NTNU
Norwegian University of
Science and Technology

ByKvalitet - A Contextual Online Survey

A concept for collecting public opinions on
urban areas

Thomas Mathisen

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Supervisor: Monica Divitini, IDI

Norwegian University of Science and Technology
Department of Computer Science

I dedicate this thesis to my family, the memory of my late grand parents, my late uncle, and my late aunt.

Summary

Planners in urban development planning processes make their decisions based on knowledge about the city as it is now and what needs improvement. The foundation of this knowledge is data collected about the city using various methods. City Life Survey is a collective term for surveys investigating how the city is being used and experienced by its citizens. This study has followed a Design Science Research Methodology, with the goal of finding an easier way of collecting data relevant for City Life Surveys without the need for hiring a large number of observers or interviewers to do so.

The study started by investigating what data public planners are interested in gathering about the city's environment. An analysis of what data City Life Surveys typically gathers has been conducted using 17 City Life Surveys, noting what data each of them gathered. The analysis found that different surveys collected a broad range of data parameters and that the surveys differed from one another in what data they collected. A brief analysis of the different data parameters' attributes found that they were diverse and that a single system would not be able to collect all data types. A subset of the data parameters found in the analysis, citizens' subjective opinions about city areas, was selected as the subject of data gathering using ICT technology. The selection of subjective opinions was made because this category of data appeared easier to gather using a software system alone than the other categories.

As part of this study, a prototype of a system called `bykvalitet.no`, collecting subjective opinions from citizens about city areas has been developed. The prototype is based on requirements derived from problem areas in public participation in urban planning, and the analysis of city life surveys conducted. Guidelines for usability, visual design, and survey design were also applied. The result is an online web page where people can provide their subjective opinion for a location in a city in the form of a feedback report. The feedback reports are displayed on a map in the system, allowing for reviewing feedback provided for different areas of the city.

An evaluation of the prototype was done using interviews with experts and usability testing with non-experts. The usability testing showed that the survey portion of the app had high usability, with the visualization- and map-part having room for improvement. The experts confirmed that the concept and prototype have a potential for use in urban planning as well as a potential for improvement. Finally, guidelines for further developing the prototype or similar systems have been made and presented of the experiences of the development process and the evaluation.

Preface

This paper is my master thesis, completing my 2 year master's degree program in informatics with a specialization in Software Engineering at the Norwegian University of Science and Technology (NTNU).

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Definitions

City Life Surveys	=	Studies conducted for or by urban planners on how the city is perceived and used by citizens.
Public participation	=	People being involved to various degrees as participators in a planning or decision-making process
Urban Planning	=	Planning taking place in urban areas like cities or towns.

Chapter 1

Introduction

1.1 Motivation

Local knowledge about the environments in a city can improve the planners' insight (Corburn, 2003), but the data has proved to be difficult to acquire (Corburn, 2003; Irvin and Stansbury, 2004; Brabham, 2009; Al-Kodmany, 1999; Stauskis, 2014; Kaminstein, 1996). Public planning meetings are often dominated by a few very engaged community members revealing their own opinion more than the community's (Stauskis, 2014). Comunity members often don't know about meetings at all (Stauskis, 2014) and even if they know about them, their threshold for showing up is very high (Irvin and Stansbury, 2004). To reach the general public, some planners have tried to actively seek out opinions from the public Corburn (2003); Brabham (2009), not only inviting them to meetings but asking communities or individuals directly face to face for input. Some cities have evaluated their cities and gathered opinions from citizens on city areas and how they could improve like (Gehl Architects, 2014; Midbe et al., 2016), referred to in this study as City Life Surveys. This provides knowledge about people's opinions, but the methods are labor intensive, and public opinion can be affected by how the people conducting the process conduct themselves (Brabham, 2009). There is a need for gathering knowledge from people in a straightforward and objective way that has a low threshold for participating (Poplin, 2012; Irvin and Stansbury, 2004; Duhl and Sanchez, 1999; Brabham, 2009).

1.2 Research questions

This study will focus on how to autonomously or more easily collect data about commonly asked for parameters in city life surveys. The research will be conducted with the following research questions in mind.

RQ1 : What are the common questions City Life Surveys seek to answer?

RQ2 : How might a system utilizing appropriate information technology to collect data on city life look like?

1.3 Research Method

This study follows a Design Science Research Methodology by Peffers et al. (2007). Design science is a problem-solving paradigm that creates and evaluates IT artifacts solving identified organizational programs (Hevner et al., 2004). This study follows a variant of design science, the Design Science Research Methodology by Peffers et al. (2007). Peffers et al. (2007) present 6 activities to complete to follow the Design Science Research Methodology. The activities and the process for this study are described below.

Activity 1. Problem identification and motivation The goal of this activity is to define the specific research problem and to justify the value of the solution.

The problem identified was to find an easier way of collecting data similar to the data collected from city life surveys without the need for hiring a large number of observers or interviewers to do so. The motivation for the research came after talks with a city planner describing that city life surveys are valuable, but labor intensive and requires extensive planning.

Activity 2. Definition of the objectives for a solution In this activity, the goals for the solution are established.

The initial objective of the solution was to collect city life survey data in general through technology in an easier way. An analysis of city life surveys was conducted to find what data city life surveys investigate. The analysis is described in chapter 4. Because the characteristics of the data collected varied greatly, the data to focus on was narrowed down to people's subjective opinions of areas in the city. This focus was selected because the potential for a solution was seen as higher and the solution easier to implement than the other survey data.

Activity 3. Design and development This activity should define the function for the solution artifact and develop the artifact.

The requirements found for the artifact are described in chapter 5.2 and are based on Theory on public participation in urban planning from chapter 2 as well as identified problems from the analysis of city life surveys done in chapter 4. To collect opinions from citizens without human observation or interviewing, a contextual online survey was considered to be a good solution. The questions used in the survey were the result of initial consultation with a city planner and the result of the analysis of city life surveys. To support accessibility and ease of use, a hybrid app framework, Ionic by (Drifty, 2013), was used to develop a prototype for both mobile and web described in chapter 5. To visualize the data, a map solution in the same system was developed. This enables anyone to see the survey responses on a map at their submitted locations.

Activity 4. Demonstration In this activity, the ability of the prototype to solve the problem in a live context is demonstrated.

As the prototype developed was functional, the demonstration could be done with the actual prototype. Even though the prototype could have been compiled for both Android and iOS, it was only uploaded to a web browser accessible web server for demonstration purposes. It still provides a platform dependent look and feel when accessed by mobile. For this study, a demonstration means a citizen being at a location in the city, providing feedback at their location, or someone viewing feedback on the system's map-function from anywhere using any platform.

Activity 5. Evaluation This activity asks the question of how well the artifact solves the problem.

Experts were asked to evaluate the artifact in terms of overall function of the system and the data it gathered. The evaluation of the experts is described in section 8.1. Their impression was positive, believing that the artifact could be useful to them in collecting citizen opinions about city areas. They also provided feedback and improvement areas to the questions posed in the survey.

In addition to an evaluation by experts, a usability test has also been conducted as described in 8.2. The usability tests showed that the system was usable but has a potential for improvements in some areas, seen in 8.2.2.

Activity 6. Communication The last activity of the Design research activity involves communicating the results of the development and evaluation of the artifact.

This study is communicated through this Master's thesis. The developed system can be found on www.bykvalitet.no at least until 11th of may 2018.

1.4 Outline

This chapter has provided motivation for the study, defined the research questions for the study amd established the research method used in the study. Chapter 2 introduces the problem and provides background theory on public participation in urban planning. Chapter 3 gives an introduction to the state of the art of methods in public participation in urban planning. Chapter 4 describes how the analysis of City Life Surveys was conducted in this survey and the analysis results. Chapter 5 explains the concept of the developed prototype, as well as outlines the requirements for the prototype. Chapter 6 briefly describes the architecture of the prototype and technologies used in its development. Chapter 7 explains the rationale behind the design and the functionality of the developed prototype. Chapter 8 describes the process of evaluating the prototype by feedback from experts and usability testing, followed by the results of the evaluation. Chapter 9 contains conclusions from the study, a summary of the results from this study, discusses the process, describes made contributions, and suggests future work.

Chapter 2

Problem Definition

This chapter gives an introduction to public participation in urban planning and problem areas found in the domain.

2.1 Public participation in urban planning

The European Commission (2003) states in a directive that public participation in environmental planning increases the accountability and transparency of decisions made by planners and raises awareness of environmental issues among the public. The planners are also in many cases interested in hearing the people's voice on matters in order to design for them. There are many advantages of involving the public in the planning process of urban areas.

By involving the users of the city, it is easier to know their needs, expectations and wishes (Brabham, 2009; Al-Kodmany, 1999). Changes in the design to meet public demands are best made early in the planning phase to avoid costly changes after construction or projection have been started (Irvin and Stansbury, 2004). Finding or avoiding disagreements between planners and the public early also avoids having a project delayed or suspended because of public protests or political pressure (Stauskis, 2014). Involving citizens in the process will also make them feel they have a say in how their community looks and functions, providing a feeling of ownership towards their neighborhood (Al-Kodmany, 1999; Stauskis, 2014). Citizens will trust the planners and the government more and increase credibility when they understand why a project is done in a certain way and know the criteria needing to be met in a project (Al-Kodmany, 1999; Stauskis, 2014). While citizen participation has many benefits, it has its trade-offs. Irvin and Stansbury (2004) have looked at advantages and disadvantages of citizen participation in decision making, summed up in table 2.1 and 2.2. The study found that citizen participation has many benefits, including those listed above, but is at the expense of time consumption for both government and citizen participants.

Table 2.1: Advantages of Citizen Participation in Government Decision Making (Irvin and Stansbury, 2004)

	Advantages to citizen participants	**Advantages to government**
Decision process	Education (learn from and inform government representatives) Persuade and enlighten government Gain Skills for activist citizenship	Education (learn from and inform citizens) Persuade citizens; build trust and allay anxiety or hostility Build strategic alliances Gain legitimacy of decisions
Outcomes	Break gridlock; achieve outcomes Gain some control over policy process Better policy and implementation decisions	Break gridlock; achieve outcomes Avoid litigation costs Better policy and implementation decisions

Table 2.2: Disadvantages of Citizen Participation in Government Decision Making Decision (Irvin and Stansbury, 2004)

	Disdvantages to citizen participants	**Disdvantages to government**
Decision process	Time consuming (even dull) Pointless if decision is ignored	Time consuming Costly May backfire, creating more hostility toward government
Outcomes	Worse policy decision if heavily influenced by opposing interest groups	Loss of decision-making control Possibility of bad decision that is politically impossible to ignore Less budget for implementation of actual projects

Added time consumption is a factor in the process involving citizens in urban planning, but the result might still be positive, even if it takes a longer time to get there. Technology might be able to help to mitigate the other disadvantages to both citizens and government. No matter what process is used to reach a decision, the process and result should benefit those affected. Measuring these benefits, however, may not be an easy task (Irvin and Stansbury, 2004).

2.1.1 Open or closed process

Duhl and Sanchez (1999), working with the World Health Organization, has looked at how urban planning should best be performed in relation to building healthy cities and areas. They found that whether a planning process is rooted in an open or closed ideology can have huge implications on the process and outcome. They pose the example of siting a solid waste landfill.

”In a closed system, the process will focus on the landfill alone. The decision-making team is comprised of city and municipal employees, a developer and firms bidding to manage the site. In some instances, the short-term costs will overshadow any discussion about the long-term costs or consequences. In contrast, an open ideology would place a stronger emphasis on the whole picture. It will consider environmental degradation and the effects of a landfill on the neighboring communities, and encourages and values community-based participation and attempts to plan for unintended consequences.” (Duhl and Sanchez, 1999).

This sort of open process involves the public, listens to their needs and opinions. They further say that such a radical shift from a closed to an open process can be uncomfortable for planners as they give up control to the public, but ”Planners must work in an interdisciplinary fashion and with the community. They must accept the fact that diverse populations understand their own needs and can offer significant contributions to the planning process.” (Duhl and Sanchez, 1999).

Stauskis (2014) who focused on participatory urban planning in Vilnius in Lithuania, found that many of the attempts to involve local residents there were carried out using the minimum of formal requirements and had no impact on the planned projects. This led to plans not supported by the community, resulting in protests. Involving the public can prevent this, making the citizens feel included and possibly providing valuable input to planners and architects. The European Parliament further states in a directive that public participation in environmental planning increases the accountability and transparency of decisions made by planners and raises awareness of environmental issues amongst the public (The European Commission, 2003).

2.1.2 Degrees of participation

Arnstein (1969) poses a typology of eight levels of participation, ranging from the lowest: Manipulation, to the highest: Citizen control. The typology, named the *Ladder of Citizen Participation* can be viewed in table 2.3. Manipulation and Therapy are substitutions for genuine participation and can only offer education of the public on topics. ”It allows the power holders to claim that all sides were considered but makes it possible for only some of those sides to benefit” (Arnstein, 1969). The next levels take greater care to include the public in understanding why plans are the way they are, and further levels might allow the public to speak their mind, but without guarantee of being taken into account and takes place on the terms of the traditional power holders. The top three levels span from an equal partnership of a project between the traditional power holders and the public, to the citizens having partial or total control over the project (Arnstein, 1969). He further states that this is a simplification of the matter, but offers insight into the fact that there are several degrees of participation including the public in various degrees. ”There is a critical difference between going through the empty ritual of participation and having the real power needed to affect the outcome of the process.” (Arnstein, 1969). Hanzl (2007) conducted a case study of participation activities in urban planning, looking at how they include the public in various ways: Either by broadcasting information to a large number of people, Sending personal letters etc, or allowing for two-way communication where citizens can say their direct opinion or give feedback. A summary of these findings can be seen in table 3.1 (Hanzl, 2007).

Table 2.3: Ladder of Citizen Participation (Arnstein, 1969)

8	Citizen control	Degrees of citizen power
7	Delegated power	
6	Partnership	
5	Placation	Degrees of tokenism
4	Consultation	
3	Informing	
2	Therapy	Nonparticipation
1	Manipulation	

2.2 Ways of inclusion

There are many ways citizens can be involved in the urban planning, some of them are shown in table 2.4 given by Stauskis (2014). The table shows three different categories of inclusion (Passive, Active and Interactive) for different phases of the planning process.

> ”Passive methods are based mainly on one-way communication between the planners and the public as one of the stakeholders with no interactivity. Active methods have some elements of interactivity as they try to establish a dialogue instead of a monologue. The emerging ICT-based techniques are attributed to interactive methods as their goal provides a person or representative group with possibilities of direct access and reliable and monitored feedback on the goals, roles, process and consequences of planning.” (Stauskis, 2014).

The UK has for several decades tried to involve the public in urban planning through a statement of community involvement, making them stakeholders in projects (Stauskis, 2014). The statement stresses the need for the planning process to be transparent and accessible to the public, both physical and intellectually. Among the tools used were: information through media, letters, public meetings, websites, distributed documents, exhibitions, and questionnaires. After first informing the residents of projects, their goal was to get the locals' opinions. The results were then to used to improve the ongoing projects.

Table 2.4: Public participation methods in urban planning and design (Stauskis, 2014)

Method	**Passive**	**Active**	**Interactive**
Preparatory	Data collection	Field Study, interviews	Internet, websites
Analytic	Case study analysis, survey	Working groups	Policy dialogue
Disseminative	Printed material	Presentation, visualisation	Open space technology, gaming and multiplayer
Monitoring	Observation	Committees, meetings, test audit	E-government, virtual urban simulation

2.3 Problem areas with public participation in urban planning

This section covers some of the problems areas of public participation in urban planning, summarized in the categories below.

2.3.1 Awareness

For the public to be able to participate in urban planning, They need to be aware of it happening in the first place. There are several sides to consider here. When to inform, and how. When citizens are informed is often related to the estimated time span and scale of planning. Table 2.5 shows the required time of notion by law in Lithuania (Stauskis, 2014). The European Commission (2003) also has amendments stating that the public should be informed and consulted by planners within reasonable time frames. Although informing and creating awareness is low on the ladder of participation (Arnstein, 1969) (table 2.3), it is a necessity all other inclusion methods depends on.

Table 2.5: Basic phases of public participation as regulated by the Planning Law of Lithuania (Stauskis, 2014)

Type of plan/time span for procedures	**General plan**	**Special plan**
Information for citizens about planning procedures	Immediately by Letters to owners, residents, companies	Immediately by Letters to owners of neighbouring and planned plots
Getting acquainted with plan	1 month	20 working days
Public exhibition time	15 working days	10 working days
Public meeting	10 working days in advance	10 working days in advance
Complains accepted from public	1 month	1 month

2.3.2 Engaging citizens

Engaging citizens in participating in urban planning efforts can be difficult. Krek (2008) states that citizens are rationally ignorant to the planning and are unwilling to participate because it represents a high investment for them. They typically have to learn about new plans and alternative plans in depth. Attend meetings or partake in other highly time-consuming processes. They feel that their investment is high, and their gain is low. Often, they also feel that their influence is limited (Krek, 2008). A result of this reluctance in the general public is that the people most willing to participate often end up being people who stand to gain significantly economically or otherwise from influencing decision-making. Stauskis (2014) states that meetings are often dominated by a selected few in the community who reveal their own opinion more than the opinion of the community. This can lead to developers and planners being reluctant to get people's opinions, relying more on only informing the citizens about plans.

2.3.3 Accessibility and non-discrimination)

City planners need to be interested in hearing the thoughts of their citizens and involving them. This means explaining plans and circumstances in understandable ways and having the right attitude (Kaminstein, 1996). As seen in the study by Kaminstein (1996), communicating in a top-down manner and using complex language discourages the public as well as makes them feel undermined. Kaminstein (1996) further states that avoiding controversial discussions and leaving out information can lead to conflicts even harder to handle than the original ones, in addition to the feeling of being overrun and patronized. A problem related to accessibility is that the public often has limited understanding and practice in planning strategies and urban planning principles, leading to meetings, committees and working groups spending more time than desired making trying to explain the subjects (Stauskis, 2014). As an extension of this, Stauskis (2014) also states that it is difficult to find individuals who can express opinions on behalf of others. Also finding children, youth or people with disabilities willing and able to participate proves to be challenging.

2.3.4 Knowledge

To achieve good urban planning, knowledge is required. Knowledge about people's needs, habits, and desires. This knowledge has traditionally been collected by planners and used as a basis for further planning. An area is made up of both the buildings and the physical environments; As well as the people who live there. The inhabitants might notice things that are not recorded in records, like sights, smells, emotional experiences or historical connections (Corburn, 2003). Corburn (2003) states that this knowledge is often viewed as being a deficit to be used in planning processes, due to the lack of technical understanding amongst the public. However, the knowledge that citizens possess is still genuine knowledge and should be treated as such (Corburn, 2003; Duhl and Sanchez, 1999; Brabham, 2009; Stauskis, 2014; Al-Kodmany, 1999). In order to access this information, planners use different traditional methods, some of which are listed in table 2.4 in section 2.2, adapted from Stauskis (2014).

Chapter 3

State of the art

Many methods have been tried to include the public in urban planning and to get knowledge on their opinions and the environment as seen in table 3.1 by Hanzl (2007), who looked at methods for public participation in urban planning evaluating their type of communication between the planners and the public. Some involve one-way communication, only informing the public about the planners' intentions; while others allow the public to respond with their opinions, making them range differently on the *ladder of participation* from section 2.1.2. Below are some methods traditionally used for involving the public in urban planning, relevant for this study.

3.1 City Life Surveys

Many city government officials are interested in improving their cities, but how do they go about doing so? To begin with, they need to know what can be improved upon, and what is working well. In what parts of the city do the citizens feel safe or unsafe, feel disgusted or appreciation? The officials and planners need data about the well-being of its citizens like discussed in section 2.3.4. As a result of this many of them are conducting, or getting studies conducted on how the city is perceived and used by citizens. Jan Gehl is viewed as the pioneer of these studies, which he calls "Public Space Public Life". The Public Space Public Life method consists of both qualitative and quantitative surveys of city areas relying heavily on observational techniques counting pedestrians and recording their activities (Matan and Newman, 2012). This type of study has since it was developed in Copenhagen, been conducted internationally. Examples include Oslo, Seattle, Apeldoorn, London, Istanbul, Sydney and Trondheim (Gehl Architects, 2014, 2009, 2010, 2004, 2011, 2007; Midbe et al., 2016). Many of these studies are labor intensive because of the need for observing or interviewing citizens and often rely on students or hired people as labor to do the work. The studies are hereby referenced to as "city life surveys". These studies are in some cities conducted periodically to have a foundation for comparing results over time or before and after changes has been made to urban environment. City life surveys provide valuable information, but only provides feedback on the time period they are executed,

they are Limited to selected areas in the city and require extensive planning. City life surveys are further analyzed in chapter 4.

3.2 Maps and images

2D visualization is a common way to give the public an impression of how the planned projects can look like upon completion. Citizens can then give feedback and thoughts on the design. To further increase understanding of planned projects, digital renderings or edited photos are also quite common to use in an attempt to give a more realistic and grounded feeling of the plan as seen in the project of Al-Kodmany (1999). The main advantage of the map-solutions is the ability of the users to access many layers of information and give the users a reference to real life situated buildings and surroundings in relation to the planned construction (Stauskis, 2014). In general, maps with different information layers can be a great source of knowledge. While planning in Vilnius, a map where streets without proper sidewalks were marked in yellow, matched the areas of another map marking pedestrian/automotive accidents (Stauskis, 2014). If these tools are used early in a process, they can give the public a great deal of information at hand to form opinions, find issues and opportunities related to the initial plans (Al-Kodmany, 1999). None of these offer participation to citizens by themselves but must be supported by other sources of dialog or input. There exist developed solutions that allow participants to interact with a map and draw shapes and comment. Often referred to as collaborative mapping using the latest Web 2.0 technologies where the public contributes using tools available to them (Sui, 2008). Brabham (2009) argues a crowdsourced model based on web technology would be beneficial, making urban planning a more democratic process by nature. Reducing the role of planners from leaders to a participating actor, relying more on collective intelligence.

3.3 Public meetings and hearings

Meetings with the population is an efficient way to include citizens in the planning and provides an opportunity to explain existing ideas. Planners can discuss with citizens, and the citizens can explain their views and even draw ideas on paper or over maps or images as seen in the research of Al-Kodmany (1999). Meeting requires citizens to meet at a location to a specific time, and has a fairly high threshold for attending, resulting in only the most engaged citizens with the strongest views participating (Al-Kodmany, 1999). Brabham (2009) notes that a lot of research sees problems with public participation in such meetings. The opinions of groups included in such events might differ from the general public. More actors in a planning process might produce a higher conflict level by having disputing parties and slow down planning through ignorance or lack of knowledge (Al-Kodmany, 1999; Brabham, 2009). Brabham (2009) argues that such meetings have many problems related to lack of objectivity. Participants are affected by the speakers' body language, political view or position in the community, potentially influencing the participants in unwanted ways. The lack of anonymity might also deter some people from speaking up or being honest (Brabham, 2009).

3.4 Virtual reality and games

Virtual reality and Games have been experimented with in recent years and have been included with success in some projects (Poplin, 2012; Stauskis, 2014; Schrenk et al., 2014; Howard and Gaborit, 2007; Hanzl, 2007). A comparative study of games used in urban planning conducted by Schrenk et al. (2014) divided games into three groups: Non-digital/traditional games, Digital games, and Pervasive games. Non-digital games are typically card games or board games designed to give the players insight into how a planning process works or to teach players about trade-offs in planning processes. Digital games are typically PC-games like the general city-building-simulator SimCity or other digital games designed specifically for certain planning projects. Pervasive games are games taking place in the urban environment, often enhanced through ICT. These might teach people about the different aspects of the city by giving them a tour of the city in-game or display suggestions for future plans on a display or even using virtual or augmented reality (Schrenk et al., 2014). The study found that games can be particularly useful to help people find out what they really need in their environment, and makes participation more playful. Stauskis (2014) found that virtual reality alone often did not provide sufficient orientation at a scene and that a two-dimensional map was needed to give more spatial awareness. Virtual reality did, however, raise participation rates and provided a good way to help citizens understand solutions.

Table 3.1: Use of computer communication in local authorities activities in physical planning: kinds, forms and valorization of communication (Hanzl, 2007)

Kinds of communication	**Forms of communication**	**Type of Communication**		
		One way: Broadcast	**One way: Personal**	**Two way**
Informing	Text	X		
	Text and graphic attachments - bitmaps or pdf files	X		
	Text and graphic attachments - use of PPGIS	X		
Education	Documents with commentaries	X		
	Drawing and plan records presented with the use of PPGIS - a form of abstract	X		
	3D simulation of planning document	X		
	Static images representing vision from birds or from passing by persons point of view.	X		
	Animations representing vision from birds or from passing-by persons point of view.	X		
	3D interactive simulation of proposed development.	X	X	
	Education games einteractive presentation of planning documents. The simplest form of interaction is ability to displace within virtual world.	X	X	
	Interactive www sites with 2D graphics.	X	X	
	Interactive www sites with 3D graphics.	X	X	
Citizens opinions	Questionnaires: close eoptions choosing, or open - Answers for questions		X	
	Survey - a form of voting		X	
	Opinions, observations or demands sent by email		X	
	Forms allowing for opinions gathering		X	
	Competitions		X	X
	Observation and recording of actions and phenomena		X	X
	Voting		X	X
Referendum	Mechanism of decision-making voting. It requires authentication of persons taking part in voting to get reliability.		X	X
Transactions	Mechanisms enabling arranging issues concerning the participation in planning via the net	X	X	X
Discussion	Chat room evirtual platform of discussion with the use of text messages in Real Time. Synchronic form of communication.	X	X	X
	Message boards, discussion boards evirtual platform of discussion with the use of text messages. Asynchronic form of communication	X	X	X
	Expositions connected with discussion	X	X	X
	Panel discussion esynchronic or asynchronic	X	X	X
Cooperation with use of groupware	Virtual public space, where users are represented by avatars who may discuss with each other, with professionals and with officials.	X	X	X
	Common use of application	X	X	X
	Data conferencing - users may modify common board.	X	X	X
	Voice conferencing	X	X	X
	Video conferencing	X	X	X
	Electronic meeting system (EMS) - conference system built into a special purpose room (screen, projector, a few computers).	X	X	X
	Collaborative management tools	X	X	X
	Collaborative software basing on WWW	X	X	X

Chapter 4

Analysis of City Life Surveys

To answer RQ1: *What are the common questions City Life Surveys seek to answer?*, an analysis of the data investigated by City Life Surveys was conducted. The analysis was conducted by finding City Life Surveys online and going through them to find parameters they investigated in their surveys related to how people perceive the city. The motivation behind city life surveys and how they are conducted are described in section 3.1. Most of the surveys were conducted with the involvement of Gehl Architects and are therefore similar in what they cover. Table 4.1 shows the result of the analysis done on the surveys. The groupings are the most common parameters.

4.1 Method of analysis

The city life surveys were found searching the Internet for reports covering how people perceived the areas of cities or how different areas of cities were utilized by the public. Keywords used include: ”City life survey”, ”public space public life”, and ”city analysis”. The goal was to find a selection of city life surveys to get an overall impression of what parameters were interesting to public planners, not find all possible relevant reports. The survey reports were read through one by one, looking at what data parameters they investigated. A table was created, containing all cities as row headings and data parameters found as column headings. If a new parameter was identified, it was added as a column with its own heading. Recurring data parameters were registered in the same column, marked with an ”x”, indicating an occurrence. Many parameters were frequent and similar in nature, pertaining what people were doing at survey sites. These were identified and categorized by the group ”Action” and put on separate tables, while the category-name remained at the top level table.

4.2 Analysis results

Table 4.1 shows the result of the analysis done on the surveys. The groupings are the most common parameters. All of the studies covered actions done by citizens in the spaces surveyed, but the types of actions recorded varied, shown in table 4.2. In addition to the actions in the table, a few parameters occurred in only one of the analyzed surveys: Istanbul recorded *Fishing* and *Tourist Activities*; Wollongong recorded *Social activities*. Further, when looking at seating, several surveys looked specifically at where people were seated, seen in table 4.3.

Table 4.1: Result of analysis of parameters in city life surveys conducted in various cities

	Pedestrian Count	Actions* See table 4.2	Demographic Registration	Questionaire	Citizens Visions	12 Quality Criteria	Physical surround-ings	Back-ground Noise
Adelaide	x	x	x				x	x
Ahmedabad	x		x	x				
Brighton and Hove		x	x				x	
Chongqing	x	x				x	x	
Christchurch	x	x	x					
Estonia				x				
Istanbul	x	x	x		x		x	
London	x	x	x				x	x
Oslo	x	x	x	x		x	x	
Pitsburg	x	x	x				x	
San Francisco - Plazas	x	x						
San Francisco - Polk	x	x						
San Francisco - Guide Document	x	x		x				
Seattle	x	x	x					
Sydney	x	x	x					
Trondheim	x	x		x				x
Wollongong	x	x	x	x	x			

Pedestrian count Almost all of the surveys had a pedestrian count of the city space, counting how many people passed through areas relative to each other at the same time of day, on the same day of the year.

Actions Performed All of them recorded actions performed in the city space grouped in different actions like seating, standing, etc. Detailed in table 4.2.

Demographic registration Along with how many passed through city spaces, and what they were doing there, many of the surveys registered things like age and gender at the same time.

Questionnaire and Citizen Visions Some of the surveys conducted questionnaires of citizens in the same city spaces as the previous parameters were recorded. The questionnaire contained questions tied to that particular area in the city and asked what they felt

being in that space and what they felt could be improved there. Some featured visions from citizens, where citizens were asked if they could provide a vision for how the city could be in the future on a more general basis than at a particular location.

12 Quality Criteria and Physical Surroundings The 12 quality criteria are from *New City Life* (Gehl, 2006), and are criteria for the design of good public spaces grouped in Protection, Comfort, and Enjoyment. Analyzing an area or a city against the criteria can be useful as guidance in a design process. Many surveys looked at physical surroundings like the quality of pavement and how attractive building facades were etc. without using the quality criteria.

Background Noise A few surveys looked at background noise or general noise levels in the city. Either measuring with devices or asking people for their subjective opinion.

Table 4.2: Result of analysis of parameters in city life surveys conducted in various cities - Focus on actions

	Standing	Waiting For Transport	Sitting* See table 4.3	Laying Down	Children Playing	Commercial Activities	Cultural Activities	Physical Activities
Adelaide	x		x	x	x	x	x	x
Apeldoorn	x	x	x	x	x	x	x	x
Brighton and Hove	x	x		x	x	x	x	x
Chongqing	x		x	x	x	x	x	x
Christchurch	x	x	x					
Istanbul	x	x	x	x	x	x	x	x
London	x			x	x	x	x	
Oslo	x	x		x	x	x	x	x
Pitsburg	x	x	x	x	x	x	x	x
San Francisco - Plazas	x		x	x				
San Francisco - Polk	x		x					
San Francisco - Guide Document	x							
Seattle	x	x	x	x	x	x	x	x
Sydney	x		x	x		x	x	x
Trondheim	x	x			x			
Wollongong	x	x	x	x	x	x	x	x

Table 4.3: Result of analysis of parameters in city life surveys conducted in various cities - Focus on seating actions

	Seated -No Specification	Seated -Movable Chairs	Seated - Benches	Seated - Secondary seating (Planters, curbs, etc)	Seated - At a Caf
Adelaide		x	x	x	x
Apeldoorn		x	x	x	
Brighton and Hove		x	x	x	x
Chongqing		x	x	x	
Christchurch		x	x	x	x
Istanbul		x	x	x	x
London		x	x	x	x
Oslo		x	x	x	
Pitsburg		x	x	x	x
San Francisco - Plazas		x	x	x	
San Francisco - Polk	x				
San Francisco - Guide Document					
Seattle		x	x	x	x
Sydney		x	x	x	
Trondheim	x				
Wollongong		x	x	x	x

4.3 Discussion of analysis results

The analysis revealed parameters investigated by the city life surveys and their characteristics. The results are discussed below.

4.3.1 Characteristics of investigated parameters

The parameters the city life surveys investigated has different characteristics. Below is a description of the aspects of the different parameter characteristics.

Context sensitive Most of the parameters from the City Life Surveys are collected in a context of time and place and are only valuable in this setting. Like Pedestrian Count, Actions, Demographic Registration, and background noise. The questionnaire is somewhat context sensitive to time, as well as the place because the impression one get from a space might rely on the weather and time of day. The Quality Criteria and Physical surroundings are not that sensitive to time but concentrate around specific spaces in the city.

Objective and subjective Pedestrian count, Actions, Demographic Registration, as well as background noise can be measured and can be considered objective. The Quality Criteria and Physical Surroundings tries to be somewhat objective, but the interpretation of the

analyzer is a factor, so they are in between objective and subjective. The Questionnaire and the Citizen Visions are entirely subjective and rely on people's thoughts for data.

Qualitative and Quantitative Pedestrian Count, Actions, Demographic Registration and, Background Noise can all be considered quantitative parameters because again, they can be measured. The Questionnaire, Citizen Visions, Quality Criteria and, Physical Surroundings all provide qualitative data which can be interpreted and provides understanding, over the level of occurrence.

Need for Interaction with Citizens The only parameters where interaction with citizens is required is the Questionnaire and the Citizen Vision. The rest of the parameters can be observed or measured without the interaction with citizens.

4.3.2 Different data requires different types of interaction with citizens

The analysis shows that the parameters planners are interested in somewhat is divided into two groups: Those who rely on observation of citizens, providing objective quantitative data; and qualitative - more subjective data which requires interaction with citizens.

Obervation of citizens The method for collecting this data, like pedestrian count, and registration of actions or behavior patterns were typically done manually by human observers in the city life surveys analyzed. Similar data, like pedestrian counting, can be collected using sensors. Schneider et al. (2009) looked at options for counting pedestrians at an intersection and listed options like laser scanners, Piezoelectric pads, Computer Vision, Infrared beam counters, Passive infrared counters, and Array counters. Studies looking at the accuracy and limitations of these sensors have been conducted. Greene-Roesel et al. (2008) found that even the best devices they tested had limitations when it came to counting people in groups, and separating cyclists, and pedestrians. They also found that even counting manually has a considerable presence of error based on the observer's motivation and complexity of the counting task. Ryus et al. (2014) found that various technologies had both positive and negative deviations from actual counts between 8.87% and 48.15%. Aggarwal and Xia (2014) has looked at the state of recognizing human actions from 3D data, and found the field to be progressing quickly and already being at a usable state, at least indoors. People interacting with objects, like sitting on chairs, etc. makes it harder to assess the actions performed.

Interacting with citizens Collecting the subjective opinions of citizens was done through personal interviews conducted by the observers or through website portals. The interviews were conducted at the locations, while the internet surveys could be conducted at any time by participants.

4.3.3 Contextualized surveys

Surveys made sure to note the context the surveys were conducted. Mostly the location and the conditions of the survey as described below.

Location To make sure the citizens responded with a basis in experiences, rather than memories - Many of the surveys about areas were conducted at the locations the questions pertained. A city planner at Trondheim municipality was consulted about their efforts on city life surveys. The importance of holding the surveys about locations at the location in question was stressed as an important factor. This allows the citizens to look around and take in new information relevant to the questions asked. Citizens may i.e. not have considered the noise level at a park before being asked about it.

Conditions The investigators in the surveys made sure to register at what time the survey was conducted, and some also included the weather that day.

Chapter 5

System Concept and Requirements

This chapter explains the concept of the developed prototype, as well as outlines the requirements for the prototype, including High-Level Requirements, usability requirements, and guidelines for the design of the survey.

5.1 Concept - An online contextual survey

The concept is a hybrid app designed to give planners information they need about the city in the simplest way possible. The system has two main functionality pages. The first page is a survey page with a form for answering short subjective questions about the place one is currently in. The answers to the form are submitted to a server along with the location and time the report was submitted at. The second page is a map where all the reports are displayed as markers representing where they were submitted. Clicking a marker brings up the feedback from that particular report. The map is meant to both be a tool for planners and the public to browse submitted feedback.

5.1.1 Advantages of online survey

Having a human interviewer has advantages like the ability to further explain a question, or to ask follow-up questions if the response was inaccurate. Similarly, errors can also occur because of the interviewee.

- Questions asked inaccurately by the interviewer.
- Failure of the interviewer to record the reply accurately or completely.
- Mistakes made by the interviewer because of boredom and fatigue.

Further advantages, according to Brace (2008) include that an online survey captures the unedited voice of a respondent and that respondent may answer more honestly because they do not feel a bias to provide a socially satisfying answer to the interviewee. These

types of interviews can be quicker to conduct than traditional face to face interviews if the site has a high level of usability.

5.1.2 Challenges of an online survey

As well as having some advantages, an online survey also has some challenges compared to traditional face to face interviews or phone interviews. The main disadvantage is not having someone to clarify questions and sort out misunderstandings (Brace, 2008). This can hopefully be mitigated by providing clear, unambiguous questions. Another disadvantage is that participants actively has to seek out the survey and be reasonably skilled at navigating and using a web-interface. The participants also need to have access to a digital device, to perform the survey. This is increasingly a smaller problem as more and more people are acquainted with, and own personal smartphones. Déglise et al. (2016) found that in 2015, the median of smartphone ownership in European countries were 60%. The same study also found a significant gap in the number of adults over 35 who owned a smartphone (35%), compared to adults under 35 owning smartphones (85%). This suggests that it might be harder to get older respondents to an online questionnaire on a smartphone.

5.2 Requirements for the system

The system will be designed to solve existing problems and include citizen opinions in urban planning. This section describes the requirements a system solving these problems should meet.

5.2.1 High-level requirements

Following is a combined list of high-level requirements for the system with a basis in the problem areas found in section 2.3, as well as discoveries made in section 4.

HLR1: Accessible and non-discriminatory As stated in section 2.3.3, making sure everyone has access to participation is important. The idea that urban planning is a process of the democratic society relies on inclusion. The system should be easy to use, available for as many people as possible, and if possible, anonymous to allow people to speak as freely as possible.

HLR2: Support public participation According to the *Ladder of Citizen Participation* (Arnstein, 1969) discussed in section 2.1.2, an effort to include the public is not necessarily participatory. The system should aim for at least level 4 on the Ladder of Citizen Participation (Consultation), to include the public in a meaningful way.

HLR3: Provide knowledge about subjective opinions The system is intended to be used as an extension of a city life survey or to provide data otherwise supplied in such a survey. Therefore, the system must provide the planners with this data and allow them to access it easily. The data targeted is data from the subjective part of the city life surveys.

HLR4: Contextual and at location As described in section 4.3.3, the context of the survey was important for the city life surveys. The surveys took place at the place in question. Otherwise, the participants might fail to remember the place accurately. According to (Brace, 2008), there are several primary sources of memory failure.

- Respondents may not have taken in the critical information in the first place.
- They may be unwilling to go through the work of retrieving it.
- Even if they do try, they may be unable to retrieve the event itself, but only generic information about events of that type.
- They may retrieve only partial information about the event and, as a result, fail to report it.
- They may recall erroneous information about the event, including incorrect inferences incorporated into the representation of the event.

Both the time of day, as well as the weather when the surveying in the City Life Surveys took place, was registered. This is important to be able to compare the results of different surveys by also taking the conditions of the survey into account.

HLR5: Engage Citizens Engaging citizens to participate more in planning processes is a goal catering both to the city planners, as well as the citizens as described in section 2.3.2. The system has to be engaging, promoting participation as well as being satisfying to use.

5.2.2 Usability Requirements

Kaczmirek (2008) has looked at usability heuristics by Norman, Shneiderman and Nielsen, and how they apply to online surveys. He found that the many of the principles matched across the heuristics and that each of them could be used in an online survey context. He further discusses what is important to focus on in the design of online surveys in regards to the principles. Below are the usability requirements for the system with a basis in a selection of the discussed principles by Kaczmirek (2008), modified to be appropriate for the conceptin this study.

UR1: Visibility of system status The system should keep the user informed of the process of the system. If a question requires being answered for the form to be submitted but has not been answered, the user should be informed. This is also important if the system spends significant time loading components or sending forms.

UR2: System should use natural language The words and phrases utilized in the system should be familiar to the user. This helps the users to understand the questions.

UR3: Support user control and freedom The User should feel that they are in control of the system. They should be able to choose what questions to answer and which to be left empty. If the user makes a mistake entering a value in a field, the action should be undo-able.

UR4: Use consistency and standards The same component should have the same functionality across the system and platform and web conventions, like using radio buttons only for ”choose one among many”.

UR5: Prevent errors The system should try to prevent errors from taking place in the first place. For input fields, the selection of adequate input elements can avoid the user responding using text instead of a number for example.

UR6: Access to information when needed Instructions and information necessary to understand and respond to a question should be available when needed. The instructions for each question should be placed alongside the question, not at the beginning of the survey. To keep information visible, possible survey responses should be visible, and not hidden in drop down fields.

5.2.3 Organization and Layout Guidelines

According to Reynolds et al. (2006), an online survey should be organized with some key elements to be effective and pleasant to respond to. These elements are described below.

Welcome page The survey should have a welcome page at domain name easy to remember. This page should be designed to load quickly, and it should be evident who is responsible for the survey. The text on the page should motivate the user, and make it evident to the user how to proceed.

Introduction The survey should have an explanation of what the survey is about and outline what privacy practices the survey has to reassure respondents.

Questionnaire Questions Reynolds et al. (2006) suggests the following guidelines for online questionnaire questions-set.

- The first question should be engaging and easy to answer to ease respondent into the questionnaire.
- Open-ended questions should appear before closed-ended questions on the same topic to prevent influencing respondent with the fixed option choices of the closed-ended options.
- If appropriate, open-ended questions should be reserved for placement at the two-thirds point of the questionnaire to provide variation that will maintain the respondent’s interest for the rest of the questionnaire.

Thank the respondents According to Reynolds et al. (2006), every questionnaire should thank the respondents for their time and effort spent answering the survey. The tone should be gentle and friendly.

5.3 Limitations

The system will not be designed with elderly users and people with disabilities specifically in mind, in the form of text size options or full support for zooming, or huge buttons with significant spacing. Even though the elderly or people with disabilities are not designed for specifically, the hope is that they can still be able to use the system, as it is based on traditional usability principles. Feedback on the city's infrastructure and appeal from the elderly and disabled are definitively desired, but designing specifically for them is outside the scope of this thesis.

Chapter 6

Architecture

The prototype was developed for cross platform use across web, mobile, iOS and Android. The prototype was not compiled to native platforms but used as a web application adapting to the look and feel of the user's platform.

6.1 Ionic

Ionic, developed by Drifty (2013) is an open source SDK for developing cross-platform applications. It is built on top of AngualJS, an open source JavaScript-based framework for creating front-end web applications initially developed by Google (2010). The code is written using web-technologies like HTML, CSS, and Javascript and can then be deployed as a web application or wrapped into a native container for i.e. iOS, Android, or Windows devices. The apps developed can be customized for different platforms, and Ionic provides a library of platform specific visual components to make the look and feel resemble native apps. Ionic utilizes Apache Cordova, formerly known as PhoneGap (Apache, 2012) for the native wrapping. Even if the app is not compiled to native apps, the framework can register the platform the web page is accessed on and provide platform appropriate styling.

6.2 Database and Server

The database is a single table SQL-database where each row represents a feedback submitted by a user. Each question is a separate column, and the row also has data about the position and time-stamp of submission. The prototype client communicates to the server holding the database through HTTPS. HTTPS was required to allow for location services to find the user's location on the client's device. A simple PHP script handles POST and GET requests between the server and the client.

Chapter 7

Design and Development

Fogg et al. (2003) did a large survey on how different element of a web page affected the credibility of the site. They found that the most important element was the design look, followed by the structure. The tone of language and usefulness for information was less important for respondents, underlining the importance of the system's design in creating credibility for the system. The system is made up of three main pages - The Welcome-Page, the Survey-Page, and the Map-page described in this chapter. A navigation bar with tabs for the pages is used for navigating the system. Following is a run through of design principles used and how the system is developed using usability theory and best practices.

7.1 Navigation bar

A horizontal navigation bar with a tab for each of the pages is used to navigate the site. Appropriate symbols for each page are used as tab icons along with a title for each page. When a tab is selected, the corresponding page is navigated to and marked with blue to indicate that this is the active tab.

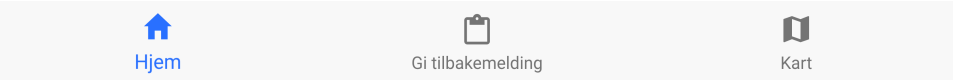

Figure 7.1: Screenshot of the navigation bar with the Home-page selected on a platform using Material Design.

7.2 Home-page

The home-page consists of simple text in a card welcoming the user as suggested in 5.2.3, noting who is responsible for the survey and helping the user proceed. A screenshot of the Home-page can be sin in figure 7.2

Figure 7.2: Screenshot of the Home-page

7.3 Survey-Page

The survey is based on the theory of usability, survey theory, and theory on adapting surveys to an online medium. It is to an integrated and functional part of the system. The Survey-Page holds the questions posed in the survey, allowing the users to easily and quickly answer the questions.

The page has a layout of three sections aligned vertically. The sections are described below.

Introduction At the top of the page is an introductory text, explaining the purpose of the form, some practical information, and instructions for the user.

Small map A map is displayed with a marker indicating to the user where the location where the submitted feedback will be registered.

Form The survey is conducted using the form covering most of the page. The form is aligned vertically down the page with the submit button at the bottom.

7.3.1 Survey questions

The Survey-page contains the questions seen in table 7.2. As a beginning to determining the survey questions, business- and research-objectives for the survey were defined as suggested by Reynolds et al. (2006), displayed in table 7.1. The questions used in the survey

are selected based on the analysis of city life surveys in section 4 with an added weight put on the questions asked in the survey from Trondheim, because of the availability of experts from this area. The questions are designed to meet the objectives of the survey. A screenshot of the Survey-page is displayed in figure 7.3.

Table 7.1: Business- and Research-objectives for the survey.

Business objective	Find and facilitate data about citizens' opinions about different areas in the city to be used in the planning process of the future city development.
Research objectives	To determine the level of satisfaction with city areas with a basis in parameters from city life survey questionnaires.
	Make the collected data contextual, by collecting location of submission and time.

Table 7.2: Questions included in survey.

Question text	**Type of input**
How do you feel about the noise level here?	Slider with values 0-10 (Little noise - A lot of noise)
How well do you like the environments here?	Slider with values 0-10 (Very bad- Very well)
What would you like to see here in order to use the city space more?	Text area
General feedback for this space	Text area
Would you let a six-year-old play freely here?	Radio-buttons (Yes - No)

7.3.2 Meeting high-level requirements

This section describes how the Survey-page is designed to meet the high-level requirements from section 5.2.

Contextuality In an attempt to meet the high-level requirement of contextually, a focus is placed on the respondent being at the location he/she is providing feedback on. At the top is a text explaining the need for the user to be at the site of the response to experience the location, not remember it. When the user has responded to the form and pressed send, the form is uploaded to the database with the responses from the form, along with the coordinates of the response, and the time of submission.

Accessibility and non-discrimination To preserve the anonymity of the respondents, no data about the user's device is stored in the database. The prototype is developed with usability in mind to allow for as many as possible being able to use the prototype.

Knowledge The questions in the form are derived from information city planners request on a general basis as well as in city life surveys, and each entry into the database increases the knowledge of the planners about areas in the city. The data open for both the planners and the public to analyze and combine as they wish.

7.3.3 Page format principles

The principles used are a primarily from an analysis of the most common principles and guidelines reviewed from 16 books, theses and journal articles on interface design recommendations (Kamaruddin and Sulaiman, 2016). This review was chosen because of its compilation of other material, as well as it had a focus on learning systems. This system, as well as a learning system, needs to be pedagogical to allow for comprehension of the system as well as delivering information in an easy and precise way. Kamaruddin and Sulaiman (2016) found many similarities in their reviewed material and were able to condense their finding into five identified principles, categorized into recommendations for different types of elements, like text, color, and images. Some of the element categories are not relevant for the developed system, but those relevant are discussed in the following sections. Reynolds et al. (2006) also has guidelines for formatting an online survey, applied to the design choices.

Text Length

Both Kamaruddin and Sulaiman (2016) and Reynolds et al. (2006) suggests keeping both sentence-length, and line-length short. Reynolds et al. (2006) suggests around 75 characters per line. Because of this, the Survey-page has a limited width of the content on the page (600 pixels). The narrow content area results in a line length under 75 characters for question labels and all other elements. Sentence length is also taken into account to make sure no sentences exceed 20 words (Reynolds et al., 2006).

Text Fonts

According to Kamaruddin and Sulaiman (2016) and Reynolds et al. (2006), fonts should be few, familiar, and readable. The system selects fonts based on the platform of use, a part of the ionic framework, introduced in section 6.1. If on Android or other devices with Material Design, *Roboto*, the standard Android and Material Design font is used. For iOS, *Helvetica Neue* is used, which is the font Ionic uses for iOS. It is very similar to the new font Apple uses for their devices, San Francisco. The fonts are native to their devices so users should be familiar with them. A font-size of 16 pixels is used across the system for content-text, like questions, options, and responses. On screen resolutions lower than 426 pixels (mobile), the font size is reduced to 13 pixels.

Colors

Users' preferences in colors are subjective and differ based on cultural norms and personal experiences. Color palettes are therefore difficult to generalize, but something can be said

about some colors. A literature study by Elliot and Maier (2014) on the psychological effects of colors suggest that some colors have specific impacts on people. Red is mentioned as the color evoking the most emotion, resembling blood, while blue and green are natural calming colors seen in vegetation and water - life necessities.

Kondratova and Goldfarb (2007) have looked at what color are most prominent in web pages from different areas of the world and made an international color palette based on their results. They found that some colors are used across all countries studied: White, Black, a light yellow color and all shades of gray and blue - suggesting that these colors are appreciated in all cultures. The basis of the color palette of the prototype is, therefore, based on these colors in an attempt to be appropriate for different tastes. The colors in the international color palette also avoid a red and green combination. Users with Red/Green Colorblindness will have a difficult time differentiating red and green, so this combination is not used in the system's interface.

Richardson et al. (2014) suggests focusing on contrasting colors when designing a color palette for a website. Suggesting light colors, white and gray, for background and black or blue for text, also fitting with the international color palette. Using light or pastel colors for background elements with large surfaces while having foreground elements in colors with higher saturation is also supported by Ware (2013). Ware (2013) also suggests that when varying text color for text highlighting of important text, dark colors with high saturation should be used on light backgrounds.

As a result of this, the background for elements is white for the main content, and light gray for navigational elements for them to stay subtle. The text is mainly black, using blue as a color for distinguishing important text or components. A darker, less saturated blue within the same hue as the primary blue, serves as a background color behind all content to provide a feeling that the questionnaire is a white sheet within the window. The color palette can be seen in table 7.3. Ware (2013) suggests using a contrast ratio of at least 3:1 differentiating background and foreground. Table 7.4 shows that the ratios are within this guideline.

Table 7.3: The Color Palette for the prototype.

Element	**Hex**	**Color**
Background	ffffff	
Navigation Backgroud	f8f8f8	
Site background	8aacc8	
Important Text & Buttons	2970FF	
Primary Text	000000	

Layout

The goal of the visual impression of an online questionnaire should be to evoke a feeling of trust about the organization conducting the survey and assist the respondents in the process of completing the questionnaire (Reynolds et al., 2006). The system has been designed with the following layout guidelines in mind, adapted from Reynolds et al. (2006), described below.

Table 7.4: Contrast ratios for colors used in the prototype calculated using *Colorable* (Jxnblk, 2015).

Background	Foreground	Contrast ratio
Background	Primary Text	21.0
Backgroud	Important Text	4.3
Navigation Background	Primary Text	19.8
Navigation Background	Important Text	4.1

- All question text are on the same page as the corresponding input field.
- Respondents are not required to provide an answer to a question to move on to the next question.
- All questions are on the same page, as there is no need for navigational buttons between question pages.
- Labels for input fields are close to their associated fields, this makes it easier to make association, and if users with visual impairment uses zoom on the page, the labels will still be on screen along with the input field.
- The submit button is at the bottom/the end of form, so that it is in natural order of proceedings, as well as being in view for users using zoom on their devices.
- Tab ordering (Iterating through the form using ”tab” on a computer) follows the visual appearance of the form
- The label and question for an input field appear before the field, not after. This is the logical order for most users, and also makes sure that people using zoom see the instructions before the input field.

7.3.4 Form and types of input

For different kinds of feedback data, various kinds of input elements are appropriate, following is a justification of various form elements.

Radio Buttons

As opposed to checkboxes, which can have multiple boxes selected, radio buttons can only hold one selected value within a grouping. For the question about child friendliness in the survey seen in table 7.2, radio buttons were selected as input form. Radio buttons are typically used when only one answer makes sense, like a yes/no value or values excluding each other. The use of radio buttons are shown in figure 7.4. Radio buttons were selected over toggle-buttons, because they have a bit more adversity in representing options, as toggle-buttons often refer to on/off state, which does not fit that many survey questions (Eaton, 2002). The design conventions for iOS and Material Design are different when it comes to radio buttons. While Material Design has an always present field for displaying whether a value is selected, iOS does not. This makes the options appear to be floating text before an option is selected, unless shown in a list, suggesting selectivity. Displaying

the radio-buttons in a list is best practice for iOS design, but displaying a border around the options indicates their ability to be selected. The difference can be seen between figure 7.4 where Material Design is displayed, and figure 7.5 where iOS guidelines is used. Drop down list could also have been used to allow for multiple answer options to a question, but is not advised by Reynolds et al. (2006) because it requires multiple actions to access, and hides options before being clicked. Radio buttons are simpler and faster for the respondent. The radio button is not checked by default as suggested by Reynolds et al. (2006) to avoid confusing the respondent.

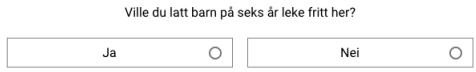

Figure 7.4: Screenshot of the Survey-page using radio buttons with Material Design guidelines.

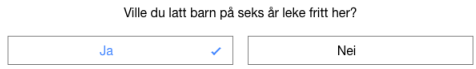

Figure 7.5: Screenshot of the Survey-page using radio buttons with iOS guidelines.

Text input

For text input, multiline text fields are used for all the survey questions. This is because single line text fields suggest that hitting ”enter” or ”return” will submit the form (Eaton, 2002) - an unwanted behavior. While the survey questions do not require large amounts of text as input, the ability to enter larger amounts of text is useful if the respondent wants to provide longer feedback. If the respondent enters text that takes up more space than the initial area of the text field, the text field is programmed to expand vertically automatically. Even though it is against best practice for both iOS and Material Design, a border was added to the text fields to distinguish it from the background, seen in figure 7.6.

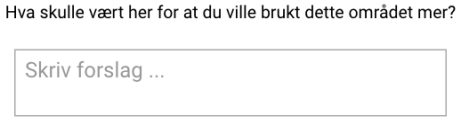

Figure 7.6: Screenshot from the Survey-page showing a bordered text field.

Range sliders

For entering feedback that is quantitative and subjectively rate-able, a range slider is used to present the possible scores available to the respondent. Range sliders are used instead of drop down lists for the same reason as radio buttons are used, to avoid hiding options and allowing the respondent to answer more efficiently. As seen in figure 7.7, the current

value of the slider is displayed in a badge above the slider to let the respondent see their selected value.

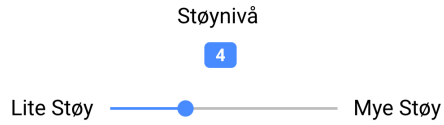

Figure 7.7: Screenshot of the Survey-page with a range-slider with the selected value displayed.

7.4 Map-Page

To provide knowledge to the urban planners, as well as the citizens. All survey results are plotted as markers on a map at the location of the response shown in figure 7.8. The results of the survey are available here if the user clicks on the marker, shown in figure 7.9.

Heatmap-filters

To view specific data and visualize it in a comprehensive matter, a filter feature is available for the user in the top header. The filters available are answers to the questions in the survey with numeric answering - noise level, and appreciation for the environment in the area. The selection of filter is made through a drop down selector. Once a filter is selected, the markers are exchanged for a heat-map, using the numeric answers of the feedback reports to determine the color of the heat-area at the location of the survey response. Red is bad, yellow medium, and green means good. An example of a generated heat-map with a filter selected from the drop down menu is displayed in figure 7.10.

Area Report

To get a collection of feedback submitted from an area. The system has a function for listing all feedback within a given radius from a click on the map. By clicking on ”Områderapport” in the header bar, the header bar transforms into an input area for the radius of the report displayed in figure 7.11. The user can enter a radius, or click abort, displayed in figure 7.12. After clicking the center of the radius, the reports for that area is listed in a modal view, displayed in figure 7.13. A modal is a view within the view covering the whole screen or just a portion, displaying information or choices to the user. The modal is meant to grab all of the user’s attention prompting them to take action or view something before continuing (Oracle Docs, 2014).

7.5 Feedback to the user

As stated in section 5.2.2, displaying important system messages and informing the user about loading taking place is good practice in usability theory. In the developed system, this is achieved through two types of overlays on the screen, toasts and loading overlays.

7.5.1 Toasts

Toasts are displayed to provide the user with information relevant at that specific moment as seen in figure 7.14 displaying a toast informing the user about the possibility to click somewhere on the map to get a report of all feedbacks in that area. The toast has a timer before it automatically is dismissed. The timer was for the prototype typically set to 2-3 seconds.

7.5.2 Loading overlays

Loading overlays are displayed instead content while the content loads. In the system developed, the only content with a loading overlay added is the map, as it takes some time to locate the user's location. The loading overlays for devices using Material Design and iOS can be seen in figure 7.15 and 7.16.

7.5.3 Thank you message

As suggested in 5.2.3, when the user completes the survey, a thank you-message is displayed on the screen.

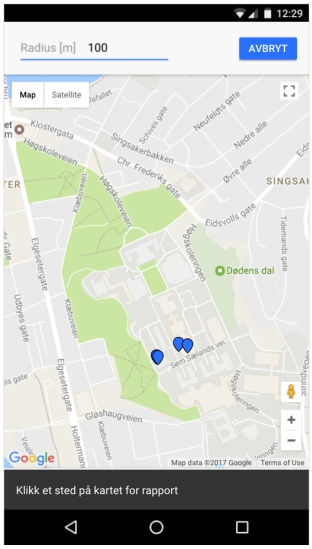

Figure 7.14: Screenshot of a toast with the text "Klikk et sted på kartet for rapport" being displayed on Material Design.

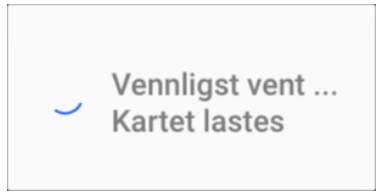

Figure 7.15: Screenshot of a loading overlay with the text "Kartet lastes" on Material Design.

Figure 7.16: Screenshot of a loading overlay with the text "Kartet lastes" on iOS.

7.6 No help-pages or documentation

Online help pages or documentation increase the complexity of a site. Its presence requires resources from the interface and is often best omitted from the system (Nielsen, 1993). The system is instead designed with usability in mind, hoping that help resources are not necessary.

Figure 7.3: Screenshot of the content of the Survey-page

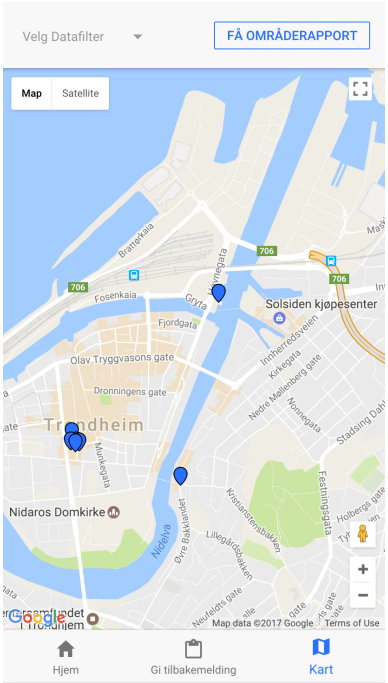

Figure 7.8: Screenshot of the markers on the map, representing submitted feedback.

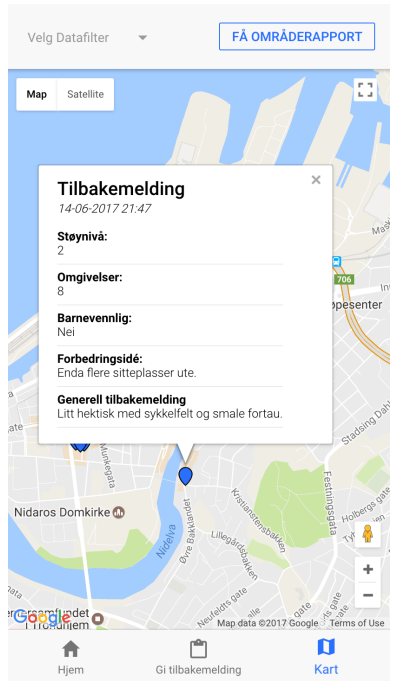

Figure 7.9: Screenshot of viewing a survey submission by clicking on a marker.

Figure 7.10: Screenshot of the heat-map with noise level selected as the filter.

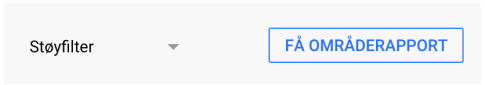

Figure 7.11: Screenshot of the area report button on the header bar on the Map-page.

Figure 7.12: Screenshot of the radius input field after the area report button has been clicked.

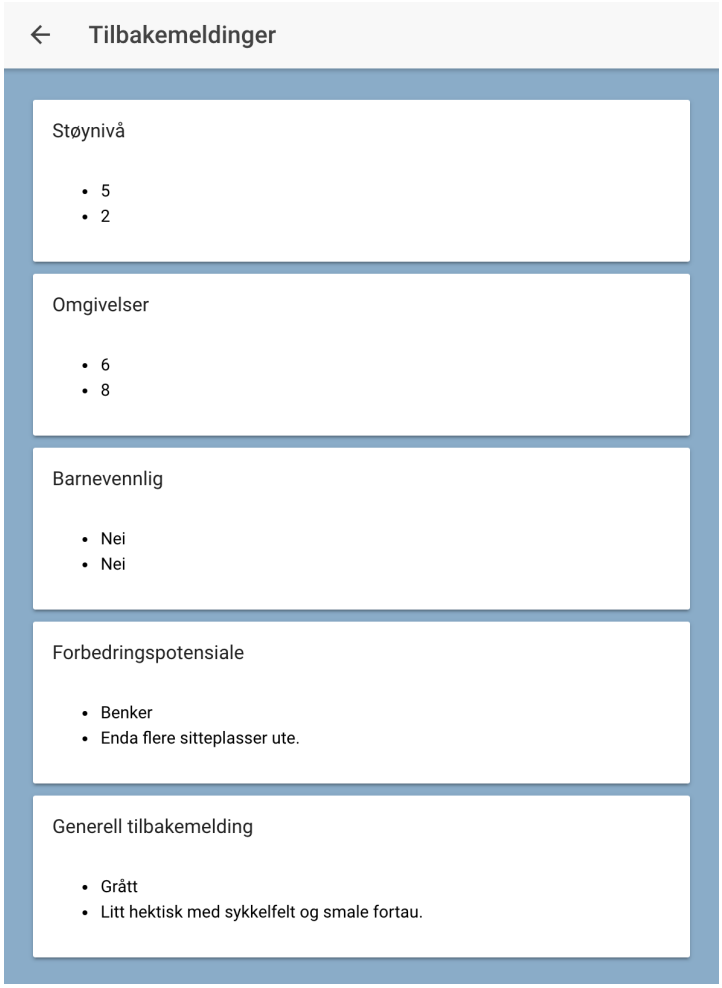

Figure 7.13: Screenshot of area report modal view.

Chapter 8

Evaluation

This chapter describes the process of evaluating the prototype. Starting with feedback from experts and followed by usability testing. Finally, guidelines for future development based on the evaluation is described.

8.1 Expert evaluation

To evaluate the features of the prototype in a planning perspective, three experts described in table 8.1 were shown, and interviewed about, the features of the prototype. The procedure and results are described in this section.

8.1.1 Expert evaluation procedure

The interviews were conducted as semi-structured interviews as outlined in Appendix A. The same questions were used for all the interviews as they were all familiar with city life surveys and the domain, so there was no need to take different levels of knowledge into account. Notes were taken during the interviews and read through afterwards to find feedback relating to similar aspects and are summarized below in categories of feedback from the experts. The experts had been emailed a link to the prototype and the questions in advance to let them prepare for the evaluation. The questions posed to the experts can be seen in Appendix A.

Table 8.1: Experts evaluating.

Occupation	Gender	Age
Professor in City Planning	Male	46
City Planner - Trondheim	Female	28
City Planner - Trondheim	Male	25

8.1.2 Expert evaluation results

This sections described the results of the expert evaluation summarized and categorized below.

General feedback

Some general feedback was given on the prototype, listed below.

- The experts though it had potential as a tool in urban planning.
- Anonymity is a good aspect - People will be more honest if their responses are anonymous.
- Important that the system can provide information about why public participation is important, letting the user know that their feedback is crucial.
- The prototype is appropriate to find city improvements both in a long term and a short term perspective.

Incentivize users

The experts were concerned about how to get people to use the prototype. A suggestion was to use it as a tool for planners to be free to use, and that they can hang up posters on places of interest to them asking people to visit the site and answer the survey. The experts proposed something in the realms of gamification. The idea was to reward respondents with points as they replied to surveys which could allow them to ”level up” their profile and eventually be recognized as a top contributor. The point system would require users to create a profile, possibly compromising the anonymity of the respondents.

Survey Questions

The experts evaluating the prototype had some suggestions for improvements and changes to the questions in the survey.

Noise-level : The labeling ”Little noise” and ”A lot of noise” were too vague, to have on a 1-10 scale. The suggestion was to either use one or several reference sound as steps on the scale; or to have a smaller range of response and only include ”Too much noise”, ”Bearable level of noise”, and ”Not much noise”.

More contextual data : The experts expressed their desire for more demographic and contextual data from the respondents. This includes the age of the respondent, gender of the respondent, and what activity the respondent did while responding to the form, like shopping, strolling, moving from a to b, relaxing, or other (possibly being able to specify their answer).

Free-text questions are tedious : The experts expressed concerns over the tediousness of free-text answers where respondents have to enter text themselves. They stated that although sometimes inevitable, their use should be minimal, perhaps only one per

survey. One expert, however, wanted more free text answers because they provided the most information, making the amount of free-text answers a trade-off between information richness and statistical potential. Based on their experience it should also not come last, having the potential to be looked at as an after-though by the respondents. A better place is in the middle, where the respondents are in a state of flow and sees the free-text question as a part of the natural order, also noted by Reynolds et al. (2006).

Free-text answers are difficult to analyze : Given X responses to a question like ”What improvements would you like to see in this area?”, Receiving the same amount of different answers is possible. This makes the responses difficult to compare, and it might be difficult to form a foundation for acting on any of the responses because there is no agreement across responses. An alternative to this suggested by an expert is to ask the same question, but provide a limited set amount of options for the respondent to choose on or more from.

Safety : It was noted by one of the experts that there is a difference between letting a child play at a location and letting their own child play there, as asked in the survey. The questions were meant to investigate the experienced safety of an area, but another expert though that having a separate question for the respondents own feeling of safety was more relevant and more concrete than a child's safety.

8.2 Usability testing

Usability tests were conducted to evaluate the usability of the prototype and reveal issues and areas of improvement. The usability tests were conducted on people of different age groups and with different technical backgrounds to evaluate the usability for the span of the target audience. All of the testers were Norwegian, having the same native language as the language used in the prototype. An overview of the testers and the devices they used is displayed in table 8.2.

Table 8.2: Participants in the usability test.

Gender	Age	Device platform
Male	62	Android (Mobile)
Male	26	Windows (Computer)
Female	67	iOS (Mobile)
Female	26	Android (Mobile)
Male	25	Android (Mobile)

8.2.1 Usability test procedure

The Usability Test procedure for the testing can be found in Appendix B. It includes tasks, checklist and a questionnaire. These elements are discussed in this section.

Introduction for testers

The testers were first introduced to usability testing, and the concept of the system, they were informed they could abort the testing at any time, as well as the results being anonymous.

Tasks

The testers were given tasks to complete in order to test the system. The tasks were designed to let the user test all the main functionality of the prototype and are listed below. The testers were asked to try to complete the tasks, while thinking out loud to easier be able to understand what the tester is trying to do or finds difficult. An example of thinking out loud was given. ”I want to do X, so I am looking for X.” And ”X looks like a button, but I am not able to click on it”.

Task 1: Open the prototype. The system is located at the URL ”www.bykvalitet.no”. Enter the web site using your device.

Task 2: Submit a feedback to a location. You are now at a location you want to submit a feedback to. Submit a feedback for this location using the system.

Task 3: View feedback from someone else. You now want to view other people’s feedback at a location, like the one you submitted.

Task 4: View heat-map filter. The system has functionality for filtering and visualizing some feedback data using colors on the map. Make the map display such a filter.

Task 5: View feedback for an area. You now want to view all the feedback anyone has given within a radius of 150 meters from a spot in the city.

Checklist

While the testers completed the tasks, a checklist of intermediate objectives was filled out while observing the tester. The checklist was used to take notes from the testing and as a documentation tool of completed sub tasks within the list. The sub goals are shown in table 8.3.

Questionnaire

After the testers had completed the tasks, they were asked to fill out a questionnaire based of the System Usability Scale. The questionnaire has ten questions, posed as statements, with a five point rating scale ranging from Strongly Disagree to Strongly Agree (Tullis and Stetson, 2004). The System usability scale was selected based on the findings of Tullis and Stetson (2004), finding the scale to yield reliable results and covers major aspects of the tester’s reaction to the system as a whole. The questionnaire is shown in table 8.4 (1 = Strongly disagree, 5 = Strongly agree).

Table 8.3: Checklist for the usability testing.

Action	**Comment**
Enter web site.	
Navigate to the Feedback Page.	
Enter value for noise level using slider.	
Enter value for environment satisfaction using slider.	
Enter improvement suggestion using text-area.	
Enter general feedback using text-area.	
Enter value for child friendliness using radio buttons.	
Submitting feedback using submit button.	
Navigate to the Map-page.	
View feedback from someone by clicking on a marker.	
Find heatmap filter dropdown.	
Select heatmap filter from dropdown.	
Find button for getting feedback from an area.	
Entering custom radius for area feedback.	
View feedback on an area by clicking on the map.	
Properly closing the modal with feedback.	

Table 8.4: System Usability Scale for testers after testing.

Q#	**Question**	**Score**				
1	I can see my self using the system often.	1	2	3	4	5
2	I found the system to be unnecessarily complex	1	2	3	4	5
3	I found the system to be easy to use.	1	2	3	4	5
4	I think I would need help from a technical person to be able to use this system.	1	2	3	4	5
5	I think the different parts of the system were integrated well.	1	2	3	4	5
6	I found the system to be illogical and inconsistent.	1	2	3	4	5
7	I believe most people can learn to use the system very quickly.	1	2	3	4	5
8	I found the system to be difficult to use.	1	2	3	4	5
9	I felt confident when using the system.	1	2	3	4	5
10	I need to learn about and familiarize myself thoroughly to be able to use the system myself.	1	2	3	4	5

8.2.2 Usability test results

The results from the usability tests are the problems recorded from the checklist, and other notes taken during the test, and scores from the questionnaire. Both are described in this section.

Problems recorded

The problems occurring were noted in the checklist-form shown in table 8.3. A summary of the comments for each of the sub-tasks are shown in table 8.5 and 8.6. table 8.5 contains comments for the survey-part of the prototype, while table 8.6 contains comments for the map-/visualization-part of the prototype.

Table 8.5: Summary of comments regarding the survey noted from the checklists filled out during usability tests.

Sub task	Comments
Enter web site	All the testers managed to enter the web page on the first try with the domain name presented orally.
Navigate to the Feedback-Page	A tester noted that it felt scary providing their position to the system, when prompted to do so by the browser on their mobile device.
	A Tester tried to click on the text ”Gi tilbakemelding” in the introduction text, instead of using the tab at the bottom with the same labeling. This did not navigate to the Survey Page as expected by the tester.
Enter value for noise level (Slider)	All the testers managed this.
	A tester noted that they though a slider was more tiresome than just clicking a radio button with a value within a range.
Enter value for environment satisfaction (Slider)	All the testers managed this.
	A tester wanted to provide deeper feedback, stating why they appreciated the environment at that location. The tester suggested using either a list of suggestions or a free-text answer.
Enter improvement suggestion (Text-Area)	All the testers understood that this was a free-text question where they should provide text themselves.
	The placeholder text encouraging them to enter text seemed important for the affordance of the text-area.
	Many of the testers noted that for some reason, there was no spelling suggestions appearing on their mobile devices while entering text into the text-area, making it more difficult to enter text than they are used to.
	A tester suggested pre-filled alternatives of improvements to choose from, while noting that it might be too many to be reasonable.
Enter general feedback (Text-Area)	As with the improvement suggestion, many of the testers noted there was no spelling suggestions, becoming a bit frustrated.
Enter value for child friendliness (Radio Buttons)	All testers managed this. Some noted they liked the simple yes/no question.
	A tester noted that since the survey was so short, it seemed strange to have many different forms of input in the same survey.
Submitting feedback (submit button)	All testers found it easy to recognize the button as a button.
	Some noted they hoped they would be thanked for completing the survey and were pleased when a thank you message appeared.

Table 8.6: Summary of comments regarding the map and visualization, noted from the checklists filled out during usability tests.

Sub task	Comments
Navigate to the Map-page.	All the testers managed to navigate to the Map-page using the tab-menu.
	Some testers did not find it intuitive that the feedback from other people was located at the Map-page before seeing other people's markers on the map.
View feedback from someone by clicking on a marker.	A tester only saw the marker of the feedback they had given themselves, at their own location. Therefore thinking the marker represented their own position, since it was the same marker as was used to display their location on the map on the Survey-page.
	A tester thought they had to click on the button for "area-report" to see a single feedback from someone.
	When the map showed many other markers. The testers intuitively thought all the markers represented other people's feedback and that they were clickable.
Find heatmap filter dropdown menu.	Some testers found it confusing with another toolbar at the top of the map for functionality. Some thought it was a part of Google-Maps, not having anything to do with the functionality of the the specific system.
	This functionality was not represented by a button, only with a dropdown list element. Making the testers overlook it in favor of the button next to it for the area-report functionality, which some testers clicked to try and find the heatmap functionality.
	The placeholder text for the dropdown when nothing was selected was grey, leading some testers to believe it was disabled.
Select heatmap filter from dropdown menu.	All the testers managed this once the dropdown selector was located.
Find button for getting feedback from an area.	This was easier to find than the dropdown.
	Many had allready clicked this when attemption to complete the previous task, already having an impression of what this button did when clicked.
Entering custom radius for area feedback.	All testers saw this functionality and entered a custom radius as a part of the task.
	Some devices saw this as a field part of a bigger form, labeling the return key of the native keyboard, which normally dismisses the keyboard with the text "next". This mislead some testers to believe there were more fields to fill in.
View feedback on an area by clicking on the map.	The toast displaying the instruction to click somewhere on the map dissapeared before many of the testers even noticed it (2 seconds). This left the users without instructions for how to proceed. Many testers stalled at this point being confused for a long time. Some by chance clicked the map at a random position. If no feedbacks had been provided within the radius at that area, a different toast was displayed stating that there were no feedback within the radius of that location. After seeing this. All testers clicked on the map somewhere within the radius of other markers and was shown an area report for that area.
Properly closing the modal with feedback.	All testers managed this.

Questionnaire results

All testers filled out a System Usability Scale questionnaire after their testing to document what they though about the system. The scores reported are listed in table 8.7 (1=Strongly disagree, 5 = Strongly agree). The questionnaire scores showed that the testers believe they can use the prototype without help from a technical person once they have learned the prototype suggesting that the prototype is easy to use, while some testers found the prototype illogical. This can be because the prototype is easy to use once you know the flow of operation, but seems illogical at first. Contributing to a sense of inconsistency and not giving the testers confidence the first time they use the system.

Table 8.7: Scores from Questionnaires after usability testing.

Questionnaire Questions	Reported Scores				
I can see my self using the system often.	3	3	2	4	2
I found the system to be unnecessarily complex.	3	1	1	1	3
I found the system to be easy to use.	3	4	5	2	3
I think I would need help from a technical person to be able to use this system.	1	1	1	1	2
I think the different parts of the system were integrated well.	3	4	4	5	3
I found the system to be illogical and inconsistent.	3	3	2	1	2
I believe most people can learn to use the system very quickly.	4	5	5	4	4
I found the system to be difficult to use.	2	2	1	1	2
I felt confident when using the system.	3	4	3	5	3
I need to learn about and familiarize myself thoroughly to be able to use the system myself.	2	1	1	1	3

8.3 Usability Evaluation discussion

The usability test showed that the Survey-page in the prototype was highly usable. Having a small number of usability problems. While the Map-page has more issues. The focus on usability during the design process has also been greater while developing the Survey-page than on the Map-page due to time constrains. This is also reflected in the comments from the checklists. The observed issues from the Survey-page were more related to minor improvements, while testers had actual problems related to using the Map-page.

Designed as standalone app

The design was initially though of as being for an app, without the wrapping by a browser providing its own toolbars. This cluttered the view when used in a browser, like in the evaluation, as the prototype had toolbars of its own. This illustrates that designing a layout for an app is different from a web page. It is reasonable to believe that if the system is compiled as an app, these issues will be non-existent.

Instructions are important

The need for instructions is important, especially for first time users. As many of the instructions in the prototype disappeared along with the toast displaying them, as described in section 7.5.1. Many of the testers simply did not notice the instructions, or missed their content, leaving them on their own in a state where instructions initially were considered as necessary.

Importance of auto-correct

Auto-correct is a feature on most mobile devices, Correcting misspelled words the user types on their keyboard by guessing words with letter-combinations similar to the word typed. Something not discovered before the usability testing was the lack of spell-checking and auto-correct when using the text-input fields on the Survey-page. The testers found this frustrating and reported they spent more time than normal entering the text, proving the importance of auto-correct on mobile devices. The reason why the auto-correct feature did not work has not been uncovered.

Importance of clear concepts and explanations

The fact that many of the testers had problems using the heat map-functionality as well as the area-report functionality might be in part because they are concepts new to the testers. When developing the usability test tasks, it was difficult to even explain the nature of the task to the tester. This could have been worked on more, to ensure that the tester at least understood the task. In addition, some of the functionality on the Map-page is functionality more interesting for the urban planners, leaving the ”non-expert” testers less motivated for these tasks.

8.4 Guidelines for future development

This section describes guidelines for future development and is composed of lessons learned from both the expert evaluation and the usability testing.

Guideline 1: Auto-correct functionality is important. Many users on mobile devices are reliant on auto-correct for typing when using small screens where missing the intended letter is easy. If this feature is not supported or missing, the user finds it much more difficult to type responses, as discussed in section 8.3. A mobile system should make sure this feature is enabled.

Guideline 2: Avoid using toast for instructional text. While toasts are good for short messages and information relevant at a given time as described in section 7.5.1, many users missed the toast completely and are left without instructions as seen in section 8.3. Instructions should be visible when the user needs them, not disappear after a set amount of time.

Guideline 3: Consider the users when creating in-app survey questions. It might be easy to only consider what the experts wants to know about and what they don’t care about when it comes to i.e feedback on an area, but to keep the questionnaire interesting and fun to complete, the users must feel they get to say what they feel. Some data received from free-text answers might be difficult to process afterwards because of many different answers, as noted by an expert in section 8.1.2, but allow the user to speak their mind. A compromise can be to include many predetermined alternatives to a question to provide the user with nuanced alternatives, suggested by a tester and commented on in table 8.5.

Guideline 4: Make clickable elements in menus look like buttons. As described in section 8.2.2, some users ignored the dropdown selector for selecting heat-map filter on the Map-page, noting it did not look clickable and was greyed out. This might be mitigated somewhat by using black text instead of grey, but can also be made more clear by having a clear button, grabbing the attention of the user and from there displaying a modal-overview to let the user select what filter the heat-map should use. A modal can be justified in this instance because it presents the user with a choice that has to be made in order to proceed.

Guideline 5: Use different markers for showing user location and feedback on maps. One of the testers noted that they thought the marker they saw on the map was their own location, being confused when it did not match their current location. The tester noted this was because the marker looked the same as the marked displaying the user location on the Survey-page. This could be especially relevant when there are given few feedbacks in an area and only one feedback marker is visible on the map. Changing the look of the markers, differentiating them could help mitigate this problem.

Guideline 6: Use clear and several labels for range sliders. As mentioned by the experts in section 8.1.2, having only two labels on a 1-10 scale can be too few, having additional labels describes the scale in a more informative and nuanced way.

Guideline 7: Collect demographic data As described in section 8.1.2, the experts wanted more demographic and contextual data collected, including age, gender, and reason for being in the area. This should be collected by the survey in an optional way.

Chapter 9

Conclusions

This chapter contains conclusions from the study starting with a summary of results, followed by a discussion of the process, a description of contributions made, and suggestions for future work.

9.1 Summary of results

This study has provided insight into what data public planners are interested in gathering about the city's environment through an analysis City Life Surveys described in chapter 4. Commonly collected parameters have been identified and categorized based on their attributes. Citizens' subjective opinions was selected as the focus area of data gathering through a software system. A prototype has been developed collecting citizens' opinions on areas in the city. Finally, the prototype has been evaluated by experts and non-experts resulting in guidelines for future development.

The goal of this study was to find a way to collect commonly asked for data parameters found in City Life Surveys. This section describes the how the research questions defined at the beginning of the study has been answered through this study.

RQ1: What are the common questions between City Life Surveys they seek to answer? This question was answered through an analysis of publicly available City Life Surveys as described in chapter 4. The parameters found are listed in table 4.1, 4.2, and 4.3. The analysis found that the data collected mainly fall into two groups. Data collected through observation of citizens, and data collected through interviews with citizens. The observational data is objective, related to how many people pass through an area and what actions they perform there. Further demographic data about the age and gender were also often gathered through observation. Most surveys focused mostly on this observational data in their surveys. The data collected through interviews with citizens aimed more at getting the citizens subjective opinions about the city area. Often utilizing questionnaires about what citizens liked, disliked or would like to see in an area of the city. The analysis

further showed that different surveys collect different data and while many surveys collected the same data parameters, only a small number of the surveys collected the same selection of data parameters.

RQ2: How might a system utilizing appropriate information technology to collect data on city life look like? A concept has been developed from requirements described in chapter 5 and turned into a prototype based on these requirements through development described in chapter 7. The resulting prototype was evaluated by experts and found to have a potential for use in urban planning as described in chapter 8. The prototype can be seen online at "www.bykvalitet.no". The system collects subjective opinions from citizens about city areas and is an online web page where people can provide their subjective opinion for a location in a city in the form of a feedback report. The feedback reports are displayed on a map in the system, allowing for reviewing feedback provided for different areas of the city.

9.2 Discussion

In this section strengths and weaknesses of the work will be discussed, as well as discussing how well the research questions have been answered.

9.2.1 City Life Survey Analysis

The analysis of the City Life Surveys was completed on surveys found online and does with high likelihood not cover all City Life Surveys. There can be similar surveys which investigate similar topics within city evaluation not discovered because they have different names not searched for or are not available openly online. City Life Survey in itself is a collective term, having a broad definition. There is, however, a reason to believe that when including a substantial number of surveys in the analysis done that the essence of what city planners find interesting have been covered. The analysis along with conversations with city planners forms a satisfactory foundation for making requirements of a system collecting data similar to City Life Surveys. The data parameters found in the City Life Surveys were looked at to find attributes of the parameters. Some of the data parameters in the surveys could relate to several of the found attributes depending on how they were collected. If the demographic data was collected through asking people instead of observing them, the data could be considered to both require citizen interaction, or not. For this specific case, most surveys used observation to collect demographic data, but even though some data parameters can have different attributes, the categories of attributes described in section 4.3.1 and section 4.3.2 remain the same.

9.2.2 Concept and Requirements

The concept is one possible concept for gathering subjective feedback from citizens, other ideas can be thought of, but for the sake of designing a prototype, a single concept was selected. The concept covers only part of the data collection typically done in City Life

Surveys, described in section 4.2. Other concepts could be developed to gather other information urban planners are interested in. According to the experts, the concept shows promise. The requirements in chapter 5 can be relevant for other systems and concepts as well, especially the high-level requirements. The usability requirements from section 5.2.2 were useful in the development of the prototype as guidelines towards what functionality, supporting usability, the prototype should strive for. They could have been used to a greater extent to explain the rationale for the system in chapter 7, but were used more as inspirational factors in the design. The layout guidelines for questionnaires mentioned in 5.2.3 seemed to work well as the experts saw potential in the survey while still having suggestions for improvements on their own. Much of the literature found was aimed at longer and more extensive questionnaires so how important some of the guidelines followed are for much smaller questionnaires as in the developed prototype is questionable.

9.2.3 Architecture

An issue with the architecture is the way the questionnaire is made of questions predefined in the database as described in chapter 6. Each question has a separate column in the table, making adding new questions difficult. The questions are also hard-coded into the code of The Survey-page. This makes it more difficult to change, add or remove questions. A different solution would be to have the questions in a different table with unique identifiers and have answers given to questions relate to that unique identifier. There is a reason this was not prioritized in the prototype, however, as changing questions often makes comparing results between different areas or over time a challenge. Responses would relate to different questions for different feedback reports if the questions were changed depending on the area the system accessed from or changed over time. Developing in Ionic as described in section 6.1 made development go faster as the framework had built in components for different user interface elements like loading, toasts, and forms with the look and feel similar to the native design for mobile devices as described in chapter 7. The prototype was not compiled to native apps, but doing so should not be a problem and the usability could benefit from a less cluttered interface as discovered in the usability test described in section 8.2.

9.2.4 Design

The design of the system is based on the usability requirements and layout guidelines from section 5.2.2 and 5.2.3. The usability test conducted with the prototype discovered that the usability and satisfaction were different for the Survey-page and the Map-page in the prototype. This can be because designing a straightforward survey is a less complex task. The flow of proceedings is vertically down the page, and the goal is quite clear: Complete the survey and submit it. The Map-page has more functionality and things that can go wrong. One of the hardest challenges was to convey the meaning and concept of the functionality on the Map-page, namely heat-map and area report, described in 7.4. This was difficult both in the design of labels for buttons on the page, as well as when trying to explain the task of testing this functionality in the usability test. A greater effort could have gone into thinking of how to explain these concepts as some testers did not understand the

task to complete or how to complete it regarding testing the heat-map filter and the area report.

9.2.5 Evaluation of the prototype

The expert evaluation was done with three experts, all of them located in Trondheim. They provided valuable feedback for future development discussed in section 8.1. Three experts is fewer than wanted, but it proved difficult to get relevant experts to take the time to provide feedback. The main purpose of the expert evaluation, however, was to get a sense of whether the concept had potential for use in urban planning. The evaluation by the three experts suggested that it has potential, but the indication would be stronger if more experts had been involved.

The usability test provided insight into how first time users experienced the system and possible issues with the design. The test and results could have been divided into a test for the survey part of the system and a test for the map/visualization part of the system. This would follow theory on usability testing, suggesting to test specific aspects of the system in separate tests (Dumas and Redish, 1999). The results of the tests and problems occurring when the testers completed the tasks testing the Map-page and its functionality were somewhat influenced by the lack of understanding of the task. It proved difficult to explain the functionality the system had with regards to the heat-map filter and the area report. The testers were unsure of what the given task meant, making it even more difficult to find a way to complete it. It would be beneficial to the results to conduct a new usability test focusing on the Map-page functionality when more work has gone into finding a way to explain the concepts of heat-map filter and area report better to the testers. The results of the System Usability Scale questionnaire showed a trend in the responses for each question but having only five testers means that the average of the scores are less reliable than they would have been with more participants. Tullis and Stetson (2004) recommends 12-14 participants to get reliable results. The score still gives some indication of the usability of the prototype and the opinions of the testers involved.

9.2.6 Meeting High-Level Requirements

The prototype has been developed to meet the requirements set in chapter 5.2. The High Level Requirements are based on problem areas in urban planning described in section 2.3 and discoveries made in section 4. The following section discusses how well they have been met.

HLR1: Accessible and non-discriminatory An important factor for meeting this requirement was to make the prototype open for everyone. This was achieved by making the prototype available openly on the web by any mobile device or computer. One can argue that not everyone has access to a device with access to the Internet. As discussed in section 5.1.2, more young people have smartphones than elders, making the elders a group more difficult to reach using the concept developed in this thesis. However, as mentioned in limitations in section 5.3, the main target audience for this prototype is not the elders, not having designed for them. Some people dislike having their device's GPS coordinates sent with their feedback report, which might put them off using the prototype, but this is a

necessity for the concept to meet HRL4. Making the prototype as easy to use as possible makes it more accessible as more people actually manage to use it and feel more comfortable using it. The usability can be improved, as seen in the usability evaluation in section 8.2 about usability testing done on the prototype, making the system more accessible.

HLR2: Support public participation The developed prototype has been deemed as the experts evaluating the prototype as having a potential for use in urban planning through public participation. To fully support public participation though, it has to be used in public participation. Hopefully, future development can turn the prototype into a tool urban planners wants to use. As far as actual participation, the prototype can be said to reach at least level 4, Consultation, on the Ladder of Citizen Participation by Arnstein (1969). Meaning the public is consulted and through that can participate actively in the planning. The prototype does not allow citizens to control planning processes or be a partner in planning processes, putting it in the middle of the ladder. By reaching level 4, it can be argued that the public is included in a meaningful way, not just being informed about plans and therefore meeting this requirement.

HLR3: Provide knowledge about subjective opinions This is the purpose of the concept and the survey portion of the prototype in particular. All feedback provided by the public is stored and readily available for anyone, including urban planners. The feedback provides knowledge and is based of subjective opinions by the public.

HLR4: Contextual and at location The prototype only allows people to submit a feedback report to the place they are located at, getting their location at the time of submission through their device's GPS sensor. This means the submitter has to be at the location in question and observing the actual location rather than recalling it from memory as was the background for this requirement, making the concept contextual.

HLR5: Engage citizens The prototype does not have any specific functionality for engaging citizens, like gamification rewarding users with points or badges or upgrades for submitting feedback. This is something which can be incorporated in the future building on the prototype or developing a new system. The absence of any engaging functionality may be some of the cause of the relatively low scores regarding how often testers could see them self using the prototype as seen in table 8.7. In general, the experts in the expert evaluation in section 8.1 was critical to whether citizens would use the system and how people would be engaged by the system. In this regard, the system can be viewed as a tool, requiring additional efforts in marketing, promoting use or further development providing greater incentives to use the app in the form of gamification or other motivating instruments.

9.3 Scientific contributions

The scientific contributions made by this study are the results of the City Life Survey analysis in section 4.2, as well as the experiences made from developing and evaluating

the prototype system. The evaluation from chapter 8 has resulted in a set of guidelines for future development, useful for building on the prototype developed in this study or developing a similar system. The guidelines can be found in section 8.4.

9.4 Future work

Based on the experts' evaluation on the prototype, there is a potential for further development, suggesting it has potential for use within urban planning with some modifications. A starting point for further development would be the feedback provided from the experts and the issues discovered by the usability tests in chapter 8. A result of this evaluation is a set of guidelines for future development described in section 8.4.

One of the main issues of the prototype usability testing was to explain the concepts heat-map filter and area report from the Map-page to the testers. More work should be done to ensure these functions can be explained in an easier way and can be labeled more intuitively in the interface. These functions should then be usability tested to uncover new potential issues with the design.

The current prototype has hard-coded questions for the Survey-page. As described in section 9.2.3, it would be beneficial to make the questions in the survey more modular, in the form of allowing for modification on the questions to be done easier than changing the system code. This could also open up for the system to be used in different versions between cities with different questions. The local urban planners could decide their own questions and use their own version of the system for their city with only having to change the configuration of questions.

It may have been natural to compile the prototype to native platform applications to provide easier access and a less cluttered interface without the browser wrapping. This might, however, increase the threshold for use, as downloading an app is more time-consuming than entering a web page. An app could, however, open up for automatically logged in user profiles allowing for more engaging use through gamification for people providing feedback, typically requiring a profile to store progress.

At the time of completing this thesis, there was an ongoing dialog with a city planner at Trondheim municipality about testing the prototype. The prototype may be used to gather opinions from the public in Trondheim with some modifications to the questions posed, as a part of their own data gathering.

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Appendix

Appendix A

Questions for experts

This is a plan for conducting interview of experts in relation to the system. The goal is to get feedback on the system and look for improvements or new features to be added before testing the concept and the usability on non-experts. The interview is designed to be efficient, without too many questions.

A.1 Introduce City Life surveys

In case the expert is not that familiar with City Life surveys, or to make sure we are on the same page regarding this concept, I will introduce the concept.

A.2 Present concept

After introducing City Life surveys, I will present the concept for the system briefly and present the goals of the system. Collecting data similar to the subjective data gathered through city life surveys, or data answering the same underlying questions as city life surveys seek to answer.

A.3 Present functionality of prototype

When the concept in understood, I will show them the functionality of the prototype, including:

- Provide feedback at current location.
- Display feedback locations represented as markers on the map.
- Display posted feedback by clicking on a marker on the map.

- Generate heat-map-overlays on the map based of various quantitative data parameters from feedback.
- Generate and display a collected list of feedback categorized in given parameters within a given radius on the map.
- The ability to set the radius for the collected feedback list.

A.4 semi-structured interview

For the interview, I am interested in feedback on the concept and the features of the system. The ideal is if they have thoughts on features that should be added or changes to be made to the existing features that would, in their view, improve the system.

- Do you think this system can be used to collect useful data about people's opinions on areas in the city?
- Do you think the visualization part of the system has value for municipality employees?
- What do you think about usefulness of the current features in the system?
- Could some of the features be improved?
- Are there any features you would like to see implemented in the system?
- What do you think about the questions in the survey?
- Are there additional questions you would like to see in the survey?
- Do you have any criticism of the system?
- Do you have any other feedback?

Appendix B

Usability Test procedure

B.1 Present Urban Planning

I will start by presenting briefly what urban planning is, and explaining that urban planners are interested in knowledge about what people feel about areas in order to be able to make improvements to that area.

B.2 Present Usability Testing

A brief introduction of usability testing will be given, informing the tester that the usability of the system is what is being tested, not their ability to perform tasks. Ask the testers to think out loud, giving some examples: ”I want to do X, so I am looking for X.” And ”X looks like a button, but I am not able to click on it”.

B.3 Present the prototype concept

After having presented urban planning, I will present the system, stating that its goal is to collect subjective opinions from people about areas in the city at the location they are right now. It has a page for submitting feedback at the place you are right now, and a page for viewing all feedback given on a map. The feedback is uploaded to a database containing all the feedback and relating it to the location from where it was submitted so it can be viewed on the map.

B.4 Tasks

The participants will be asked to complete a number of tasks, with the chosen device in front of them. By completing the tasks, the testers will see and test all the functionality of the prototype and uncover potential usability problems. The test will take place in a

setting similar to the intended use, outside in an urban environment which the tester can provide feedback on. The test will be performed on the testers own device, as he/she is accustomed to their own device and is similar to the real world setting. A secondary device is also available if the tester does not want to, or are unable to, use their own device. Below are the tasks presented to the testers.

Task 1: Open the prototype - The system is located at the URL ”www.bykvalitet.no”. Enter the web site using your device.

Task 2: Submit a feedback to a location - You are now at a location you want to submit a feedback to. Submit a feedback for this location using the system.

Task 3: View feedback from someone else - You now want to view other people’s feedback at a location, like the one you submitted.

Task 4: View heat-map filter - The system has functionality for filtering and visualizing some feedback data using colors on the map. Make the map display such a filter.

Task 5: View feedback for an area - You now want to view all the feedback anyone has given within a radius of 150 meters from a spot in the city.

B.5 Observation checklist

While the testers complete the tasks, I will observe and comment in the checklist shown in table B.1, whether the testers manage to complete the actions, and comment potential problems they have.

B.6 Questionnaire

After the usability test, testers will be asked to fill out the questionnaire shown in table B.2. Selecting a score per question based on their experience using the prototype.

Table B.1: Checklist for the usability testing.

Action	**Comment**
Enter web site.	
Navigate to the Feedback Page.	
Enter value for noise level using slider.	
Enter value for environment satisfaction using slider.	
Enter improvement suggestion using text-area.	
Enter general feedback using text-area.	
Enter value for child friendliness using radio buttons.	
Submitting feedback using submit button.	
Navigate to the Map-Page.	
View feedback from someone by clicking on a marker.	
Find heatmap filter dropdown.	
Select heatmap filter from dropdown.	
Find button for getting feedback from an area.	
Entering custom radius for area feedback.	
View feedback on an area by clicking on the map.	
Properly closing the modal with feedback.	

Table B.2: Questionnaire for testers after testing. 1=Strongly disagree, 5 = Strongly agree.

Q#	Question	Score				
1	I can see my self using the system often.	1	2	3	4	5
2	I found the system to be unnecessarily complex	1	2	3	4	5
3	I found the system to be easy to use.	1	2	3	4	5
4	I think I would need help from a technical person to be able to use this system.	1	2	3	4	5
5	I think the different parts of the system were integrated well.	1	2	3	4	5
6	I found the system to be illogical and inconsistent.	1	2	3	4	5
7	I believe most people can learn to use the system very quickly.	1	2	3	4	5
8	I found the system to be difficult to use.	1	2	3	4	5
9	I felt confident when using the system.	1	2	3	4	5
10	I need to learn about and familiarize myself thoroughly to be able to use the system myself.	1	2	3	4	5