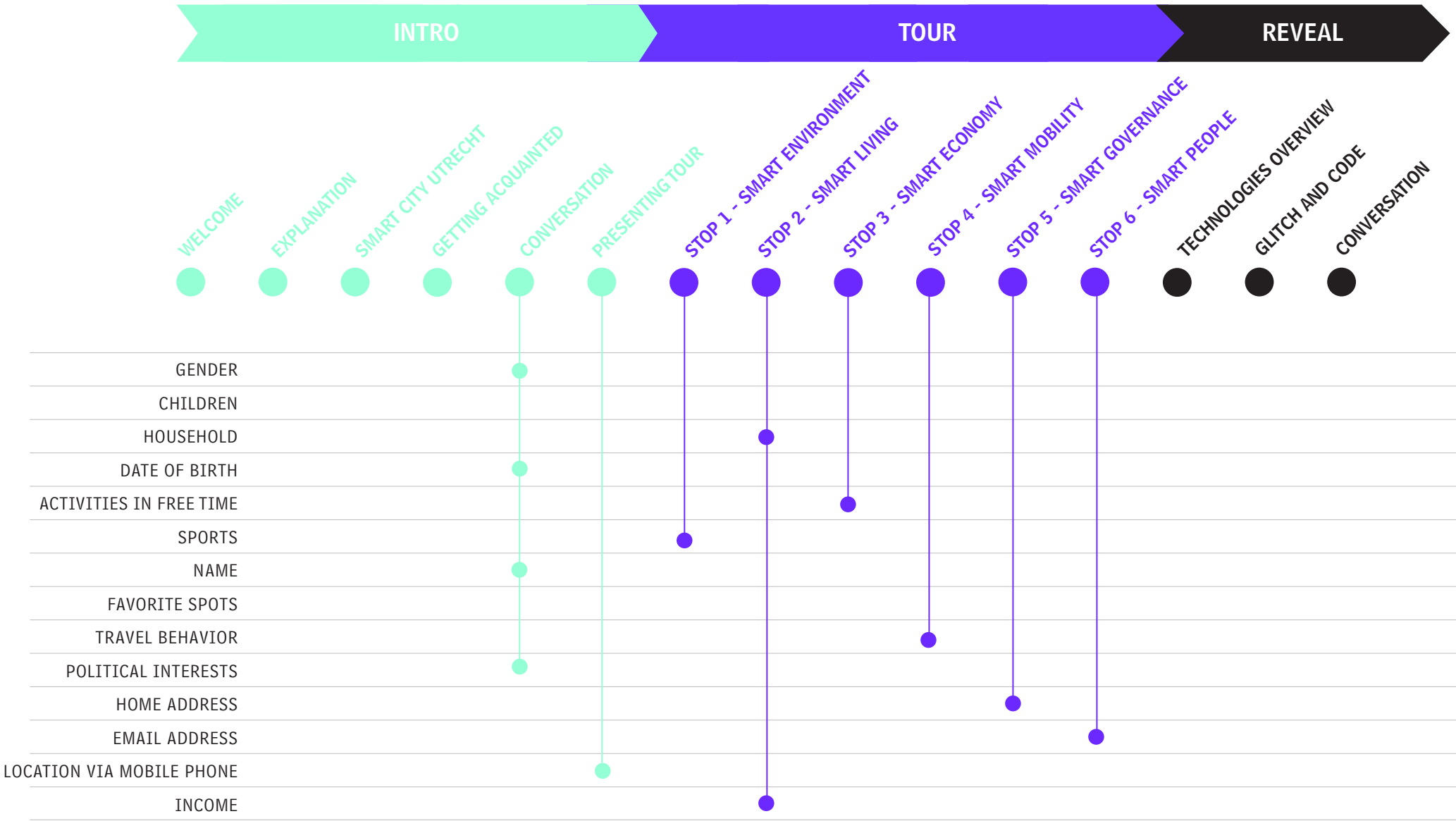


Fig. 30: Data table

3.2.5 What is the moment of reveal?

The final design question that needs to be answered is how to design the reveal at the end of the tour. The goal is to confront the user with sharing their personal data by discriminating, confront with unwanted information or experience the feeling of loss of autonomy. These are the three main privacy concerns that individuals have around data collection (see section 1.4.2). To find out how to confront users based on their personal data, desk research was conducted. This research is the basis for designing three different reveals. Each of these reveals is tested through an iteration and the most confronting reveal will be selected for the final concept design.

3.2.5.1 Desk research

The goal of the project is not only to let users critically reflect on their own behavior, but also on the data collection and use within the smart city. Therefore it is chosen to show the user both sides of the coin: a positive experience during the tour and negative consequences of sharing their personal data. In this way the user will be able to compare the two experiences and has a complete view to critically reflect on the problem. A design strategy is proposed by Khovanskaya et al. (2013) to promote awareness of and reflection on the infrastructures behind personal informatics and the modes of engagement, instead of only motivating people to examine their own behaviors (see fig. 31). Personal informatics can be described as reflecting on personal data to change behavior and reach a personal goal (Epstein et al., 2015). Although, personal informatics is different from what is used in the tour, voluntarily sharing personal data and getting information in return that can be acted upon, is very similar. In this literature, the interface is designed in such a way that it draws attention to the scope of the collected data, using purposeful malfunction as a way to encourage reversed engineering and displaying information in unconventional ways to challenge normative expectation in data collection (Khovanskaya et al., 2013). These goals can be achieved by using three different strategies: make it creepy, make it malfunction and make it strange.

In the next section these strategies are used to create three different reveals for the end of the tour to let the user critically reflect on the personal data collection, use and the user's own behavior.

3.2.5.2 Ideation

Each of the strategies has been sketched out to create three different reveals (see appendix O: Ideation three reveals sketch). These sketches are based on screens using adobe XD to create a video. The screens are put together in Adobe Premiere Pro to create three separate reveals. Each of the reveals will be explained in detail in the next sections. This test was done in English to better communicate the design and test results with the team.

DESIGN STRATEGY	*INFRASTRUCTURE DIMENSION*	*MOTIVATION*
Make it creepy: Display the sensitive and highly personal aspects of gathered data.	Reach or scope of data infrastructure	Raise implications of data-gathering systems for surveillance and individual privacy.
Make it malfunction: deliberately display gaps in gathered data.	Infrastructure becomes visible upon breakdown	Promote reflection on the limitations of data gathering.
Make it strange: show information in unconventional ways	Infrastructure links with conventions of practice	Highlight the role of personal informatics systems in perpetuating dominant social norms in data gathering and presentation.

Fig. 31: Three general strategies for designing provocative facts, their relationship to Star's infrastructures, and their design goals (Khovanskaya et al., 2013).

Creepy

The creepy strategy is used to create the feeling of a malicious entity that deliberately steals the user's personal data for an unknown goal (see fig. 31 to 36). This highlights the aspect of privacy infringement of the user with the goal to raise implications of data-gathering systems for surveillance and individual privacy.

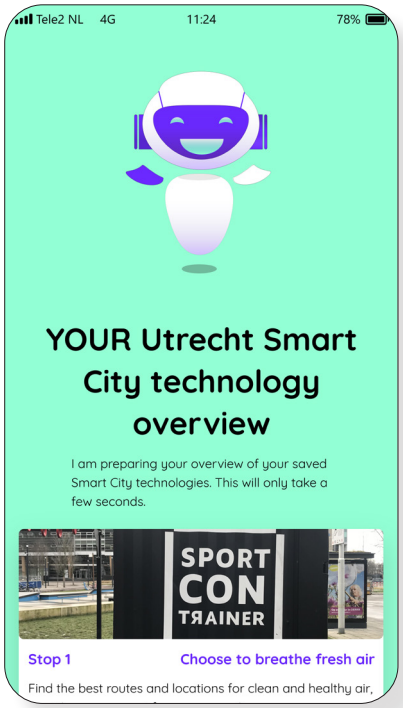


Fig. 32: Creepy design screen 1

Fig. 33: Creepy design screen 2

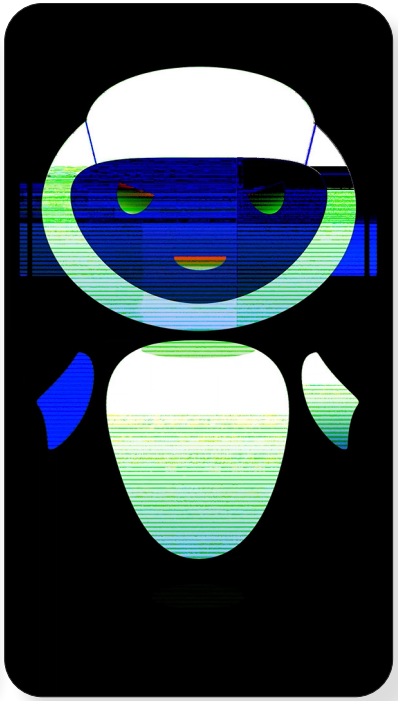


Fig. 34: Creepy design screen 3

Fig. 35: Creepy design screen 4

Fig. 36: Creepy design screen 5

Malfunctioning

The malfunctioning strategy is created to give the user a quick look into what is happening in the app and how the user's personal data is used. A glitching effect highlights the malfunctioning part to let the user see what the purpose is for the collected personal data and that it can be used for other purposes than they thought (see fig. 37 to 41). The goal of this strategy is to promote reflection on the limitations of data gathering.

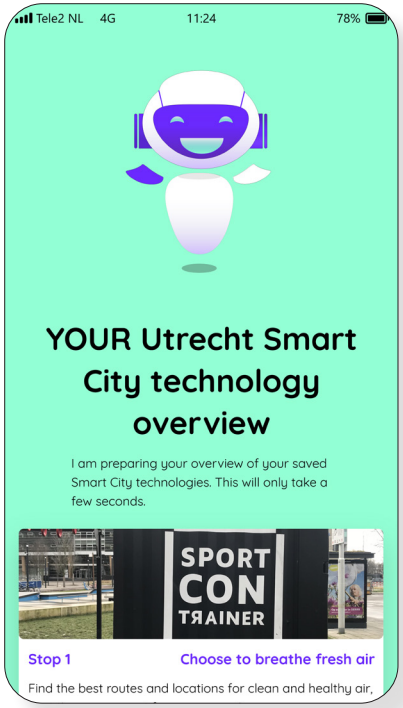


Fig. 37: Malfunctioning design screen 1

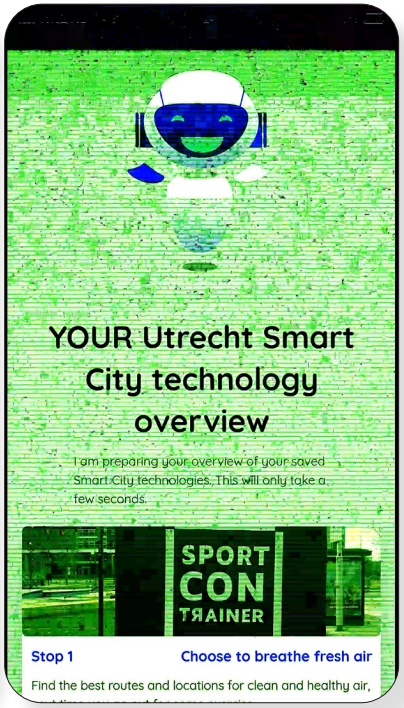


Fig. 38: Malfunctioning design screen 2

```
import { pusca, data } from
'data';
        import { Voornaam }
from './page/login.po';
import { Achternaam } from './
page/login.po';
        import { Geboorte-
datum } from './page/login.
po';
        import { Geslacht }
from './page/login.po';
        import { Maatschap-
pelijke interesses } from './
page/login.po';
        import { Locatie
} from './page/login.po';

        import { Sport } from
'./stop1/data.po';
        import { Sport per
week } from './stop1/data.
po';
        import { Huis speci-
ficaties } from './stop2/data.
po';
        import { Huishouden }
from './stop2/data.po';
      import { Inkomen } from
'./stop2/data.po';
        import { Vrije tijd
activiteiten} from './stop3/
data.po';
        import { Reisgedrag }
'./stop4/data.po';
        import { Postcode }
from './stop5/data.po';
        import { Huisnummer }
from './stop5/data.po';
        import { FacebookLo-
gin } from './stop6/data.
po';
        import { Emailadres }
from './stop6/data.po';

 "/sell/buyer/orderDetail",

                $("#wait_to_
pay").text(data.waitToPay);
}

------------------------------
--------------
(data.totalAmount > €0,13){

            }
```

Fig. 39: Malfunctioning design screen 3

Fig. 40: Malfunctioning design screen 4

Fig. 41: Malfunctioning design screen 5

Strange

The Strange strategy is focused on using the collected personal data and confronting the user with that. A set of strange pop-ups is shown that highlights that their data is used and shared with other parties (see fig. 42 to 45). This strategy has the goal of highlighting the role of personal data collection and use in perpetuating dominant social norms.

In the following section the three reveals will be tested to see which will let the user critically reflect and in what way.

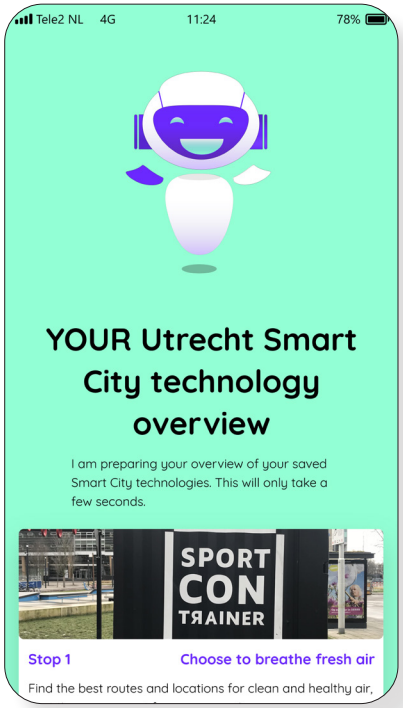


Fig. 42: Strange design screen 1

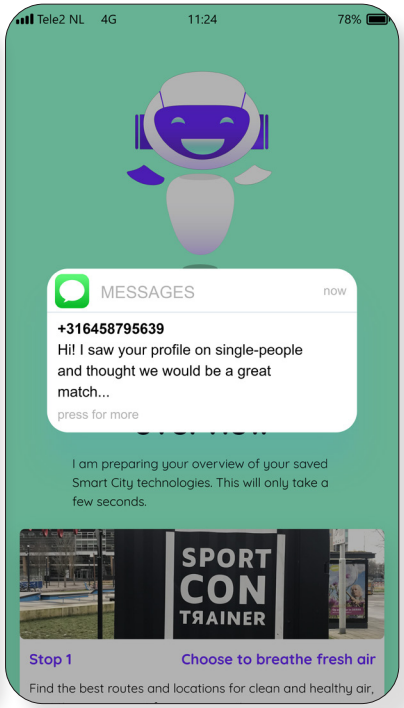


Fig. 43: Strange design screen 2

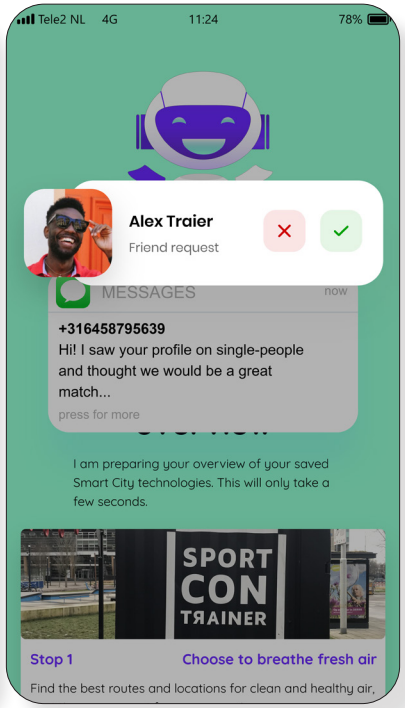


Fig. 44: Strange design screen 3

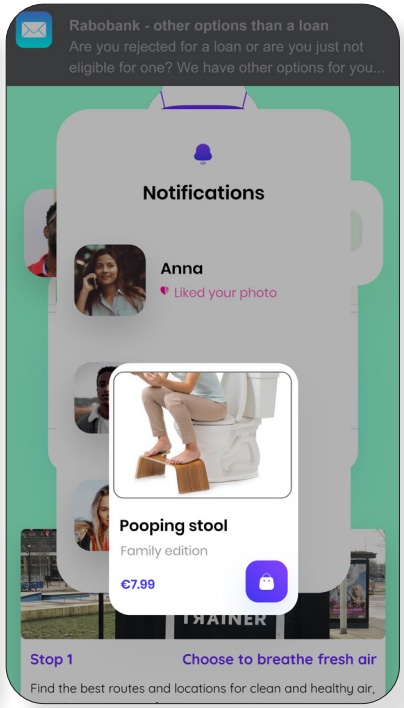


Fig. 45: Strange design screen 4

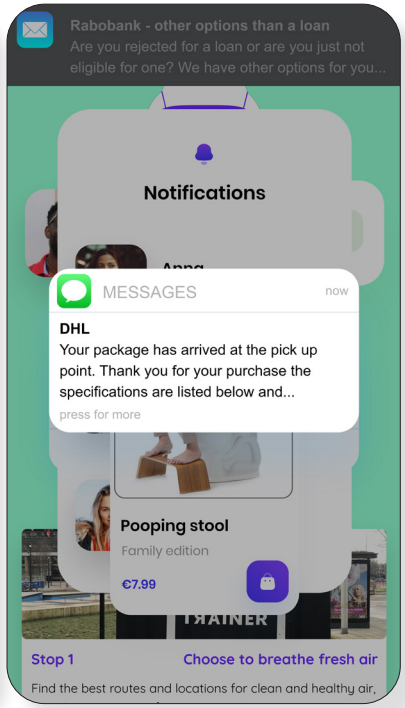


Fig. 46: Strange design screen 5

3.2.5.3 Iteration

To find out which of the three reveals is best in letting the user critically reflect, the three reveals are tested. The previous findings of the final narrative, smart city technologies, geographical touchpoints and collected data are implemented into the design that is tested. This overview can be seen in the previous section. This is essential to let the participants experience the 'positive side' of the technologies first, so that the 'negative side' of the technologies, the reveal, can be tested properly. The outcome will give answers on how to design the reveal in the final concept design to reach the design goal.

Setup

In total 6 participants were asked to do the reveal testing. The setup is behind a desk using the Adobe XD prototype of the app on an iPhone (see fig. 46). This iteration focuses on the effect of the reveal, so it is considered not essential to do this testing in the real context of Utrecht. In order to give the user a sense of their surroundings, a laptop with Google Maps is opened. When the participant reaches a stop, the address can be looked up in Google Maps and Street view lets the participant explore the location. The laptop is also used to let the user type their answers of the questions asked at the end of the iteration. During the tour the participant is asked to fill in data in the app, but Adobe XD does not technically support this function. Therefore the participant is asked to write down the answers they give on a piece of paper. The used prototype is designed from the introduction of the tour to the end of the three reveals. Each participant gets to see one of the three reveals, so that each reveal is seen by two participants. Although, the number of participants is too small to draw any definitive conclusions on which reveal is most effective the results will be used to guide my decision-making on which design is most confronting. During the test the participant is observed and asked to say what they think to make observation easier.

Questions

At the end of the experience the participant gets asked two questions about the experience that will be ranked on a Likert scale from 1 to 7 (see appendix P: Questions iteration three reveals). After answering these questions they are asked to give a reason for their given rate, so more information can be derived to see why a reveal works or not.

Q1: Did you find the end confronting?
Why?

Q2: Did this experience make you more critical about giving away your personal data?
Why?

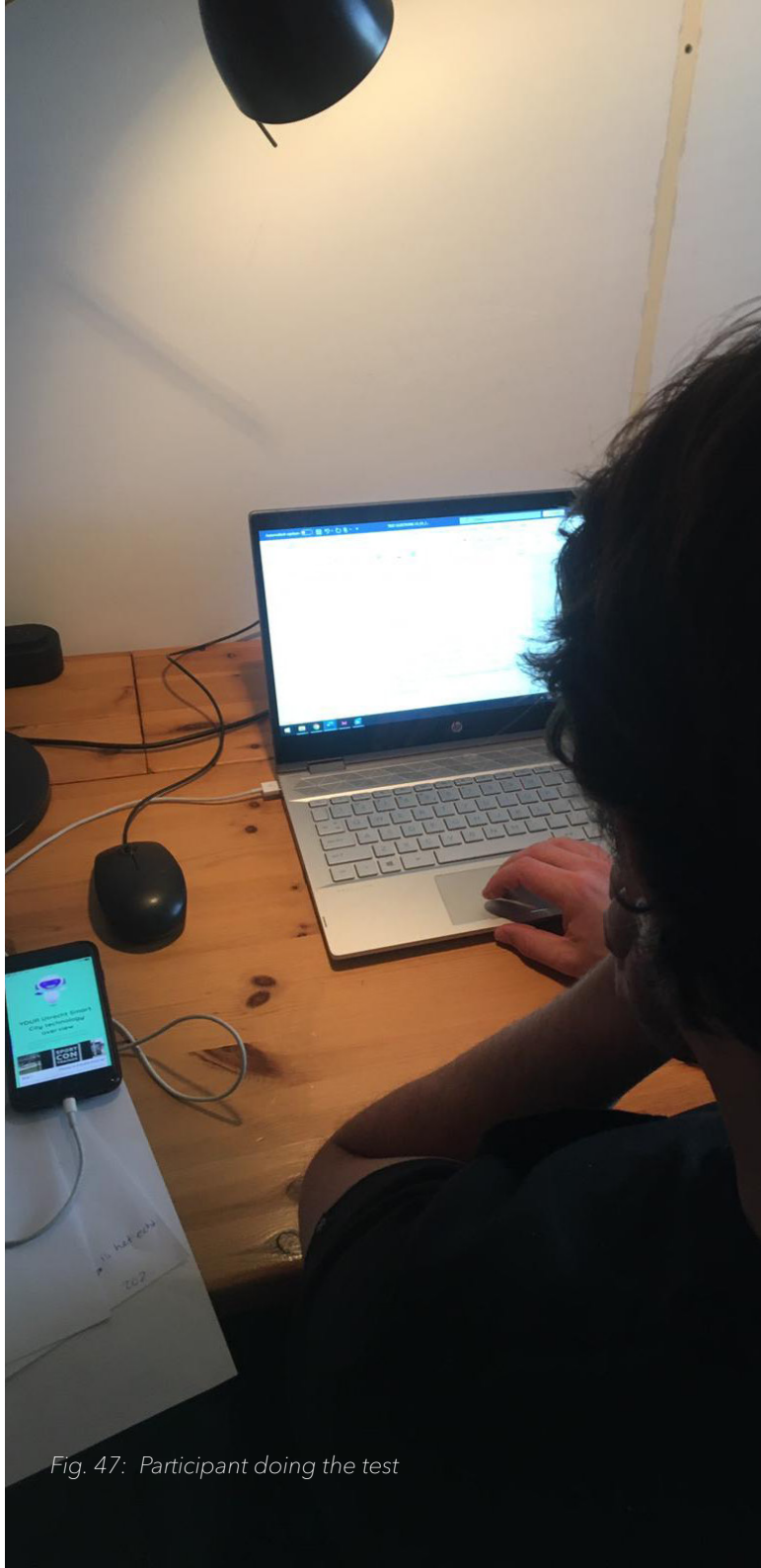


Fig. 47: Participant doing the test

Results

Some participants found it easier to answer in Dutch, so some of the information will be translated in English to communicate the results of the iteration (see appendix Q: Answers iteration three reveals). The first question was about if the reveal is considered confronting.

Q1: Did you find the end confronting? Why?

The results of each reveal have been analyzed and displayed in the graph below (see fig. 47). Reveal 1 Creepy and reveal 2 Malfunctioning are considered confronting to the participants. Both scoring a 6,5 on a Likert scale of 7, that says that the reveals are experienced as confronting to very much confronting. Answers to the question why participants found Reveal 1 confronting was the unexpected change of character of the app and the realization of the amount of personal data that they gave away.

Reveal 1

Answers to the question why participants found Reveal 1 confronting was the unexpected change of character of the app and the realization of the amount of personal data that they gave away.

"I don't care, I did not give away so much data... *looks at paper with answers given* oh wait a minute..."

Reveal 2

Reveal 2 made clear that participants could have a peek inside the app and what was happening. It made participants aware and they felt violated.

"Byeee loser, I feel violated.."

Reveal 3

Reveal 3 Strange scored a 3,5 that communicates the experience as not really to neutral confronting. Participants did not understand what was happening during the reveal and if it was even part of the test or not. Both of them were a bit irritated because they did not ask for this to happen.

"What is happening? I did not ask for this"

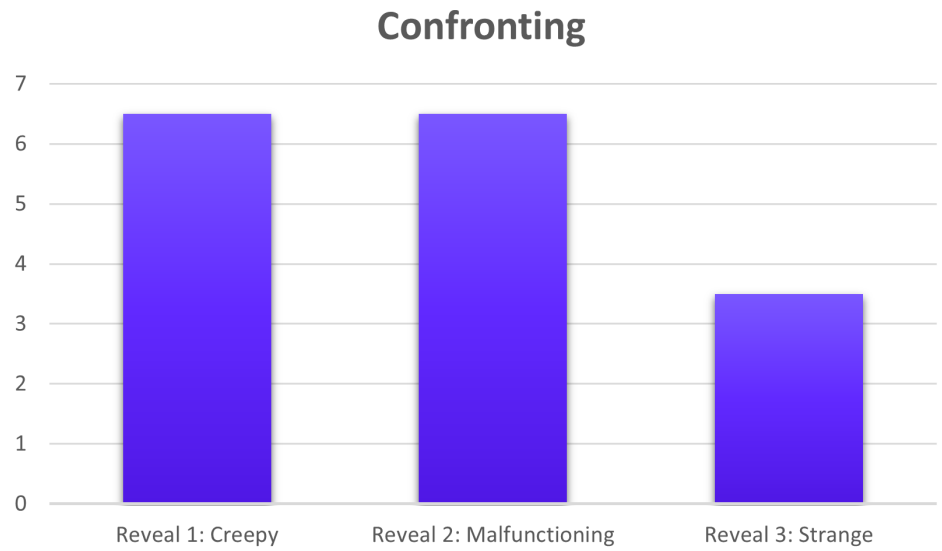


Fig. 48: Result test three reveals Q1: Did you find the end confronting?

Q2: Did this experience make you more critical about giving away your personal data?
Why?

The second question was about if participants are more critical about giving away their personal data because of this experience. The results of each reveal have been analyzed and displayed in the graph below (see fig. 48).

Reveal 1
The first reveal 'Creepy' scored a 5,5 on a Likert scale from 1 -7, being a bit more critical to more critical. Participants said that they did not think about the consequences of sharing personal data when the tour begins, but they also said that it was not completely clear what happens with their personal data or the reason why the app turned 'evil'.

"Slap in the face"

Reveal 2
The second reveal 'Malfunctioning' scored a five, which means that participants are a bit more critical about giving away their personal data because of this experience. They felt more aware about sharing their personal data, but the risks of what could happen with it is not completely made clear in this reveal, just like the first reveal.

"What is missing for me is information about the risks of sharing your data, why should you be careful with this?"

Reveal 3
The third reveal 'Strange' scored a 3,5, meaning participants are not really more critical to neutral in being more critical towards sharing their personal data. This is significantly lower than the other two reveals. In this reveal participants were made more critical about the consequences of sharing personal data, rather than the process itself. The reason that this reveal scored much lower, is because there was a lot of question about what actually happened and what the cause of the pop-ups were. It was also not very confronting because participants know that personal advertising is being done and they do not experience this as confronting, but irritating.

"I am aware that it works this way, but it is confronting if you get it shoved in your face like this"

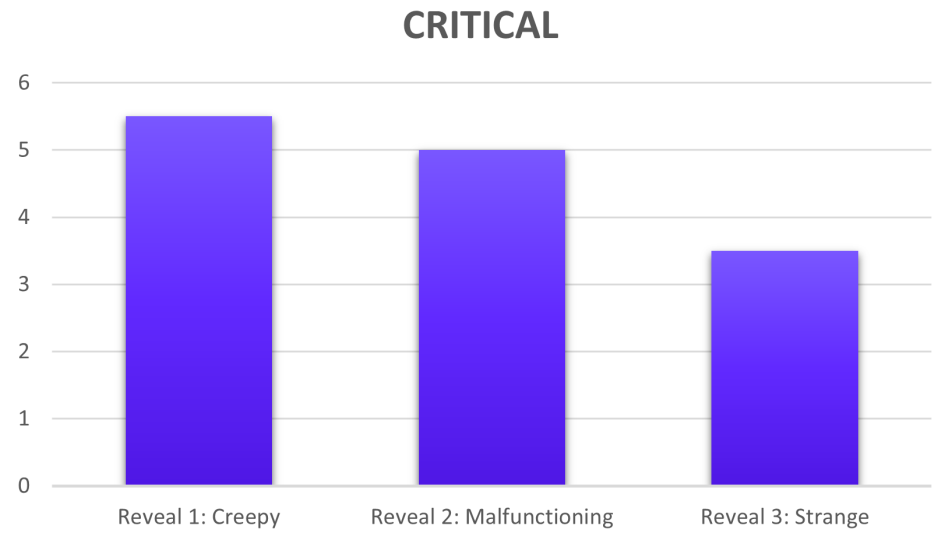


Fig. 49: Result test three reveals Q2: Did this experience make you more critical about giving away your personal data?

Conclusions

The first reveal ‘Creepy’ scored highest on being confronting and reflecting, closely followed by the second reveal ‘Malfunctioning’. Both of the reveals showed that the participants were made more aware about the process of what personal data they shared, but the consequences of this process were not clear enough. The opposite occurred in reveal 3 ‘Strange’, where the process was unclear to the participants, but the consequences of sharing personal data were communicated. Even though the first reveal scored highest, the reasons why it was so confronting and making the participant more critical weren’t clear. The second reveal ‘Malfunctioning’ helped the participants understand what was happening and that the app was collecting the participants’ personal data. The third reveal showed consequences of personal data collection, but those were considered not invasive enough. Because of the explanations of the participants, a combination of reveal 2 ‘Malfunctioning’ and reveal 3 ‘Strange’ will be used to design the reveal in the final concept design. A more invasive and harsher consequences should be implemented to really let the user experience the negative side of sharing their personal data. The combination would give users the information what happens during the process of the app and the consequences that personal data collection can bring, which ultimately gives the user a better reason to be critical on the experience.

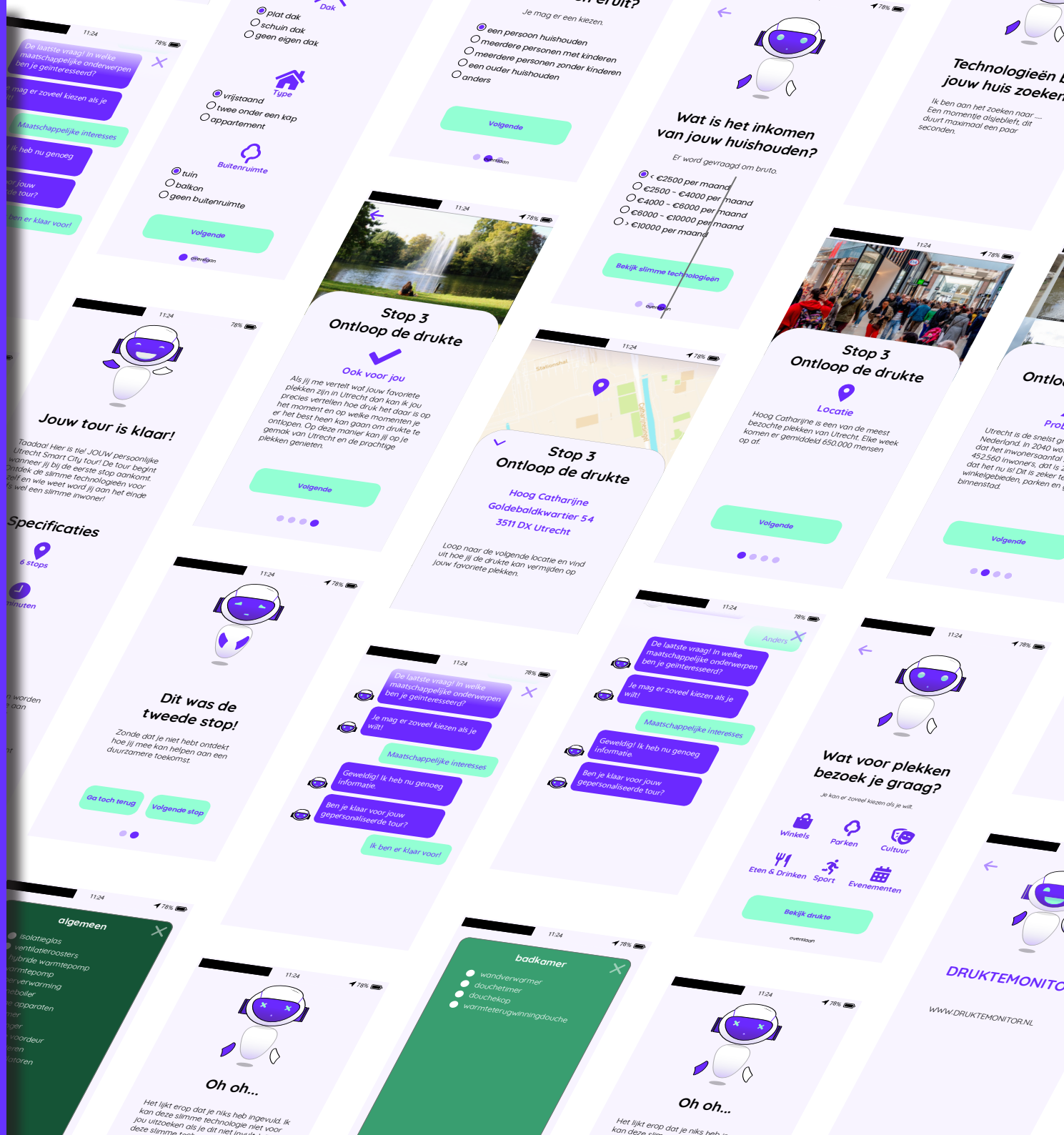
CONCLUSION CHAPTER

The goal of this chapter was to determine the design space, discover design questions and find answers to these design questions. In total five design questions were found and have been solved through brainstorms, ideations and iterations. The focus of the narrative of the tour will lie on discovering Utrecht’s smart city technologies that have personal benefits for the user (DQ1). In total six smart city technologies are selected that each represent one of the six smart city pillars to let the user explore the scope of a smart city (DQ2). The stops have been assigned geographical touchpoints that match the pillars and smart technologies (DQ3). A data table presents a clear overview of what personal data is collected and when (DQ4) and a strange and malfunctioning reveal should lead to provoking the user to think critically about their personal data collection in the smart city.

4

DELIVER

Guided by the interaction vision and the answers from the design questions, the ideation phase lead to Pusca, an application based personalized tour through Utrecht to let citizens explore smart city technologies and confronts them with the consequences of sharing personal data. In this chapter I present the final concept design.



4.1 FINAL CONCEPT DESIGN: PUSCA

Pusca is an application based Personal Utrecht Smart City Assistant that takes the user on a one time tour through Utrecht to explore and experience smart city technologies that could improve their quality of life (see fig. 50). Each of the stops in the tour presents a smart city technology that can be experienced by sharing personal data. The user is asked to make a trade-off between their estimated privacy value of the asked personal data and the benefits of the presented smart city technology. At the end the user is presented with an overview of all the explored smart city technologies and information about how they could be used. A glitch in the application takes the user from this smart city technology overview to an insight of what is actually happening with their shared personal data. After that, a message from Pusca confronts the user with the privacy consequences of sharing their personal data and provokes a critical reflection on the trade-offs that the user made during the tour.

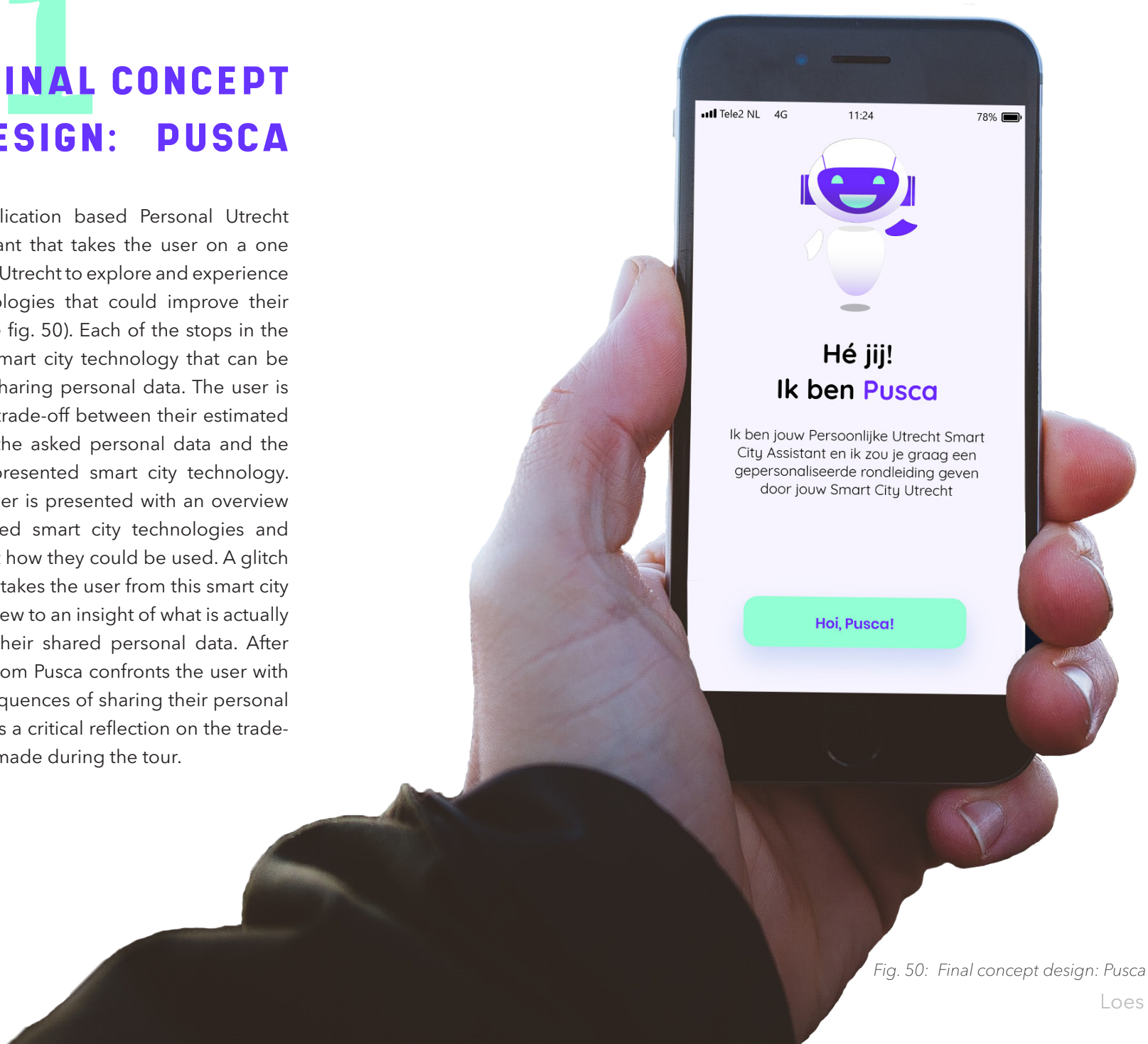


Fig. 50: Final concept design: Pusca

4.1.1 Pusca

The character Pusca is based on the IV character Clippy (see section 2.6). Just like Clippy, Pusca is portrayed as friendly and helpful and guides the user through the tour from introduction, passed the stops and to the reveal at the end. Inspiration for the character comes from Cozmo, a real-life artificially intelligent tiny truck robot for kids and adults to learn creatively code and he uses his big, blue digital eyes to convey convincing emotions (Meet Cozmo | Digital Dream Labs, n.d.) (see fig. 51). The eyes of Pusca are based on Cozmo's to have a more emotional and personal interaction with the user (see fig 52).

Not only the character Pusca, but also the interaction with it should be experienced as personal, friendly and helpful as explained in the IV. I looked into multiple applications that are similar on personal guidance to give inspiration on how to design the desired interaction (see appendix R: Aesthetics moodboard).

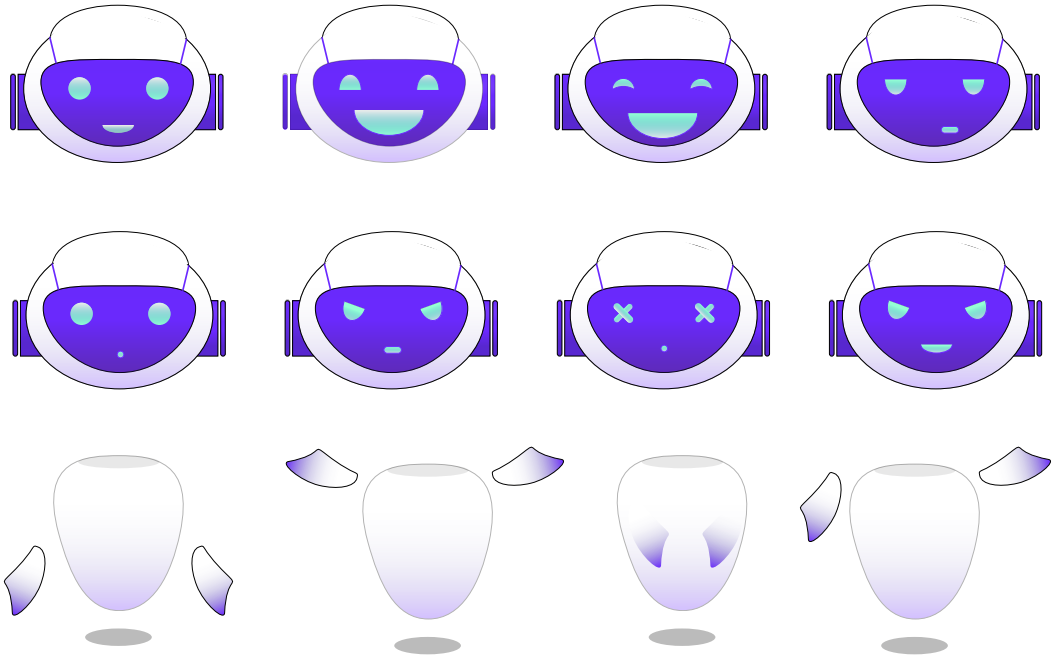


Fig. 52: Design of the Pusca character

Fig. 51: Design Cozmo's eyes (Meet Cozmo | Digital Dream Labs, n.d.)

Many of these applications used a conversation format between the application's character and the user to create a more personal experience. I applied this to Pusca in the introduction to get to know the user and ask basic personal data. The language used is very informal and complimentary to make the user feel at ease (see fig. 53).

The aesthetics mood board (see appendix R: Aesthetics moodboard) has also been the basis for creating a color scheme that communicates a friendly and trusting interaction. The color scheme that I chose is blue with a bright green. The blue is chosen to communicate calmness and trustworthiness, because blue is considered the most trustworthy color in website design (Alberts, 2011). The bright green is chosen to pop out and attract attention to show the user where to click on and guide them through the tour.

Fig. 53: Example of informal language

4.1.2 Privacy over functionality

For the final concept design of Pusca to work, be tested and evaluated, I had to make a choice in which program or platform would be best to design in. I gained inspiration by looking at other apps that were similar on the field of technical aspects that are involved in a location based tour (see appendix S: Technicalities moodboard). From these apps I found that the following technical aspects are essential: to give directions and enter data. Other aspects that I found important in the final design of Pusca are to portray the desired aesthetic look and feel to make the user trust Pusca, to implement and play a video to let the user experience the big reveal at the end, and to not store any data to reassure the user that the solely goal of this project is to critically reflect. I explored several mediums to see which suits this project the best: Adobe XD, Appiepie, Appmakr and INtractive (see fig. 54). The latter three are online app builders.

The online app building platforms do not provide the desired aesthetic look and feel, but have more of a standardized aesthetic, whereas Adobe XD is focused on creating User Interfaces (UI) and aesthetics can be made any way you want. Even though Adobe XD is not capable of giving directions, entering data or implementing and playing a video, I chose it as the medium to design Pusca's final concept design. The main reason for choosing Adobe XD is that the online app builders store user data and that is out of my control. I do not want Pusca's final prototype to store any data, because I think it is important to not do the exact thing that this project is designed to critique: collecting personal data that could harm an individual's privacy. Technicalities that are not met will be solved in other ways for the final concept design.

	ONLINE APP BUILDERS	***ADOBE XD***
Desired aesthetic look and feel	-	x
Give directions	x	-
Enter data	x	-
Implement and play video	x	-
Store data	x	-

Fig. 54: Table of pro's and con's of different mediums

4.1.3 Three stages of the tour

The smart city tour is based on the IV qualities explained earlier: attractive, engaging, confronting and thought-provoking (see section 2.6). From these four IV qualities the tour is split up in three phases: introduction, tour and the reveal (see fig. 55).

The introduction phase provides the user with an explanation of what the tour is about, and is focused on getting to know the user and generating a personalized tour. This phase is about attracting the user to the topic of the tour.

The second phase is the tour itself where users are able to explore the smart city technologies at each stop. This phase engages the user in the context of Utrecht as a smart city and the benefits of the smart city technologies that are explored. The introduction and tour combined can also be described as the 'positive' experience of personal data collection within smart city technologies. It lets the user explore the smart city technologies and what benefits these can bring for the user if they share their personal data.

The last phase is the reveal, where users are confronted with consequences of sharing their personal data. During this phase the user will experience the 'negative' side of sharing their personal data. After the tour ends the users are provoked to look back on the interaction and criticize the choices they made.

The overview of the three phases was the basis of creating the first prototype of the app. The prototype was first sketched out in a storyboard (see appendix T: Storyboard) to communicate what the design experience is going to be like.

After that a wireframe sketch (see appendix U: Wireframe sketch) formed the basis of the screens that had to be designed. This finally resulted in the final concept design Pusca. In the next section each of the phases and the design choices are explained in depth.

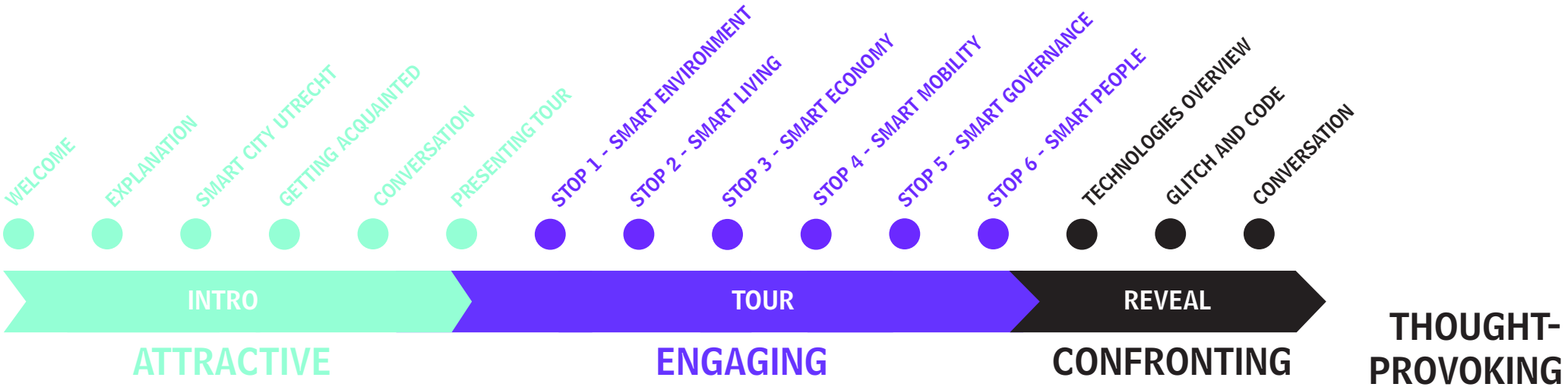


Fig. 55: Three stages of the tour

4.1.4 Six steps for each stop

Each stop matches one of the six smart city pillars (see section 1.2.3) and consists out of six steps (see fig. 56). The first step provides information about that stop's location that has been chosen in the third design question from chapter 4: What are the geographical touchpoints of the tour? (see section 3.2.3). The second step states a social problem that matches that particular smart city pillar. In the third step the smart city technology is presented as a solution to this problem and is selected by answering the second design question in chapter 4: What smart city technologies in Utrecht are explored? (see section 3.2.2.). The fourth step gives information on how this technology could not only solve the proposed problem, but also that it can benefit the user personally. If the user wants to experience the presented smart city technology they are asked to share some personal data in the next step. This personal data has been selected by answering the fourth design question in chapter 4: What personal data should be collected during the tour and when (see section 3.2.4.)? If the user is not willing to share the asked personal data, the user gets the option to skip the following steps and continue to the next stop. The fifth step is about letting the user share specific personal datapoints that Pusca says that are necessary to see how the technology works. In the sixth step the user gets to experience how the particular smart city technology works and how it could benefit their lives. At the end of each stop the user is informed that they have completed that stop and that they can continue to the next.

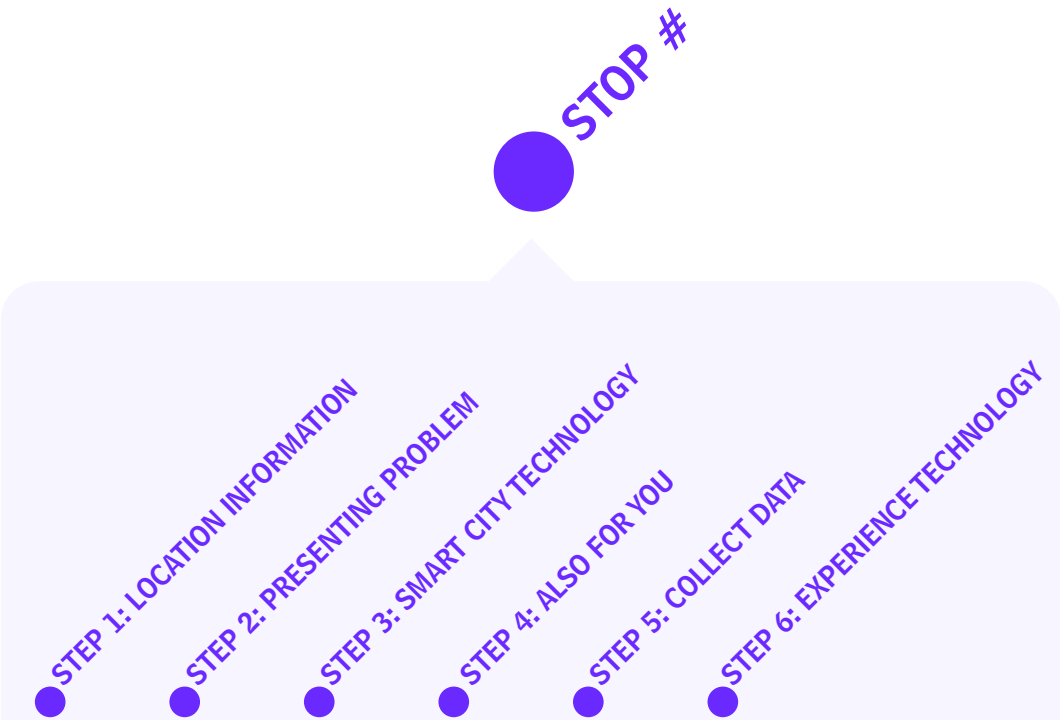


Fig. 56: Six steps for each stop

4.2 TOUR PHASE 1: GETTING PERSONAL

At the beginning of this phase the user gets acquainted with Pusca. Pusca then gives a short explanation about what a smart city is, what this tour is about and how this tour could benefit the life of the user (see section 3.2.1). This phase of the tour is about generating a personal tour by sharing basic personal data points (see section 3.2.4) in a chatbot conversation with Pusca. The personal data collected is used to provide the service (see section 2.2.3) of exploring Utrecht as a smart city. At the end of this phase an overview of the personalized tour with specifications is presented to the user. Each of the steps in this phase is explained further in the next sections.

4.2.1 Explanation

The first design question stated in chapter 4 was: What is the narrative of the tour? The results showed that discovering the future development of Utrecht that has personal benefit for the user was considered an attractive narrative (see section 3.2.1). When the application is opened, a friendly robot waves at you and introduces itself (see fig. 57). During the introduction part, Pusca explains that this app is about creating a personalized tour through Utrecht as a smart city to let the user explore and experience smart city technologies that improve their quality of life. A short explanation follows about what can be expected of the tour: explore smart city technologies in Utrecht, experience them for yourself and get an overview at the end on where to find and use these discovered technologies for yourself (see fig. 58). The user is then informed what a smart city is, based on the definitions (see section 1.2.3) to get a better sense of what the tour is about (see fig. 59). The end of this explanation provides the user with information that the tour is customized by collecting personal data from the user to create a tour that matches their interests (see fig. 60). This is to attract the user to the stops of the tour and signal that these technologies are specifically chosen for that user and to improve their quality of life in Utrecht.

4.2.2 Chatbot Conversation

After the explanation the user is invited to a chatbot conversation with Pusca. During this conversation Pusca asks for some general personal information to get to know the user: the user's first name, last name, date of birth and gender. These datapoints are selected because the iteration done earlier revealed that users are very willing to share these three datapoints (see section 3.2.4.1). To be able to generate a personal tour specifically for that user, Pusca also asks about the user's interests in topics about social challenges according to the Staat van Utrecht's Databank (Over Staat van Utrecht | Staat van Utrecht, n.d.) (see section 2.2.4). The user can choose as many options as they like from: population, employment, health, mobility, living, education, climate, culture, environment, safety, economy and citizenship (see fig. 61). When the user has answered all of the above questions, the end of the chatbot conversation is marked with a button to let Pusca generate their personalized tour.

4.2.3 Create personalized tour

After the chatbot conversation, a loading screen of Pusca creating their personalized tour takes only a few seconds (see fig. 62). Whereafter the user is informed that their tour is ready (see fig. 63). The app then shows specifications about the amount of stops, duration and walking distance, along with some practical tips that make use of the app easier. From this point the user is able to start their personalized tour.

WELCOME

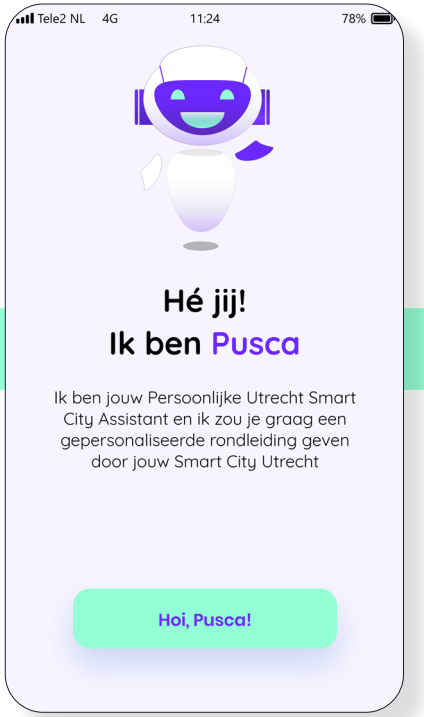


Fig. 57: Introduction screen 1: Welcome

EXPLANATION

Fig. 58: Introduction screen 2: explanation

SMART CITY UTRECHT

Fig. 59: Introduction screen 3: Smart city Utrecht

GETTING ACQUAINTED

Fig. 60: Introduction screen 4: Getting aquainted.

CONVERSATION

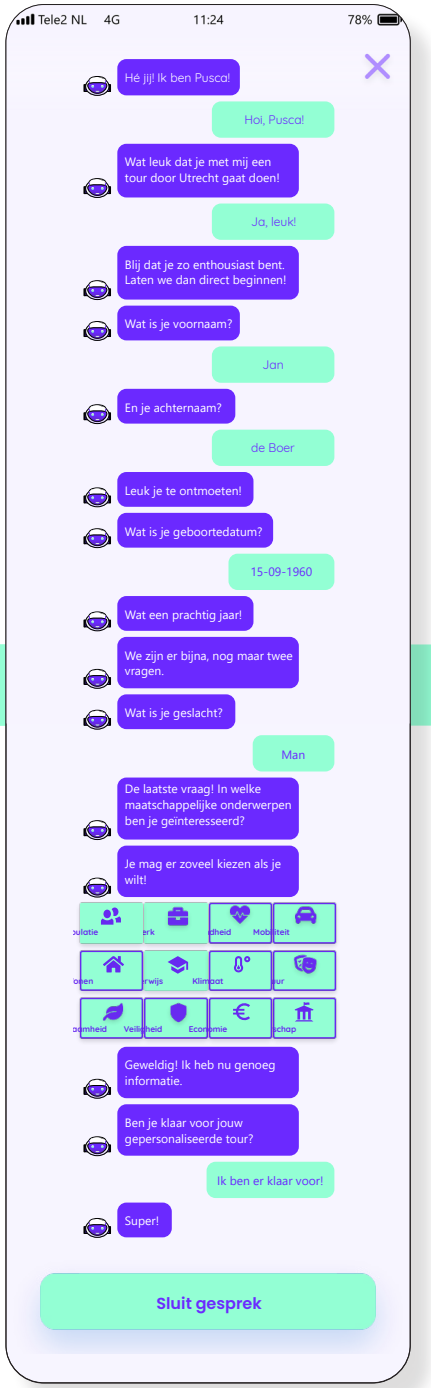


Fig. 61: Introduction screen 5: Conversation.

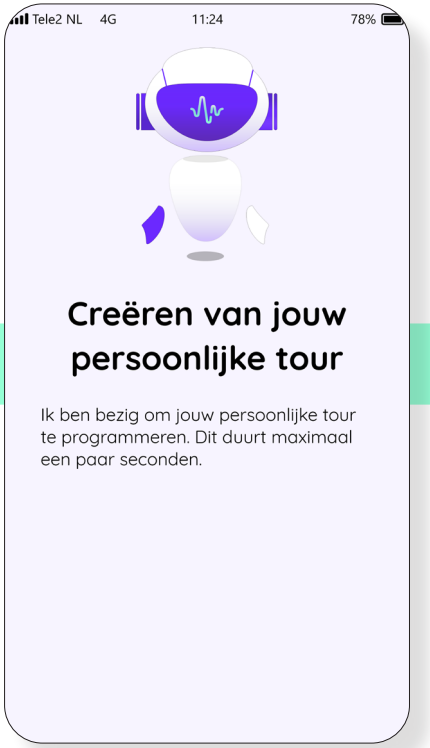


Fig. 62: Introduction screen 6: Creating personalized tour.

PRESENTING TOUR

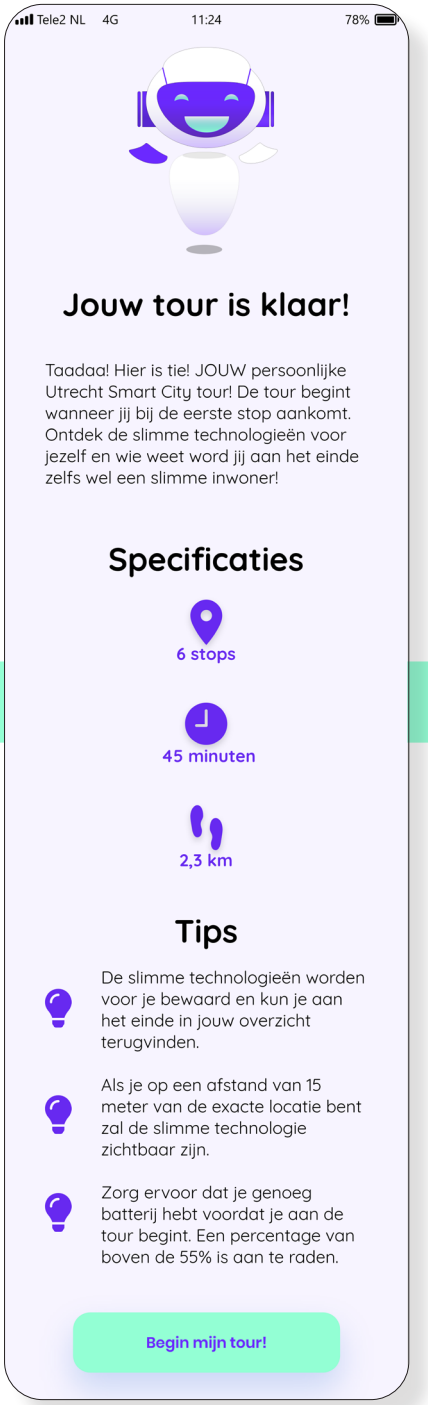


Fig. 63: Introduction screen 7: Presenting tour.

4.3 TOUR PHASE 2: EXPLORING UTRECHT'S SMART CITY TECHNOLOGIES

At the beginning of this phase the user is asked for permission to use their location (see fig. 64). If they consent, the app shows directions to the first stop. If the user does not consent they are informed that they are not able to use the app, because giving directions is not possible without knowing the user's location. This phase ends with the user being informed that they have completed the sixth and final stop of the tour. In the following sections each of the stops and their steps will be presented.

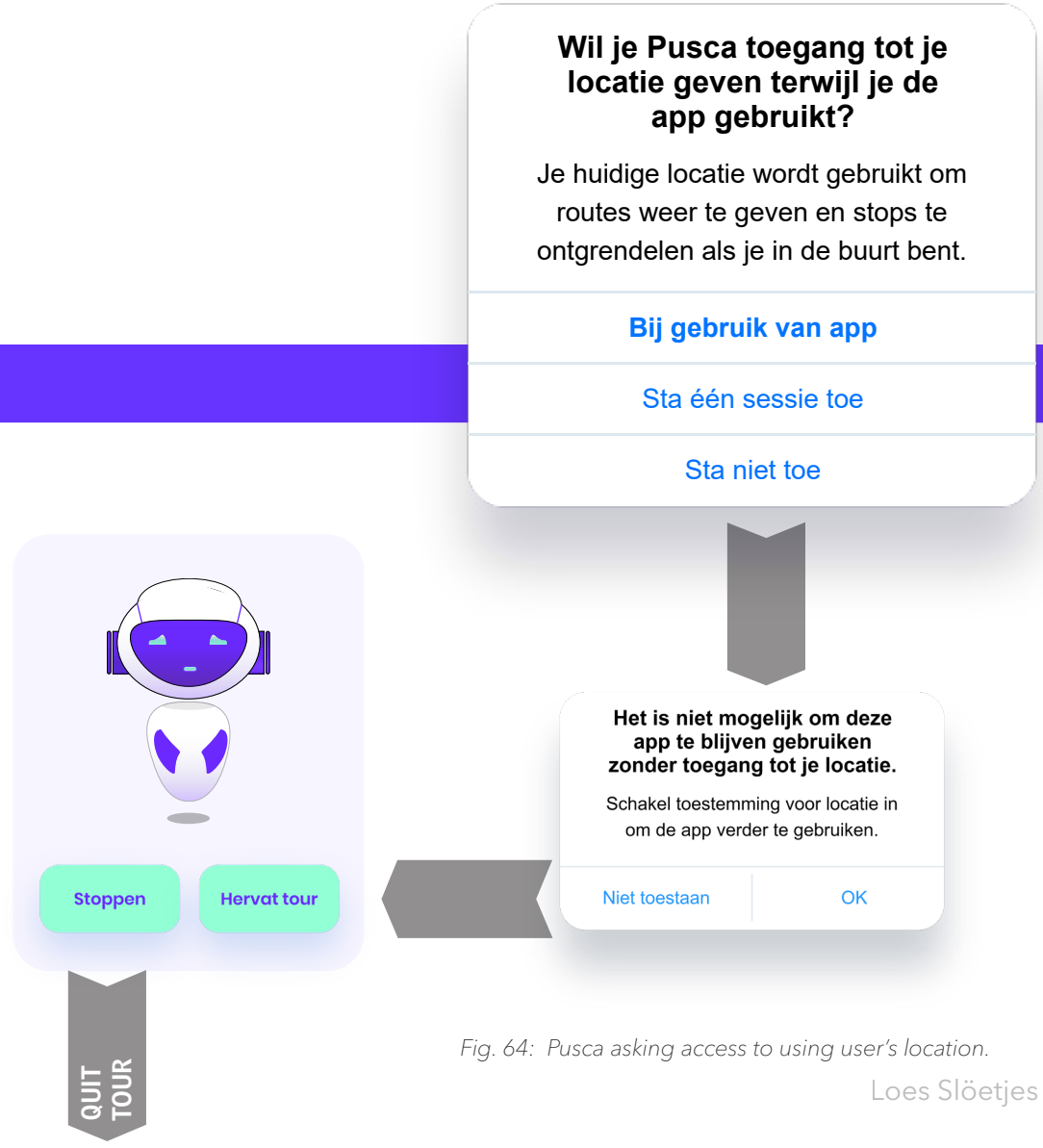


Fig. 64: Pusca asking access to using user's location.

STOP 1

4.3.1 Stop 1 - Smart Environment

If the user gives permission to use their location data, the address of the first stop is presented, along with the title of the stop and a hint of the smart city technology that is to be explored at that following stop (see fig. 65).

Step 1 - Location information

The first stop is based on the Environment Smart city Pillar and the location is the Skatebaan Jaarbeursplein. This is the only outdoor sport park in Utrecht of this size and is ideal for skaters, joggers and other fitness fanatics who can let off steam in the fresh outdoor air (Skatepark Jaarbeursplein SkateOn Skateparks freerun concrete shotcrete, n.d.). This location is chosen because it links directly to outdoor sports and the air quality is poor according to Longfonds (n.d.). (see fig. 66).

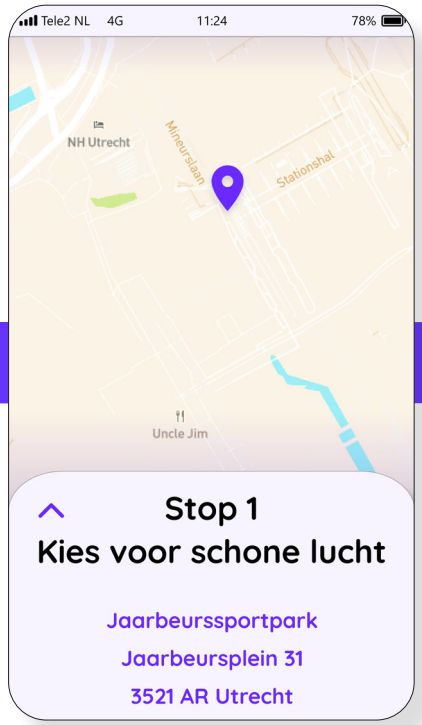


Fig. 65: Tour stop 1 screen 1: Directions to the location of the first stop.

STEP 1: LOCATION INFORMATION

Fig. 66: Tour stop 1 screen 2: Information about the location.

STEP 2: PRESENTING PROBLEM

Fig. 67: Tour stop 1 screen 3: Presenting the problem.

STEP 3: SMART CITY TECHNOLOGY

Fig. 68: Tour stop 1 screen 4: Smart technology solution.

STEP 4: ALSO FOR YOU

Fig. 69: Tour stop 1 screen 5: Also for you.

Step 2 – Problem

The app presents the air quality measurement of the user's current location at Skatebaan Jaarbeurspark and it shows how bad the air quality is (Longfonds. Nl - Gezonde Lucht, n.d.) (see fig. 67). The problem for this location is that there are lots of particulate emissions in the air. "Particulate emissions" is a collective name for invisible small particles that float in the air and are a form of pollution. They are mostly produced by traffic, lifestock farming and household products like lotions, paint and cleaning supplies (Waarom is fijnstof zo'n groot probleem?, n.d.). However, multiple factors such as the weather can influence the amount of particulate measures and therefore it can vary from day to day. Breathing in too much of these particulate emissions one or two times is no problem, but taking in too much of it throughout the year can cause serious health damage. It is estimated that 7.000 to 12.000 people die each year because of the consequences of breathing in particulate matters (Waarom is fijnstof zo'n groot probleem?, n.d.). The Skatebaan Jaarbeursplein scores extremely high on the amount of particulate matters that float in the air and almost exceeds the limits set by the World Health Organisation (WHO) (Provincie Utrecht, 2018). The danger is that these molecules are so small that it is unnoticeable for people and therefore it is difficult to be aware of how much you breathe in.

STEP 5: COLLECT DATA

Fig. 70: Tour stop 1 screen 6: Asking the user about their favorite outdoor sports.

Fig. 71: Tour stop 1 screen 7: Asking the user about how often they practice these sports a week.

Fig. 72: Tour stop 1 screen 8: Loading screen of Pusca looking for the cleanest air.

Step 3 – Smart city technology solution

Snuffelfiets has found a solution to this invisible problem. Snuffelfiets is an initiative where normal bikes get equipped with a sensor that measures air quality (Over Snuffelfiets – Snuffelfiets, n.d.). Air quality in one place can vary from day to day, but because bikes are mobile and have access to places in the city where cars can't come, accurate daily measurements can give a clear overview of the current air quality in the city (see fig. 68).

Step 4 – Also for you

For the user to find out what places in Utrecht are suited to go for some exercise on that day an air quality map of Utrecht can be presented. In this way the user can consult Snuffelfiets' air quality data before going for some exercise and not only keeping their bodies but also their lungs healthy (see fig. 69).

Step 5 – Share data

The user is asked about what kind of outdoor sports they practice and how often they do so (see fig. 70 and 71). The selected outdoor sports that the user can choose from are based on the most practiced outdoor sports in the Netherlands (Netherlands: Popular Sports 2020 | Statista, n.d.). Pusca explains that this information will be combined with the measured air quality data of Snuffelfiets on that particular day, to mark locations that are suitable for the selected sports with good air quality.

Step 6 – Experience smart city

After the user shared their information Pusca shows a loading screen that says Pusca is looking for the best areas with good air quality (see fig. 72). After that the user gets presented with the smart technology and the user is told that the map provided below shows areas that have very good and very bad air quality, so the user knows what locations to go to and what locations can better be avoided (see fig. 73). When the user opens the map they can scroll around and click on the dots that display the air quality measurement of that exact location at that moment (see fig. 74). When the user is done exploring the map they can continue the tour by clicking 'next'. The user is then informed again that the smart city technology that they just discovered is displayed at the end of the tour, so the user is able to find where and how to use this technology for themselves (see fig. 75).

Fig. 73: Tour stop 1 screen 9: Letting the user experience the smart city technology.

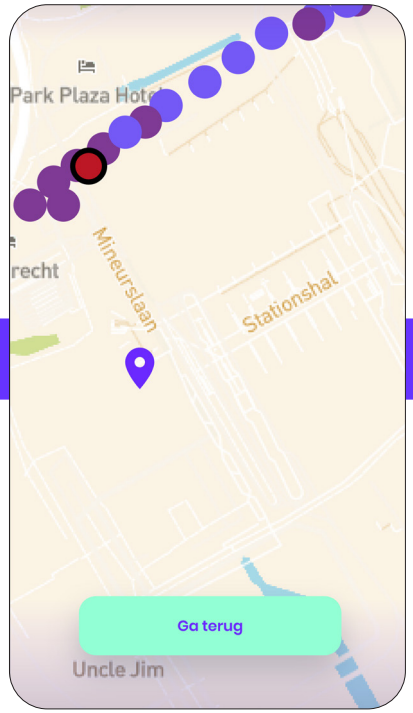


Fig. 74: Tour stop 1 screen 10: Map of locations with good and bad air quality.

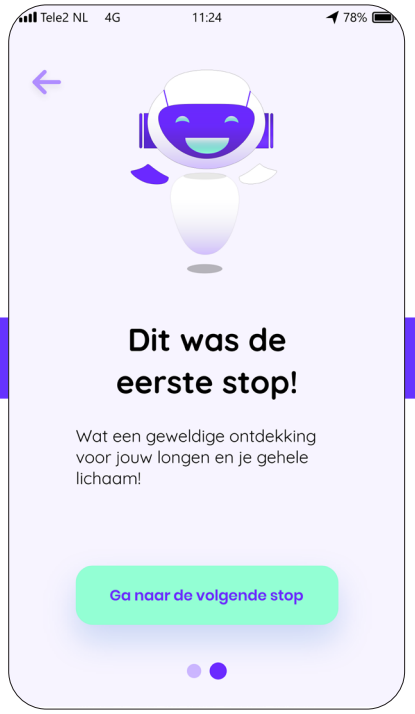


Fig. 75: Tour stop 1 screen 11: Congratulating the user on completing the stop.

STOP 2

Fig. 76: Tour stop 2 screen 1: Directions to the location of the second stop.

STEP 1: LOCATION INFORMATION

Fig. 77: Tour stop 2 screen 2: Information about the location.

4.3.2 Stop 2 - Smart Living

When the first stop is completed the user is presented with a screen that shows the address of the second stop and a hint of what sort of smart city technology can be explored there (see fig. 76).

Step 1 - Location information

The location of the second stop is based on the Living smart city pillar and is called: The Green House. It is a completely circular and sustainable restaurant, urban farm, green hub and city terrace in one (The Green House | Restaurant in Utrecht, n.d.). This location is selected because several technologies are implemented to reduce the building's carbon footprint and electricity use, and the building itself is an inspiration for circular and sustainable architecture (see fig. 77).

Step 2 - Problem

Resources are scarce and new ways of energy are needed to save our planet and future generations. All small bits help and everyone should do one's bit, only then we can make a difference (see fig. 78).

Step 3 – Smart city technology solution

Everyone can contribute to a better world and be more environmentally friendly. This starts at our homes. Many smart living technologies in our own homes can contribute to this goal and the Huis&Energie platform is especially created for this. The platform is made possible by Rijksoverheid, milieu centraal, Gamma and GreenChoice and is focused on informing citizens on making their own homes more sustainable and energy neutral (Energie, n.d.) (see fig. 79).

Step 4 – Also for you

Pusca informs the user that they can also make a contribution to a more sustainable world, starting at their own homes. If they are willing to share some personal data, several smart living technologies that are suited for their home will be presented (see fig. 80).

Step 5 – Share data

The user is asked to share three questions about their house: the type of roof, the type of house the type of outdoor space if there is any (see fig. 81). The fourth question is about what the user's household looks like and the last question is about the income of this household a month (see fig. 82 and 83). Each of these datapoints will contribute to creating a selection from all the possible living technologies presented on the platform Huis&Energie.

STEP 2: PRESENTING PROBLEM

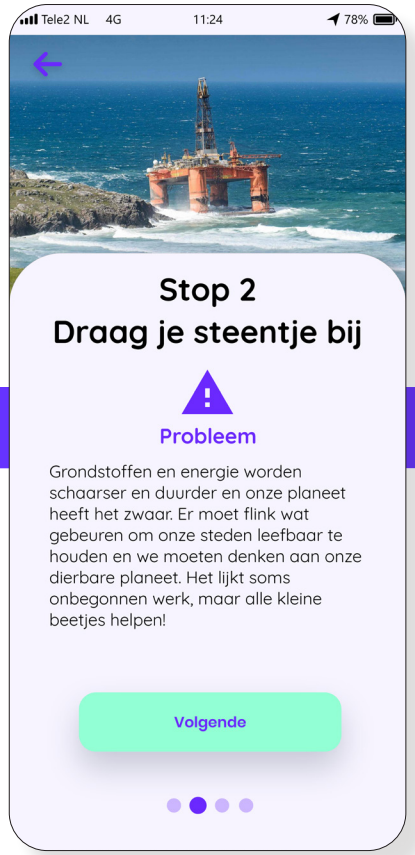


Fig. 78: Tour stop 2 screen 3: Presenting the problem.

STEP 3: SMART CITY TECHNOLOGY

Fig. 79: Tour stop 2 screen 4: Smart technology solution.

STEP 4: ALSO FOR YOU

Fig. 80: Tour stop 2 screen 5: Also for you.

STEP 5: COLLECT DATA

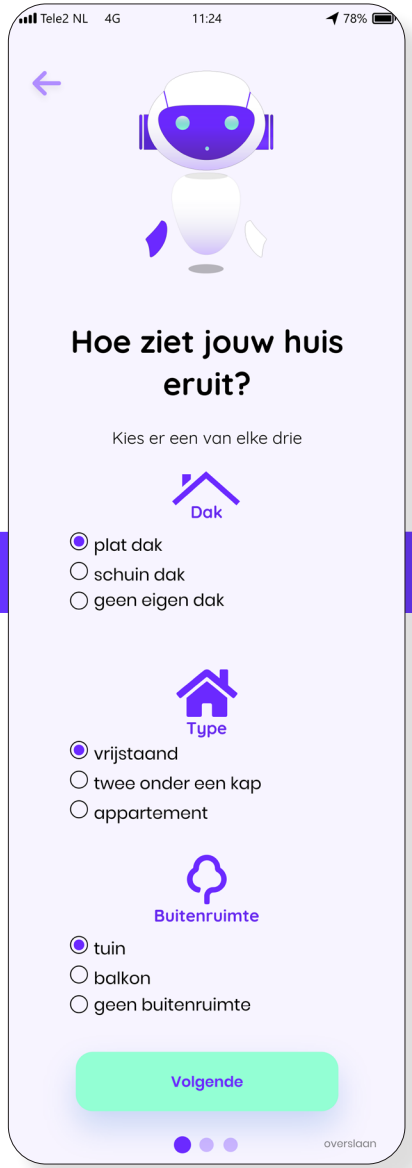


Fig. 81: Tour stop 2 screen 6: Asking the user about their home.

Fig. 82: Tour stop 2 screen 7: Asking the user about their household.

Fig. 83: Tour stop 2 screen 8: Asking the user about their income.

Step 6 – Experience Smart City

After the user shared their information Pusca shows a loading screen saying that Pusca is searching for smart living technologies that match the user's house and household (see fig. 84). In the next screen the user is presented with a schematic house that is divided into four sections: bathroom, kitchen, living room and general (see fig. 85). When clicking on one of these sections, specific smart living technologies are listed that are suited for the user's house and household (see fig. 86 to 90). These smart living technologies are selected from the Huis&Energie platform and are all suited for any household and any house (Energie, n.d.). After the user is done exploring the smart living technologies, they can continue the tour by clicking 'next'. The user is then informed again that the smart city technology that they just discovered is displayed at the end of the tour, so the user is able to find where and how to use this technology for themselves (see fig. 91).

STEP 6: EXPERIENCE TECHNOLOGY

Fig. 84: Tour stop 2 screen 9: Loading screen of Pusca looking for smart home technologies.

Fig. 85: Tour stop 2 screen 10: Letting the user experience the smart city technology.

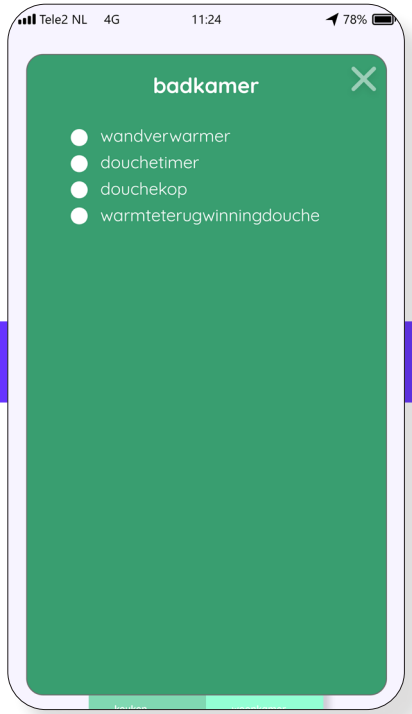


Fig. 86: Tour stop 2 screen 11A: Smart home technologies bathroom.

Fig. 87: Tour stop 2 screen 11B: Smart home technologies general.

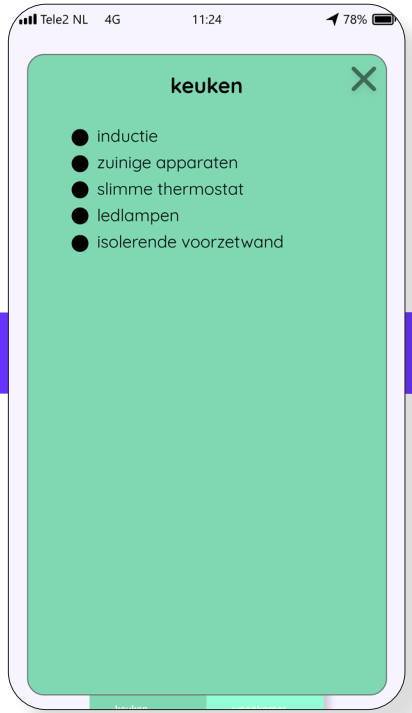


Fig. 88: Tour stop 2 screen 11C: Smart home technologies kitchen.

Fig. 89: Tour stop 2 screen 11D: Smart home technologies living room.

Fig. 90: Tour stop 2 screen 11E: Example of one of the smart home technologies.

Fig. 91: Tour stop 2 screen 12: Congratulating the user on completing the stop.

4.3.3 Stop 3 - Smart Economy

After completing the second stop the user gets presented with a screen that shows the address of the third stop and a hint of what sort of smart city technology can be explored there (see fig. 92).

Step 1 - Location information

The location of the third stop is at the entrance of the shopping mall 'Hoog Catharijne', and is based on the Economy smart city pillar (see fig. 93). This location is selected because Hoog Catharijne has approximately 30 million visitors each year and is one of the most crowded areas of Utrecht ('Winkelcentra', n.d.).

STOP 3

Fig. 92: Tour stop 3 screen 1: Directions to the location of the third stop.

STEP 1: LOCATION INFORMATION

Fig. 93: Tour stop 3 screen 2: Information about the location.

STEP 2: PRESENTING PROBLEM

Fig. 94: Tour stop 3 screen 3: Presenting the problem.

STEP 3: SMART CITY TECHNOLOGY

Fig. 95: Tour stop 3 screen 4: Smart technology solution.

STEP 4: ALSO FOR YOU

Fig. 96: Tour stop 3 screen 5: Also for you.

Step 2 – Problem

Utrecht is the fastest growing city of the Netherlands. In 2040 it is estimated to be home to 452.560 citizens, that is an increase of more than 26% than it is now (Bevolkingsprognose 2020, n.d.). Not only in shopping malls but in the entire city it will be more crowded and in order to keep the city livable this has to be managed (see fig. 94).

Step 3 – Smart city technology solution

To manage the crowdedness in the city, the municipality of Utrecht has introduced Druktemonitor, an online map where visitors can see what places are crowded and which are not (see fig. 95)(Druktemonitor, n.d.). With multiple measurements over time, an estimation of the expected amount of people for that location can be made. With this information the municipality is aware of the locations where actions should be taken to make it less crowded.

Step 4 – Also for you

Druktemonitor could not only benefit Utrecht's municipality, but it can also give citizens an insight in which locations in the city are or which locations are expected to be more or less crowded than average (see fig. 96). If the user is willing to share information about their favorite free time activities in the city, Pusca will present a map with the measured and predicted crowdedness of those activity areas.

Step 5 – Share data

The user is asked to share information about their favorite free time activities or places in the city, which are based on the free time themes of the municipality Utrecht (Vrije Tijd | Gemeente Utrecht, n.d.) (see fig. 97).

Step 6 – Experience the smart city

After the user shared their information Pusca shows a loading screen saying that Pusca is estimating crowdedness in and around Utrecht (see fig. 98). The next screen explains to the user that the map provided below shows how crowded the areas of their stated free time activities are at the moment (see fig. 99). When the user opens the map they can scroll around and click on the activity icons too see the current crowdedness of that location (see fig. 100). When the user is done exploring the map they can continue by clicking 'next'. The user is then informed again that the smart city technology that they just discovered is displayed at the end of the tour, so the user is able to find where and how to use this technology for themselves (see fig. 101).

STEP 5: COLLECT DATA

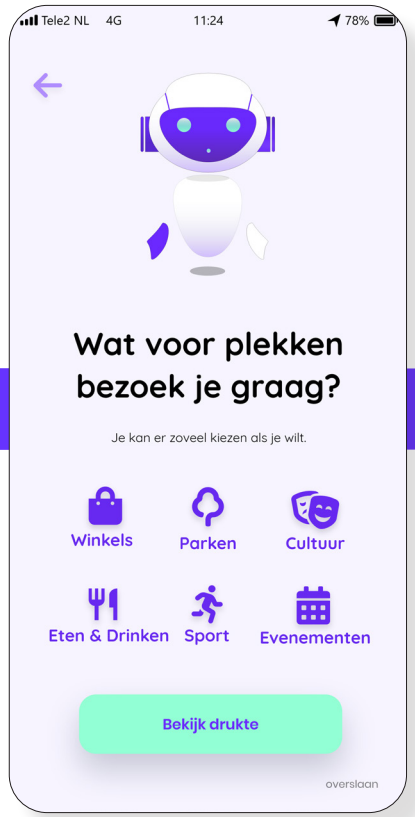


Fig. 97: Tour stop 3 screen 6: Asking the user about their free time activities.

Fig. 98: Tour stop 3 screen 7: Loading screen of Pusca looking for crowdedness.

STEP 6: EXPERIENCE TECHNOLOGY

Fig. 99: Tour stop 3 screen 8: Letting the user experience the smart city technology.

A pop-up appears that Pusca predicts that the direction that the user is guided to is very crowded (see fig. 102). The pop-up gives the user the choice to let Pusca adjust the route to avoid crowdedness or to keep the current route. This pop-up is implemented to let the user experience direct benefit of the smart city technology that they just explored. The reason for this is to make them aware of how they could use this technology and increase their willingness of implementing the technology into their lives. If the user allows Pusca to adjust the route a screen appears that informs the user that Pusca is adjusting their route (see fig. 103). After that Pusca presents the adjusted route to the fourth stop. If the user choses not to change the route they are able to close the pop-up and continue the tour (see fig. 104).

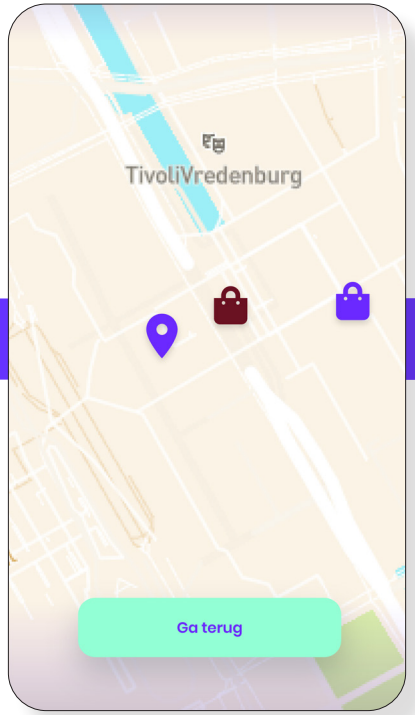


Fig. 100: Tour stop 3 screen 9: Map of areas with the user's favorite activites and estimated crowdedness.

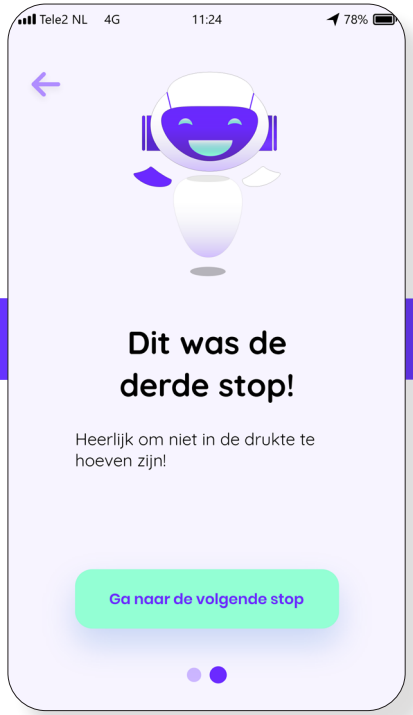


Fig. 101: Tour stop 3 screen 10: Congratulating the user on completing the stop.

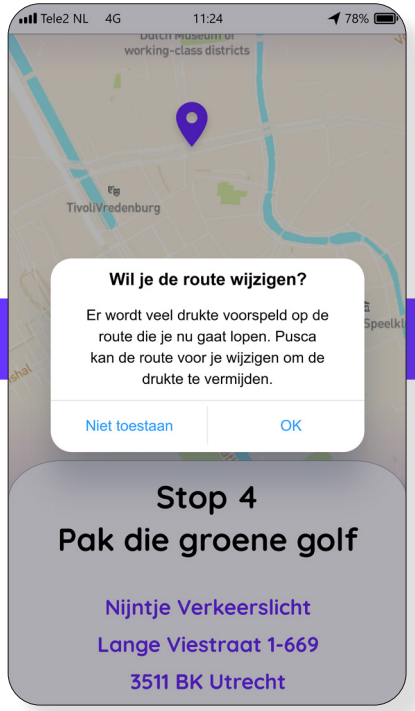


Fig. 102: Tour stop 3 screen 11: Asking the user to adjust their route.

Fig. 103: Tour stop 3 screen 12: Loading screen to adjust the route of the tour.

STOP 4

STEP 1: LOCATION INFORMATION

Fig. 104: Tour stop 4 screen 1: Directions to the location of the fourth stop.

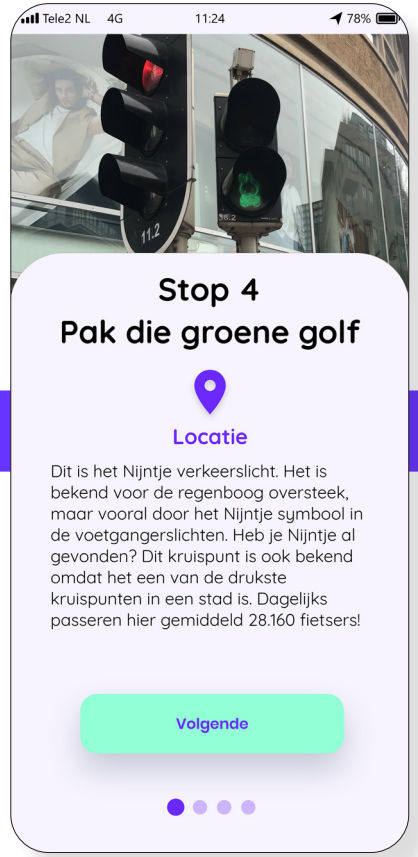


Fig. 105: Tour stop 4 screen 2: Information about the location.

4.3.4 Stop 4 - Smart Mobility

After completing the third stop the user gets presented with a screen that shows the address of the fourth stop and a hint of what sort of smart city technology can be explored there (see fig. 104).

Step 1 – Location information

The fourth stop is based on the Mobility smart city pillar and the location is the Nijntje traffic light (Nijntje pleintje, 2012). The traffic light is known for the rainbow colored pedestrian crossing and the world famous Nijntje icon in the traffic lights. This location is selected because the intersection is one of the busiest in any city in the Netherlands. Around 28.160 cyclists pass by daily (Tachtig Procent Minder Fietsers Op Vredenburg Sinds Coronamaatregelen, n.d.). (see fig. 105).

STEP 2: PRESENTING PROBLEM

Fig. 106: Tour stop 4 screen 3: Presenting the problem.

STEP 3: SMART CITY TECHNOLOGY

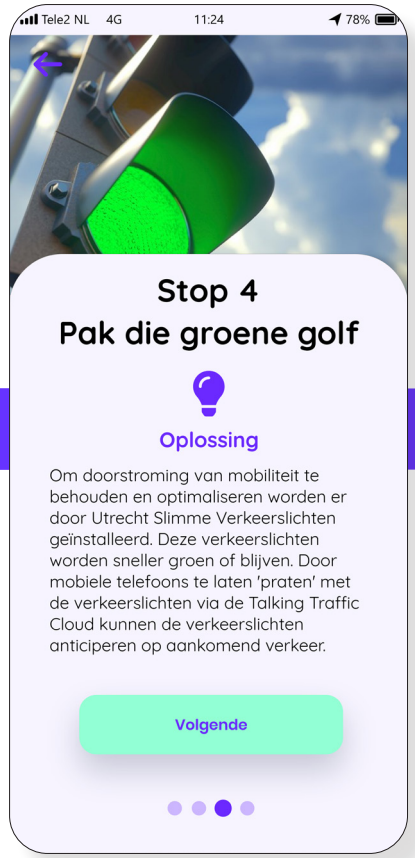


Fig. 107: Tour stop 3 screen 4: Smart technology solution.

STEP 4: ALSO FOR YOU

Fig. 108: Tour stop 4 screen 5: Also for you.

Step 2 – Problem

Too much traffic can hinder the mobility flow in a city and increase the amount of exhaust gasses (see fig. 106). This causes discomfort for the travelers and has a negative effect on the environment (Talking Traffic, n.d.).

Step 3 – Smart city technology solution

Utrecht is installing smart traffic lights throughout the city to optimize mobility flow (see fig. 107). These smart traffic lights turn green faster or stay longer green. By communicating with mobile phones through Talking Traffic, these traffic lights can anticipate on upcoming traffic (Talking Traffic, n.d.).

Step 4 – Also for you

Pusca informs the user that if they share their bike travel information Pusca can show routes that pass by smart traffic lights (see fig. 108). An estimation is made of the routes that the user can take best to make use of the green flow and not be stopped at a red light.

Step 5 – Share data

The user is asked to share information about how many hours a week they take the car and ride their bike (see fig. 109 and 110). This information is useful to predict how much travel time the user can save using Talking Traffic.

Step 6 – Experience the smart city

After the user shared their information Pusca shows a loading screen that says Pusca is using the information to predict green flows throughout the city (see fig. 111). On the next screen Pusca tells the user that they can save around 15% of their travel time in the morning rush hour and up to 25% in the evening rush hour by making use of Talking Traffic. These numbers are shared increase the user's desire to wanting to use this smart city technology. On the same screen the user is explained that the map provided below shows locations of already installed smart traffic lights and smart traffic lights that will be installed in the future (see fig. 112). In the coming years all traffic lights will be replaced by smart ones (Talking Traffic, n.d.). When the user opens the map they can scroll around and identify where these smart traffic lights are located and how they should navigate through the city to make use of these and catch the green flow (see fig. 113). When the user is done exploring the map they can continue by clicking 'next'. The user is then informed again that the smart city technology that they just discovered is displayed at the end of the tour, so the user is able to find where and how to use this technology for themselves (see fig. 114).

Fig. 109: Tour stop 4 screen 6: Asking the user about their car travel behavior.

Fig. 110: Tour stop 4 screen 7: Asking the user about their bike travel behavior.

Fig. 111: Tour stop 4 screen 8: Loading screen of Pusca looking for smart traffic lights.

STEP 6: EXPERIENCE TECHNOLOGY

Fig. 112: Tour stop 4 screen 9: Letting the user experience the smart city technology.

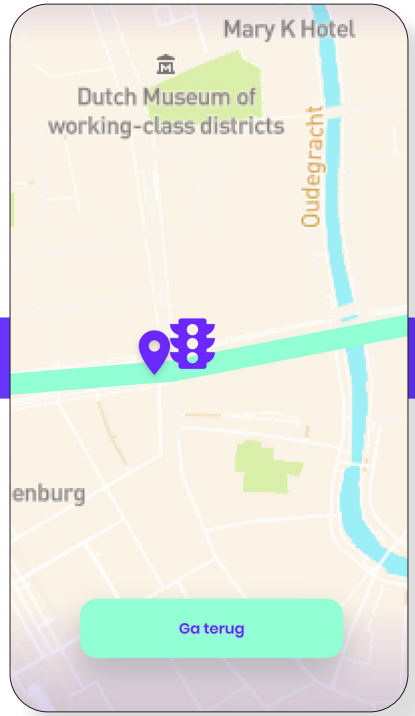


Fig. 113: Tour stop 4 screen 10: Map of areas with smart traffic lights.

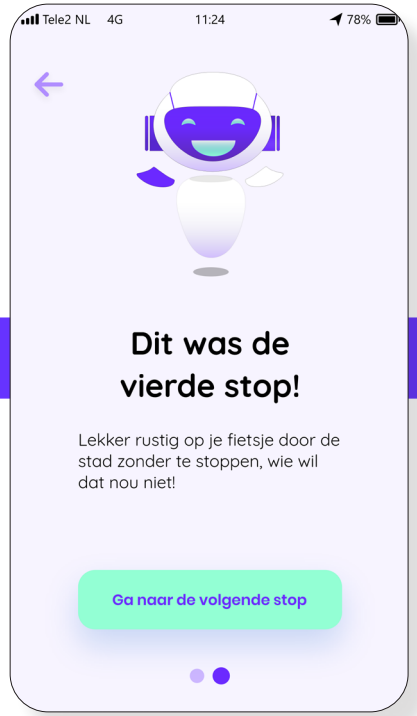


Fig. 114: Tour stop 4 screen 11: Congratulating the user on completing the stop.

4.3.5 Stop 5 - Smart Governance

After completing the fourth stop the user gets presented with a screen that shows the address of the fifth stop and a hint of what sort of smart city technology can be explored there (see fig. 115).

Step 1 – Location information

The fifth stop is based on the Governance smart city pillar and the location is the square 'de Neude' (De Neude. Het Leukste Plein van Utrecht., n.d.) (see fig. 116). De Neude has a very busy nightlife with lots of cafés and bars. However, nightlife is not only thriving because of people going out, it also is the area where most burglaries occur (StatLine - Geregistreerde misdrijven; wijken en buurten 2017, n.d.) and that is why this location is selected.

STOP 5

STEP 1: LOCATION INFORMATION

Fig. 115: Tour stop 5 screen 1: Directions to the location of the fourth stop.

Fig. 116: Tour stop 5 screen 2: Information about the location.

STEP 2: PRESENTING PROBLEM

Fig. 117: Tour stop 5 screen 3: Presenting the problem.

STEP 3: SMART CITY TECHNOLOGY

Fig. 118: Tour stop 5 screen 4: Smart technology solution.

STEP 4: ALSO FOR YOU

Fig. 119: Tour stop 5 screen 5: Also for you.

Step 2 – Problem

The number of burglaries a year is declining in Utrecht, but 90% of the cases are not solved (Voor Bijna 90 Procent van de Woninginbraken in Utrecht Wordt Geen Verdachte Opgepakt, 2021). The city center of Utrecht has one of the highest burglary rates of the city (see fig. 117).

Step 3 – Smart city technology solution

The Inbraakbarometer combines burglary history with demographic data to make predictions about burglary risks (Inbraakbarometer, n.d.). This information can be used by local police to anticipate to direct policemen to areas with high risks (see fig. 118).

Step 4 – Also for you

Pusca informs the user that predicting burglaries is not only helpful for the local police, it also informs citizens of burglary risks in their neighborhood (see fig. 119). By sharing data about their postal code and house number the Inbraakbarometer can predict burglary risks in their neighborhood. Pusca tells the user that they are able to set an alarm when the burglary risk in their area increases and they know when to take better safety measures to secure their homes.

Step 5 - Share data

Pusca asks the user to share their postal code and house number (see fig. 120 and 121). This information is combined with demographic data to make predictions about burglaries in their neighborhood.

STEP 5: COLLECT DATA

Fig. 120: Tour stop 5 screen 6: Asking the user about their postal code.

Fig. 121: Tour stop 5 screen 7: Asking the user about their housenumber.

Fig. 122: Tour stop 4 screen 8: Loading screen of Pusca looking for smart traffic lights.

Step 6 – Experience the smart city

After the user shared their information Pusca shows a loading screen that says Pusca is calculating the burglary risks in their neighborhood (see fig. 122). The next screen presents the current burglary risk for the user's home and a five day burglary risk prediction (see fig. 123). When the user is done exploring statistics they can continue by clicking 'next'. The user is then informed again that the smart city technology that they just discovered is displayed at the end of the tour, so the user is able to find where and how to use this technology for themselves (see fig. 124).

STEP 6: EXPERIENCE TECHNOLOGY

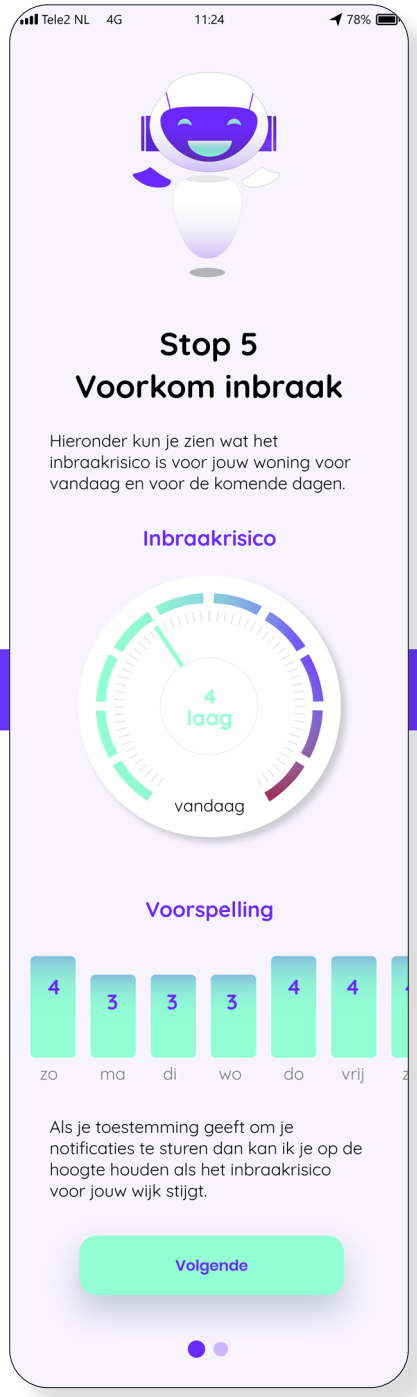


Fig. 123: Tour stop 5 screen 9: Letting the user experience the smart city technology.

Fig. 124: Tour stop 5 screen 10: Congratulating the user on completing the stop.

4.3.6 Stop 6 - Smart People

After completing the fifth stop the user gets presented with a screen that shows the address of the sixth stop and a hint of what sort of smart city technology can be explored there (see fig. 125).

Step 1 – Location information

The sixth stop is based on the People smart city pillar and the location is Utrecht city hall, where the mayor and local council come together to talk about plans (see fig. 126). This location is selected because it is seen as a symbol where citizens can make contact with the policymakers of Utrecht.

STOP 6

Fig. 125: Tour stop 6 screen 1: Directions to the location of the fourth stop.

STEP 1: LOCATION INFORMATION

Fig. 126: Tour stop 6 screen 2: Information about the location.

STEP 2: PRESENTING PROBLEM

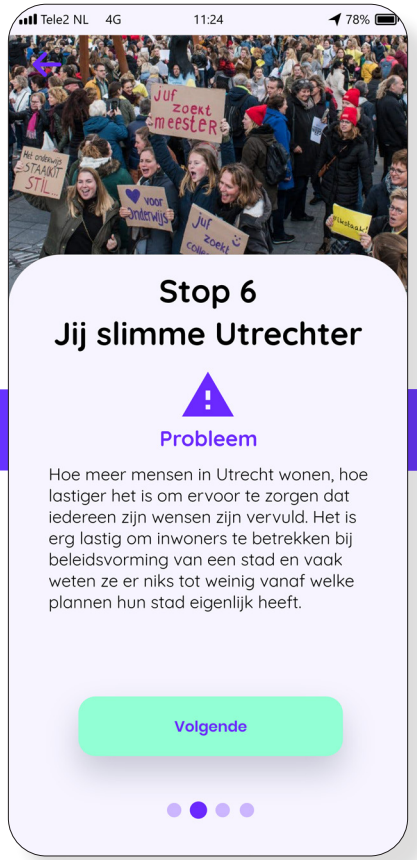


Fig. 127: Tour stop 6 screen 3: Presenting the problem.

STEP 3: SMART CITY TECHNOLOGY

Fig. 128: Tour stop 6 screen 4: Smart technology solution.

STEP 4: ALSO FOR YOU

Fig. 129: Tour stop 6 screen 5: Also for you.

Step 2 – Problem

Previous research of CLEVER°FRANKE states that about 50% of Utrecht's citizens are interested in being able to put issues on the political agenda, however it is challenging to engage citizens in smart urban governance (see fig. 127).

Step 3 – Smart city technology solution

The government created the digital platform DENKMEE where citizens can share their opinion about future plans of Utrecht (Denk Mee over Utrecht, n.d.). The government wants to stimulate co-creating the city with its citizens and want to provide an easy way for citizens to share their thoughts about the future of Utrecht (see fig. 128).

Step 4 – Also for you

Pusca informs the user that by creating an account with their email address they are able to see which plans are currently being realized in and around Utrecht (see fig. 129).

Step 5 – Share data

Pusca asks the user to create an account on the DENKMEE platform by entering their Facebook, Google or email address (see fig. 130 to 133). With this account the user is able to see and talk about the future plans of Utrecht.

Fig. 130: Tour stop 6 screen 6: Asking the user about how they want to login to DENKMEE.

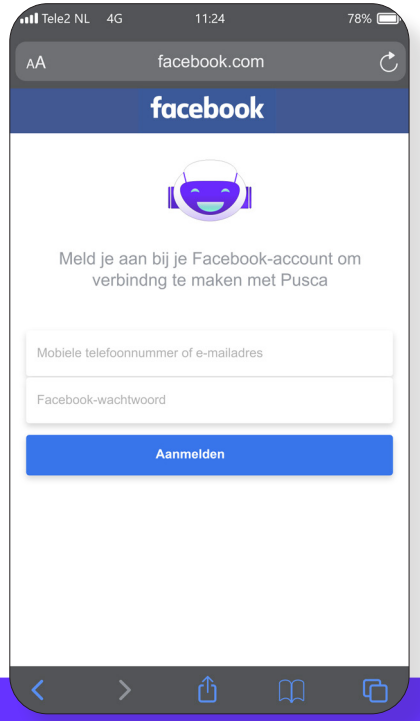


Fig. 131: Tour stop 6 screen 7A: Asking the user about their facebook login.

Fig. 132: Tour stop 6 screen 7B: Asking the user about their email or gmail login.

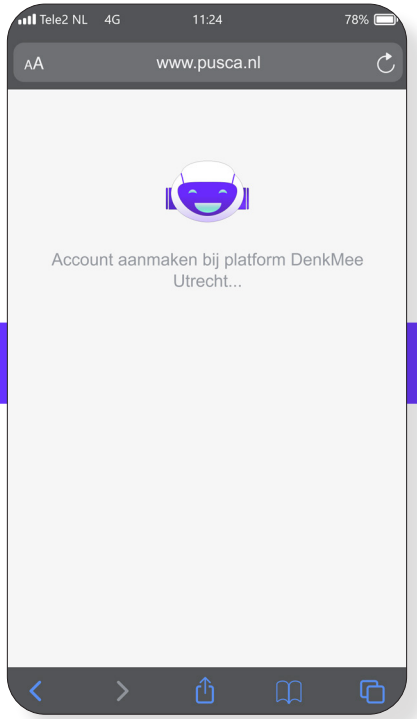


Fig. 133: Tour stop 6 screen 8: Loading screen of Pusca logging in on DENKMEE.

Step 6 - Experience the smart city

After the user shared their information Pusca shows a loading screen that says Pusca is creating an account for the online platform DENKMEE. The next screen presents the homescreen of the online platform where projects in and around Utrecht are displayed (see fig. 134). The user is able to explore the different projects and share their opinion about them and when they are done they can continue the tour by clicking 'go back to Pusca (ga terug naar Pusca)'. The user is then informed again that the smart city technology that they just discovered is displayed at the end of the tour, so the user is able to find where and how to use this technology for themselves (see fig. 135).

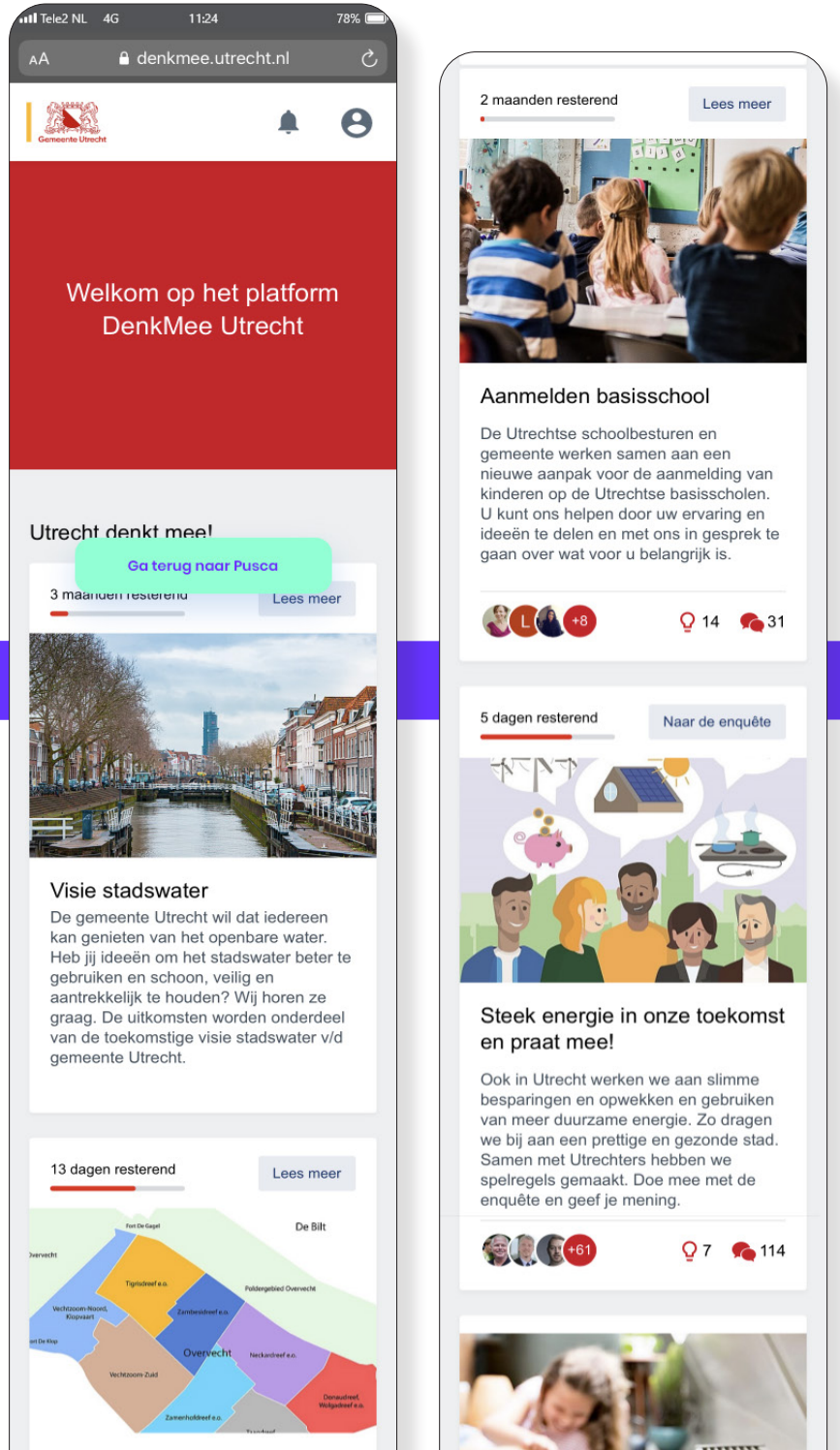


Fig. 134: Tour stop 6 screen 9: Letting the user experience the smart city technology.

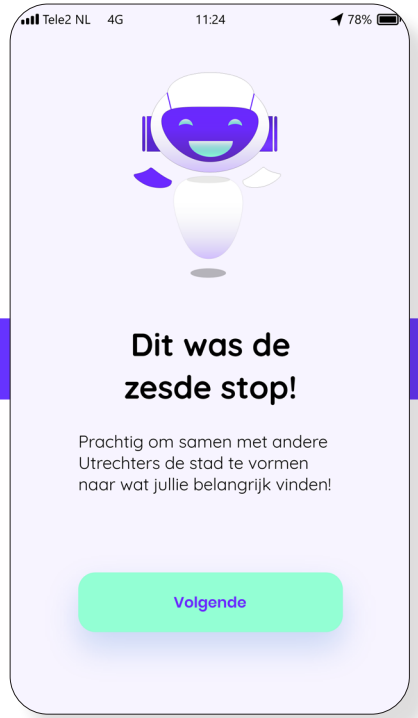


Fig. 135: Tour stop 6 screen 10: Congratulating the user on completing the stop.

4.4 TOUR PHASE 3: THE REVEAL

After finishing all the stops in the second phase, the user enters the third phase of the tour. In this phase the user is shown an overview of all the smart city technologies that they discovered during the tour, but something unexpected also happens. The user gets confronted with how much and what kind of personal data they shared, and how this could negatively impact their privacy instead of providing benefits (see section 3.2.5). After the reveal the user is guided back to the smart city technologies overview and is left there with their thoughts. At the end of the experience the user is reassured that their privacy wasn't actually violated by revealing the goal of the project. A few tips and links about how to protect and manage their privacy can also be found on that screen. Each of the steps in this phase will be explained further in the next sections.

4.4.1 Overview smart city technologies

After completing all the stops the user is congratulated (see fig. 136). Information and sources about the discovered and experienced smart city technologies from each stop are visible on the overview screen (see fig. 138). In this way the user is able to see where they could find these existing smart city technologies and how they could implement these into their lives.

Fig. 136: The reveal screen 1: Overview of completed smart city tour.

Fig. 137: The reveal screen 2: Loading screen.

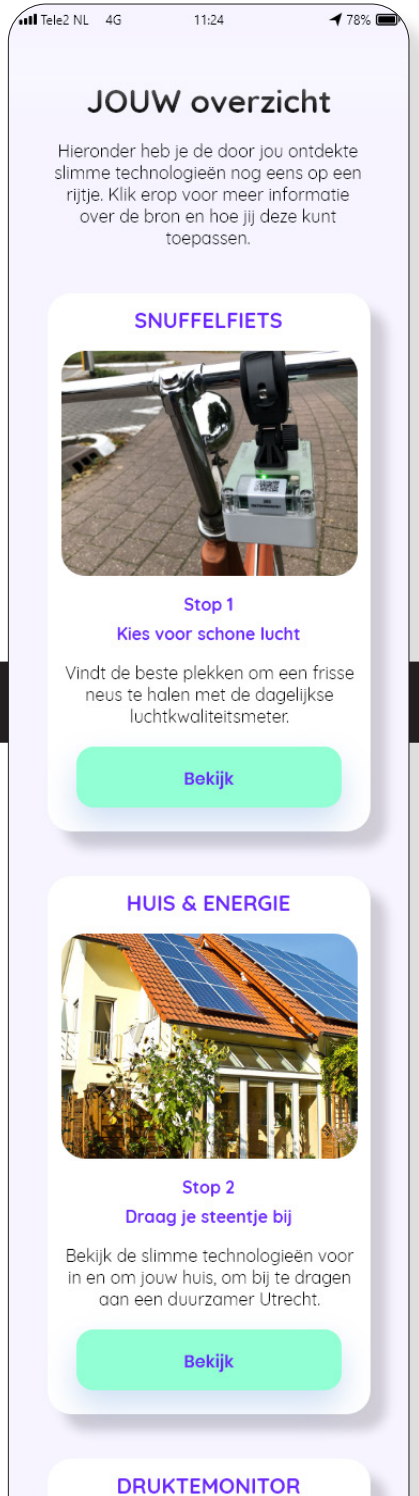


Fig. 138: The reveal screen 3: Smart city technologies overview.

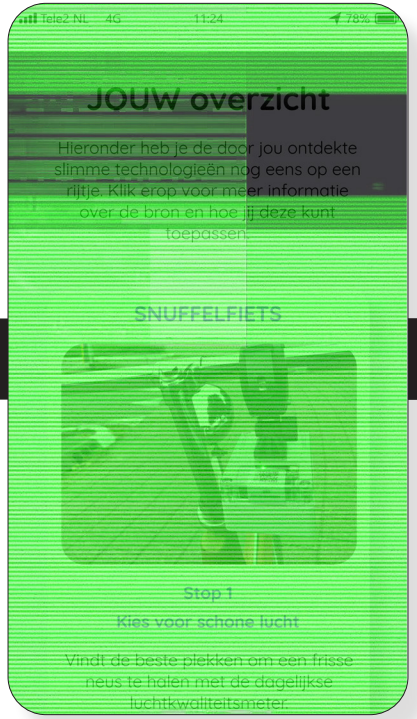


Fig. 139: The reveal screen 4: Glitch

```
import { pusca, data } from 'data';
       import { Voornaam } from './page/
login.po';
import { Achternaam } from './page/
login.po';
       import { Geboortedatum } from './
page/login.po';
       import { Geslacht } from './page/
login.po';
       import { Maatschappelijke
interesses } from './page/login.po';
       import { Locatie } from './page/
login.po';
       import { Sport } from './stop1/
data.po';
       import { Sport per week } from './
stop1/data.po';
       import { Huis specificaties } from
'./stop2/data.po';
       import { Huishouden } from './stop2/
data.po';
      import { Inkomen } from
'./stop2/data.po';
       import { Vrije tijd activiteiten}
from './stop3/data.po';
       import { Reisgedrag } './stop4/
data.po';
       import { Postcode } from './stop5/
data.po';
       import { Huisnummer } from './stop5/
data.po';
       import { FacebookLogin } from './
stop6/data.po';
       import { Emailadres } from './stop6/
data.po';

 "/sell/buyer/orderDetail",
$("#wait_to_pay").text(data.waitToPay);     }
self::get_customer_personal_data(
       'item_id'           => 'user',
       'data'              =>

$customer_personal_data,
return array(
       'data' => $data_to_sell,
$("#wait_to_receive").text(data.waitToReceiv
e);                                  }

-----------------------------------------
(data.totalAmount > €0,13){
                                  }
```

Fig. 140: The reveal screen 5: Code

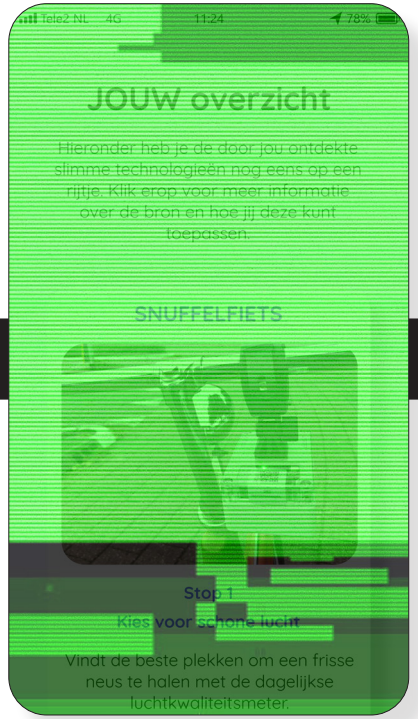


Fig. 141: The reveal screen 6: Glitch

4.4.2 Glitch, code, glitch

After a minute or so on the overview page the user is confronted with a glitch in the app (see fig. 139). This glitch guides the user to a screen where a code starts running (see fig. 140). This code sums up all the data that is collected from the user during the tour at the end it displayed that this personal data is sold for €0,13. This amount is converted from dollars and is based on the calculator by the Financial Times, that checks how much the multibillion-dollar data broker industry might pay for your personal data in dollars (How Much Is Your Personal Data Worth?, n.d.). This amount is significantly lower than the price that individuals are willing to accept for their personal data, namely €63,05 (Winegar & Sunstein, 2019).

I am not implying that it would be fine to sell people's data without consent if they get money for it, but I state that if people are given the choice to sell their data, €63,05 is considered the average price. The user is confronted with how little their personal data is worth in the data broker industry, compared to their own estimated value of their personal data. After the code is done running a similar glitch as the first one (see fig. 141) takes the user back to the smart city technologies overview (see fig. 138).

4.4.3 Message and conversation

When back at the overview the user is able to scroll through the technologies again, for half a minute or so (see fig. 138). This is done to let the glitch that just occurred sink in. After that a text message from Pusca appears on screen (see fig. 142). Only a small part of the message can be read to trigger the curiosity of the user to open the message. When opening the message the user is brought to a chat with Pusca (see fig. 143). In this chat Pusca first informs the user that their data is saved and shared with a list of companies. These companies are considered the biggest data brokers in the Netherlands (Big Data – JournalistEnSchaker, n.d.; Goslinga, 2015).

Fig. 142: The reveal screen 7: Message Pusca.

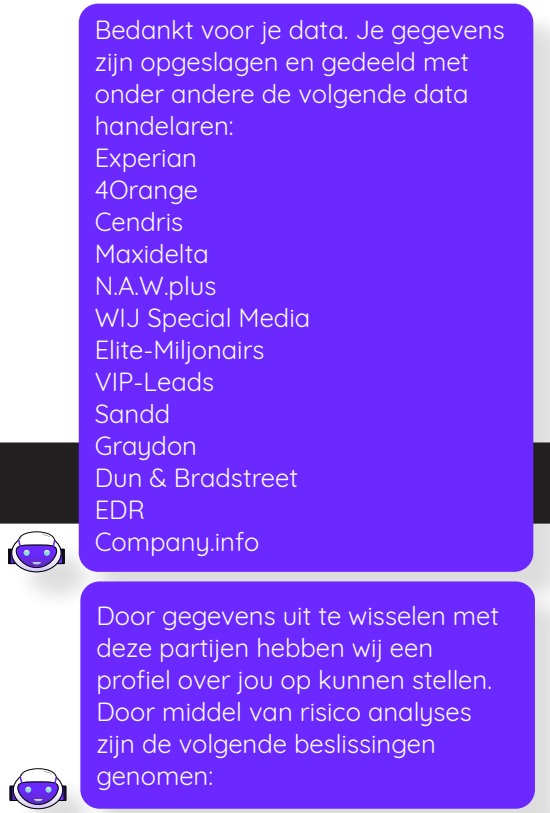


Fig. 143: The reveal screen 8: Conversation part A

Most citizens are not familiar with any of these companies, but most of them do know something about every individual (Goslinga, 2015). It is said that the collected personal data during this tour and already existing data about this particular user from these data brokers is combined and a personal profile is created. Pusca informs the user that analysing this profile has identified a few risks that also bring consequences from now on (see fig. 144). These consequences are based on the three main privacy concerns that individuals have when it comes to sharing their personal data (see section 1.4.2).

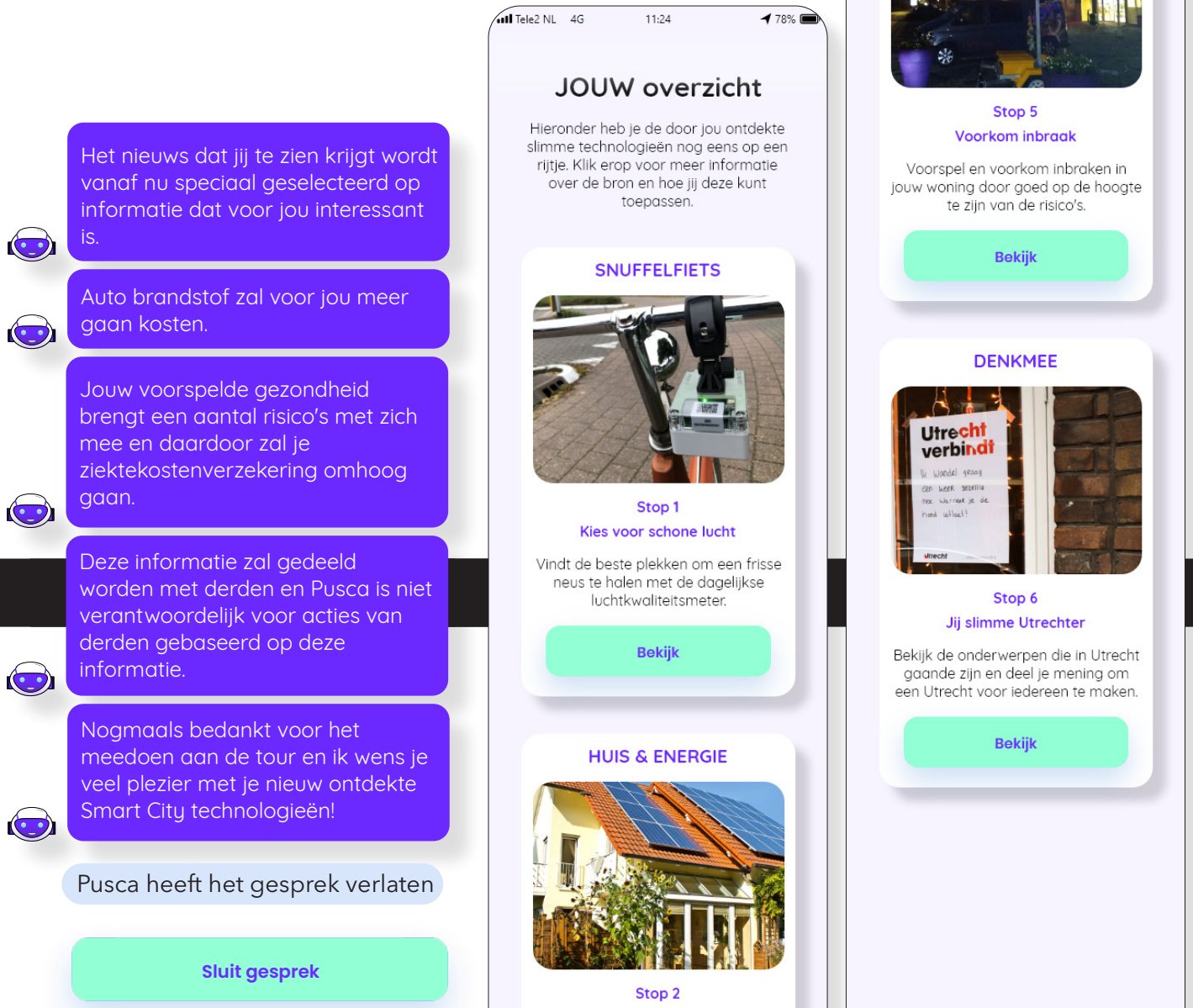


Fig. 144: The reveal screen 8: Conversation part B

1.Confrontation with unwanted information: News information that the user gets presented with will from now on be specifically selected on the basis of their interests.

2. Discrimination: Car fuel prices for the user will go up.

3. Loss of Autonomy: Based on the user's current health and lifestyle, future predictions about their health have identified risks, and user's health insurance will increase.

Pusca tells the user that this information will be shared with third parties and that Pusca can't be held responsible for any actions third parties may take based on the provided information. Finally, the user is thanked for going on the tour and Pusca leaves the chat. In order to enhance the feeling of powerlessness, the user is unable to respond in this conversation and has therefore no other option than to close the chat (see fig. 144). When the chat is closed the user is brought back to the smart city technologies overview and left with their thoughts to reflect about what just happened (see fig. 145).

Fig. 145: Smart technologies overview and closing Pusca

4.5 REASSURANCE

that the goal of the project is to encourage the user to form a critical view on data collection and privacy and not to collect and use their personal data. I think it is essential to communicate to the user that Pusca practices what it preaches.

The purpose of the design is to let the user critically reflect on personal data privacy, but the Pusca experience can raise some privacy questions on its own. The user might wonder what personal data is collected from them, how this data is used and if the data is actually sold to third parties. As explained before (section 4.2.1), an important design decision was to avoid creating a design that collects and uses personal data that may cause privacy issues. In order to inform and reassure the user after the Pusca experience that no personal data was collected or used in any way, a follow-up screen is presented to the user (see fig. 146). For further information about data privacy three external links are provided. These links provide the user with more information about data privacy and provide tips on how they can optimize their own data privacy (Archief Kennisbanken | About Privacy, n.d.; Privacy Op Internet » Tips Om Grip Te Krijgen Op Jouw Online Identiteit, n.d.; Schimmige Handel in Data Uit Apps | Consumentenbond, n.d.). At the bottom of the page information about this graduation project is given. A pop-up screen explains the goal of the graduation project to the user and if they wish to ask questions or if they are interested they can reach out and send an email. This screen is essential as a follow-up of the experience to make sure that the user knows

Fig. 146: Reassurance screen 1.

CONCLUSION CHAPTER

The goal of this chapter was to present the final concept design and explain the experience of Pusca: an application based personalized tour through Utrecht to let citizens explore smart city technologies and confronts them with the consequences of sharing personal data.

5

CONCLUSION

In this chapter the final concept design will be tested and evaluated by using a thematic qualitative analysis to see if it meets the sub-design goals and design goal set in chapter 2. After the validation I will discuss the project technicalities, the critical message and the design process. The chapter ends with a conclusion of the project with recommendations for the next steps the project could take.

5.1 FINAL CONCEPT DESIGN TEST

In this section I describe the test of the final concept design of Pusca. The goal is to collect information about the experience from the users. During this test six participants went go on a tour with Pusca through Utrecht to explore smart city technologies. I explain how the test was set up and conducted, and finally I present the findings. These findings lead to the final validation of the design and its design goals in the next section.

5.1.1 Setup

The participants are guided by the character Pusca through Utrecht to discover smart technologies that could improve their quality of life. In order for participants to have a short experience of these technologies they are asked to share personal data about themselves. At the end of the tour Pusca confronts the participants with negative privacy consequences of the personal data that they shared.

Participants

The design goal is set for citizens of Utrecht. In total six participants were recruited, one of whom lives in Utrecht and two of them have lived in Utrecht in the past. The age of the participants ranges from 25 to 60.

Technicalities

The design was created in Adobe XD and used on an iPhone. Some technical aspects of the final concept design are not supported by Adobe XD. As explained above, no data can be entered in the app, so the participants were asked to write these answers down on a piece of paper. The possibility of giving directions is also not supported by Adobe XD, therefore the participants had to switch to the Google Maps app. The last technical issue is the moment of reveal. The created video could not be played in the Adobe XD app, so the user has to switch to documents on the phone where the video is stored. During the tour I accompanied the participants and guided them through these technicalities by using the wizard of Oz-method (Dahlbäck et al., 1993).

Questions

I conducted semi-structured interviews to gather data about a set of topics, but also allowing some exploration when new topics or issues emerge (Wilson, 2014). I created a predefined set of questions to ask the participant before and after the test (see appendix V: Final concept design questions). Before the final concept test the participants were asked a few questions about their knowledge of the smart city and data collection in general. After the tour participants were asked about the Pusca app experience. Both of the semi-structured interviews were recorded for documentation and analysis later on. The interviews were conducted in Dutch, however the questions and answers are translated in English for readability. Each of the questions is linked to one of the sub-design goals to make it easier to see if they can be validated in the thematic analysis in the next chapter.

Follow-up

The follow up as presented in the final concept design will be shown to the participant after the test and the post test questions, because this displays information about the goal of the project and that information could steer the participant's answers.

5.1.2 Test

The starting point of the test is Utrecht Central station. Before the test starts, each participant is asked to fill in and sign a permission form (see appendix W: Final concept design test permission forms). After that, a brief explanation is given to the participant about the test. First, the expected duration of the test and interview moments are explained. Secondly, the participants are told that Adobe XD does not support some of the technicalities in the design. Therefore the text entering fields can't be filled in, but instead they are asked to write down their answers on a piece of paper (see appendix X: Final concept test answers participants). Pusca is not able to give directions, so the user is instructed to switch to the Google Maps app and type in the addresses of the stops provided by Pusca. Also, I will be observing during the tour and can sometimes intervene to play wizard of Oz. Finally, the participants is asked to imagine being a citizen of Utrecht if they are not. They are asked to think aloud to make observation easier, they are encouraged to ask questions and they are informed that they can do nothing wrong, to make them feel at ease. After the instruction the participant is interviewed based on the semi-structured pre-test questions, which is recorded for documentation. Finally, the participant gets handed the iPhone with the installed Pusca app and they can start the tour (see appendix Y: Final concept design test photos).

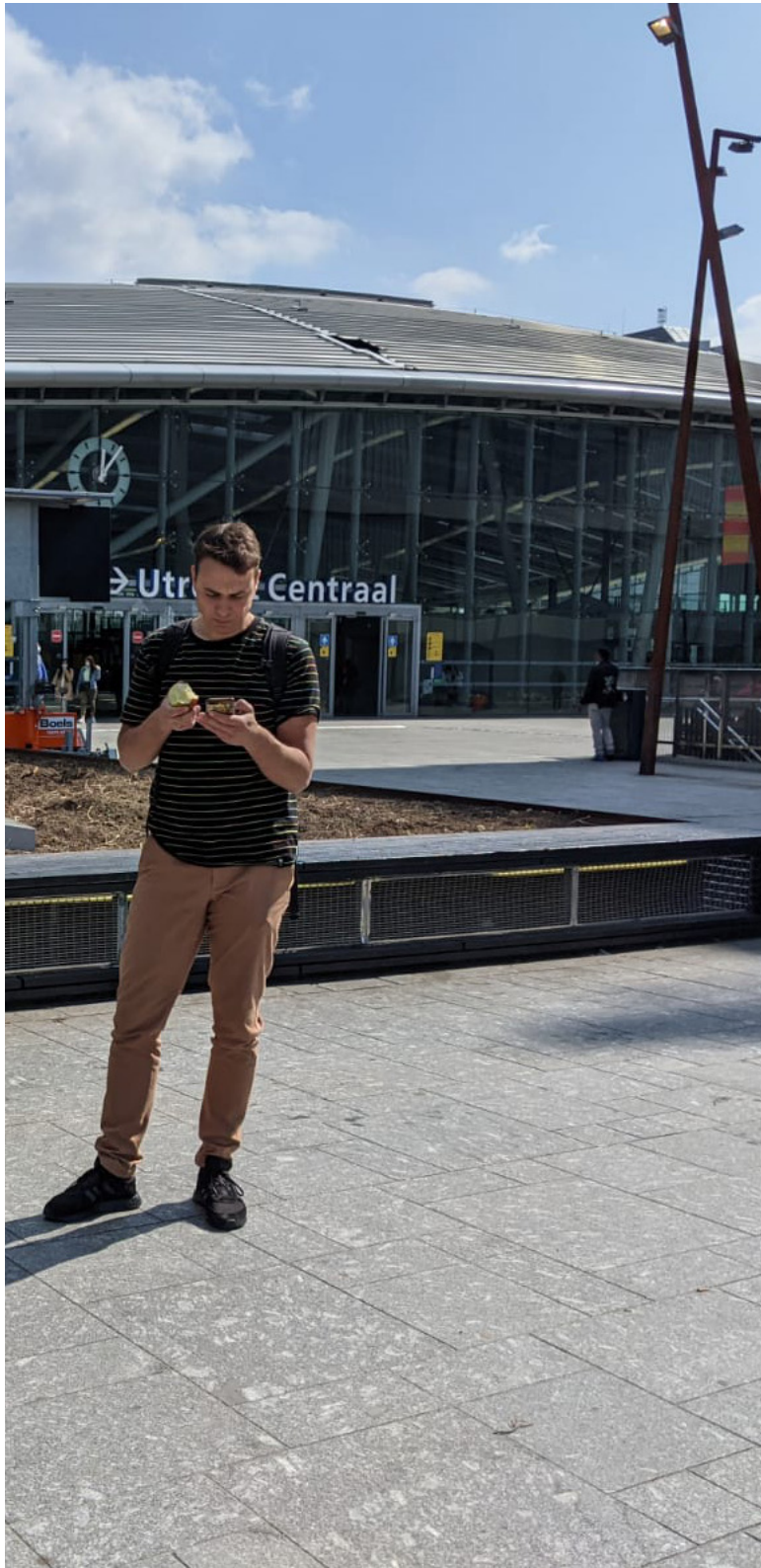
EXPECTED TIME:

Instructions
10 min

Interview
5 min

Test
50 min

Interview
10 min



5.2 FINDINGS

The recordings from the pre and post interviews were transcribed, along with notes taken during observations (see appendix ZA: Transcriptions final concept design test and appendix ZB: Observations final concept test). These two types of data were used to conduct a thematic qualitative analysis. Thematic qualitative analysis can be described as the process of identifying themes or patterns within qualitative data (Maguire & Delahunt, 2017). The six step approach described by Braun and Clarke is used in this project as a framework (Braun & Clarke, 2012).

Step 1: Become familiar with the data

The transcripts and observation notes were read and re-read to get familiar with the entire body of data. Thea data transcriptions from the pre and post interviews and the observation were written out and carefully read a few times (see appendix # Transcriptions final concept test and appendix # Observations final concept test).

Step 2: Generate initial codes

The entire body of data was coded to identify and provide a label for particular features of the data. The data was color-coded to define if the data is relevant for any of the sub-design goals or if the data could be relevant for other themes that still have to be identified. Each of the design goals has its own color code because they are already identified as themes, and the newly identified themes are colored pink.

Step 3: Search for themes

The coded data was reviewed to identify areas of similarity and overlap between them. I generated themes by clustering the overlapping codes. Other findings are clustered and five themes have been identified.

Theme A: DG1 reflect on personal data collection
Theme B: DG2 reflect on use of personal data and privacy consequences
Theme C: DG3 reflect on own behavior personal data collection and privacy consequences

Other themes:

1. Dark patterns
2. Cognitive biases
3. Behavioral change
4. Trade-off
5. Privacy concerns

Step 4: Review themes

The generated themes were reviewed in relation to the entire data set to check the quality of the analysis. Looking back to the data it can be concluded that the identified themes communicate the content of the data (see appendix ZA: Transcriptions final concept design test and appendix ZB: Observations final concept design test).

Step 5: Define themes

The essence of each theme was written down in a few sentences to state the uniqueness of each theme.

Step 6: Write-up

Analysis of the data was written down.

In the next sections findings for each theme are explained in detail. For each sub-design goal post and pre-test interviews are analysed to see what participants thought about that particular sub-design goal before and after the test. These two outcomes are compared to see if the sub-design goal is met.

5.2.1 Sub-design Goal A

A. "Designing a tour that enables citizens of Utrecht to critically reflect on *personal data collection within the smart city and its technologies*".

In the pre-test interview participants state that they have little to no knowledge about what data is collected in a smart city. After the tour all of the participants said that they are more aware of the fact that their personal data has value and they are more cautious and suspicious of sharing it. Some of the participants did mention that they are not aware of what data is collected and for what purpose, and sometimes they are not even aware that data is collected from them. After the tour, all participants stated that they have a more critical view on data collection in the smart city and its consequences.

P2: "Well, the fact that you are confronted with sharing all that information and that it can really harm you shocked me".

5.2.2 Sub-design Goal B

B. "Designing a tour that enables citizens of Utrecht to critically reflect on *the use of personal data and its privacy consequences*".

In the pre-test interviews participants stated that they have no idea how data can be used, but they do know that it has value. They expressed anxieties about privacy consequences of sharing personal data, however they had little to no knowledge about what these consequences might be. In the post-test interviews several participants said they are more aware of the negative side that sharing personal data might bring for their privacy, but they expressed no actual concern about constraining consequences. After the tour, all of the participants said they have a more critical view of the use of personal data and its privacy consequences. However, they also expressed that it is still not clear to them what the relation is between sharing specific personal data and the personal benefits or privacy consequences that derive from that. Estimating privacy consequences when sharing personal data is therefore difficult. Despite the fact that participants have a more critical stance towards the use of personal data, it is hard for them to be critical about data sharing consequences because of a lack of information.

P3: "I maybe trust too much that you can not do anything with my data: my email address, my date of birth, where I live or whatever. That is what I think, but apparently that is not the case"

5.2.3 Sub-design Goal C

C. "Designing a tour that enables citizens of Utrecht to critically reflect on *their own behavior of sharing their personal data*".

In the pre-test interviews participants stated that they are not very interested in their own behavior regarding sharing personal data, because the consequences are not directly related. Some of the participants do not consider privacy a priority and therefore pay little attention to it. In the post-test interviews, most participants said they have a more critical view of their own behavior when it comes to sharing personal data. One of the participants (P1) considers themselves very much aware of why they share personal data and is able to justify their actions. Therefore they are not more critical towards their own behavior of sharing personal data after the Pusca experience. Although most participants are more critical about their own behavior, they still put the biggest responsibility of safeguarding their privacy in the hands of the government or policymakers.

P4: "I would think twice if people want to have information from me "do they really need that information?". And, if they really need that information, do I think it is worth it to give it to them in order to get a service?"

5.2.4 Other findings

In the pre and post-test interviews I identified five other themes. Findings related to small technicalities and visual design aspects in the application are already implemented in the final design presented in the previous section. These adjustments can be seen in the appendix (see appendix # Final Concept design adjustments). The statements and opinions of the participants which are the result of the Pusca experience are explained for each theme below.

1. Dark patterns

Most of the participants are aware that they are being nudged and steered by technology and design into sharing their personal data.

P6: "Well, that we are being seduced to do stuff, to press buttons, that we later regret."

2. Cognitive biases

Most participants think they do not have the time or the knowledge to be completely aware of the consequences of sharing their personal data. Participants appear to feel overwhelmed, which might lead to them giving up on attempts to take control over their personal data.

P4: "Well, actually I notice that I can not read those [refers to privacy policy and terms of service of Pusca] things. And then I saw how much information it was and I completely lost interest. So actually I do not care. Because, if you really care, you would read that stuff and you would not share that much data. But, that is not who I am."

3. Behavioral change

Most participants want to have more information about how to protect their own personal data and privacy and are more interested in the topic, but changing their own behavior seems difficult. Not using several technologies does not seem like an option, because that would make their life much more inconvenient.

P5: "This is a mobile phone with all possibilities, it gives you freedom, but actually you are also restraining yourself with it, in the long term. It doesn't give you so much freedom as you think it does."

4. Trade-off

All of the participants are constantly making trade-offs between privacy and convenience. The negative privacy consequences of sharing personal data is often too indirect to be taken into account when making the trade-off. Also, the participants stated that they have too little information about the consequences of sharing personal data, negative and positive, so that a fair trade-off is almost impossible.

P3: "The trade-off is really important, but I do not have a clear image of what trade-off I am making, I think. Otherwise I would have probably chose to make the trade-off differently".

5. Privacy concerns

Most of the participants consider themselves trusting of the government and privacy policies to safeguard their privacy. The biggest concern is about not having enough information about sharing personal data and their privacy and that they consider themselves to be too naïve.

P6: "I know that we are being followed in everything, so it is basically an illusion to think that you are privacy safe".

5.3 CONCLUSION

To conclude the thesis, I validate the design goal that was set in chapter 2:

"Designing a tour that enables citizens of Utrecht to critically reflect on the collection and use of their personal data and its privacy consequences within the smart city."

To be able to validate this design goal I conducted a literature review to uncover the six smart city pillars, explore the value of data, and to understand that the value of privacy is situational dependent and differs per person. I found that any type of personal data could harm an individual's privacy and should therefore be protected if desired.

The results of the survey gave me the insights that sensitive personal data as described by the GDPR is not considered as important for individuals to keep private and that personal data collected for a service has a different acceptance rate in different situations.

The insights from the literature research and survey helped to determine the design space and identify five design questions that had to be answered:

1. What is the ***narrative***?
2. What ***smart city technologies*** are explored?
3. What are the ***geographical touchpoints***?
4. What ***personal data*** is collected and when?
5. What is the moment of ***reveal***?

Through brainstorms, ideations and iterations I answered these five design questions. Guided by the answers to the design questions and the interaction vision the final concept design was presented. Pusca is an application based personalized tour through Utrecht to let citizens explore smart city technologies and confronts them with the consequences of sharing personal data. The narrative of the tour focuses on discovering Utrecht's smart city technologies that bring personal benefits for the user in terms of a service. In total six smart city technologies were selected that each represent one of the six smart city pillars to let the user explore the scope of a smart city. Geographical touchpoints have been assigned to the stops that match the pillars and smart technologies. In the introduction and at each stop data is collected from the user that match the stop and these data points have been selected by creating a data table. This collected data is used to create a strange and malfunctioning reveal to confront the user with the three main privacy consequences of sharing their personal data: discrimination, loss of autonomy and confrontation with unwanted information.

I will use the findings of the thematic qualitative analysis of the final concept test in the previous chapter, to validate if the design has met its design goal. In the previous section I showed that the three sub-design goals have been met. All of the participants state that they have a more critical view on data collection (sub-design goal A) and data use and its privacy consequences (sub-design goal B). Five out of the six participants said they are more critical about their own behavior when it comes to sharing personal data (sub-design goal C).

All of the participants are more aware and have raised concerns about the collection and use of personal data and its privacy consequences in the smart city. Most participants have the desire to know more about the social implications of the technologies we build and most participants stated that they want to change their way of managing their data privacy in the smart city (Quote3). Participants also mentioned that there is a lack of transparency in what data is collected, when it is collected, by whom and for what goal. They feel like it is not their responsibility and it is impossible to know exactly how that works, because it is too much information. Most participants are trusting towards the government and policy makers to protect their

privacy, but they also are not aware of how their privacy is actually protected by legislation. It was also mentioned several times that participants do not understand the value of their personal data and what privacy consequences sharing their data may bring for them, because they have not encountered direct negative consequences. Most participants felt like they had nothing to hide and thus nothing to fear before the tour started. However, the experience made the participants more conscious about their lack of knowledge about data collection, the use of personal data and the possible privacy consequences. Most participants did feel like their privacy was violated in a way and this lead to the users feeling provoked to think critically about their personal data collection in the smart city. Some of the participants said they even want to educate themselves more about personal data and how they can protect it better. So, I guess that most people do have something to hide and they should be able to know how to protect it in order not having to fear negative privacy consequences.

P2:" Well, I think that I was aware of it, of the dangers. But, because of the examples that you showed, next to the fact that I have become more interested in the new technologies, I will start thinking more about what impact every technology has on my life next to the fact that it can do something for me".

5.4 REFLECTION

Participants stated that the tour could be a bit more dynamic.I have thought about implementing a gaming element, to complete a challenge at each stop for example and maybe using technologies such as AR and VR to let the users better experience and understand the highlighted problem.

In this project critical design was used as an approach to create a design that focuses on problem finding rather than problem solving and implementing a big reveal to make the user critical reflect on the experience (see section 2.5). The choice of using Adobe XD as a medium (see section 4.1.2) enabled me to design the desired aesthetic look and feel of the application and making sure that no data is stored from the user in any way. However, this also lead to the user not being able to fill in data in the final design. This made it almost impossible to make the user believe that their personal data was collected by Pusca and therefore the believability of the confrontation was not as high as intended. Despite that, bringing the unconscious aspects of experience to conscious awareness about personal data privacy has succeeded. Because of the experience the user is now able to make more conscious choices about the trade-off of personal data and their privacy in the smart city context. This might even lead to the desire to know more about the social implications of the technologies we build and finally find a way in changing behavior by imagining alternatives of how to manage data privacy in the smart city.

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