Influencing the Experience of People in Urban Public Places through Mobile Mediated Interactions

A THESIS SUBMITTED TO
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Abstract

This study presents research findings to inform the design and development of innovative mobile services aiming to enable collocated people to interact with each other in public urban places. The main goal of this research is to provide applications and deliver guidelines to positively influence the user experience of different public urban places during everyday urban life. This study describes the design and evaluation of mobile content and services enabling mobile mediated interactions in an anonymous way.

The research described in this thesis is threefold. First, this study investigates how Information and Communication Technology (ICT) can be utilised in particular urban public places to influence the experience of urban dwellers during everyday life. The research into urban residents and public places guides the design of three different technologies that form case studies to investigate and discover possibilities to digitally augment the public urban space and make the invisible data of our interactions in the urban environment visible.

- Capital Music enables urban dwellers to listen to their music on their mobile devices as usual but also visualises the artworks of songs currently being played and listened to by other users in ones’ vicinity.

- PlaceTagz uses QR codes printed on stickers that link to a digital message board enabling collocated users to interact with each other over time resulting in a place-based digital memory.

- Sapporo World Window, Brisbane Hot Spots, and YourScreen are interactive content applications allowing people to share data with their mobile phones on public urban screens. The applications employ mobile phones to mediate interactions in form of location and
video sharing.

Second, this study sets out to explore the quality and nature of the experiences created through the developed and deployed case study applications. The development of a user experience framework for evaluating mobile mediated interactions in urban public places is described and applied within each case.

Third, drawing on research from urban sociology, psychology, urban design, and the findings from this study, this thesis discusses how such interactions can have an impact on the urban experience.
Keywords

Context Sharing
Digital Augmentations
Human Computer Interaction
Mobile Interaction
Mobile Mediated Interactions
Mobile Phones
Music
Public Displays
Public Places
Ubiquitous Computing
Urban Experience
Urban Informatics
Urban Screens
User Experience
QR Codes
List of Publications

Publications Which Form Part of the Thesis


Chapter 6


Additional Publications Arising from this Research


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Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Jan Seeburger

Signature:

Date:
Acknowledgements

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Chapter 1

Introduction

1.1 Influencing the Experience of People in Urban Public Places through Mobile Mediated Interactions


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1.1.1 Preamble

The introduction of this PhD thesis has been published and presented at the 3rd International Workshop on Pervasive Collaboration and Social Networking (PerCol 2012) in 2012. This peer-reviewed workshop paper presents the motivation behind this PhD research, the research problem including the research questions, and discusses the significance and innovation of this PhD thesis followed by a brief introduction of the created design interventions.
1.1.2 Abstract

This paper introduces our research on influencing the experience of people in urban public places through mobile mediated interactions. Information and communication technology (ICT) devices are sometimes used to create personal space while in public. ICT devices could also be utilised to digitally augment the urban space with non-privacy sensitive data enabling mobile mediated interactions in an anonymous way between collocated strangers. We present what motivates the research on digital augmentations and mobile mediated interactions between unknown urban dwellers, define the research problem that drives this study and why it is significant research in the field of pervasive social networking. The paper illustrates three design interventions enabling social pervasive content sharing and employing pervasive presence, awareness and anonymous social user interaction in urban public places. The paper concludes with an outlook and summarises the research effort.

Keywords: Urban Informatics, Digital Augmentations, Mobile Mediated Interactions, User Experience

1.1.3 Motivation

Life in the city is busy. We travel from one place to another and meet people at different locations for socialising, business, or entertainment. Thereby, city dwellers cross streets, places, buildings, and other public and anonymous urban places using cars, public transport, or even just walk to their destination.

Travelling can lead to delays and people have to wait for each other. City dwellers not only wait for others, they also wait for public transport to arrive, airplanes to take off, in queues at super markets and coffee shops, or at park benches to just have a rest. These idle times occur in everyday activities and mostly take part in public urban places where a diversity of people congregates.

During their daily life in the city, urban residents carry their phone device, containing their personal database of contacts, text messages, and sometimes music playlists, photos or even videos with the ability to access information from the World Wide Web (WWW) anytime,
1.1. INFLUENCING THE EXPERIENCE OF PEOPLE IN URBAN PUBLIC PLACES THROUGH MOBILE MEDIATED INTERACTIONS

anywhere. Furthermore, the next generation of mobile phone devices is equipped with Global Positioning System (GPS) receivers and compass functionality, which adds new possibilities to gather even more information and create applications which take users’ location into account (Gordon and de Souza e Silva, 2011).

Mobile phones are sometimes used as “cocooning” items in public urban places for creating your own personal space and therefore avoiding direct contact with others (Mainwaring et al., 2005). Even when there is no signal, like in underground railways, people tend to use their devices for different purposes such as playing games or deleting old text messages (Bassoli et al., 2007). “Mobile engagement of this sort is so clearly about (among other things) occupying a cocoon of private space while in public that the mobile phone can function in many cases as [...] effectively closing off interaction with anyone not already on one’s contact list” (Crawford, 2008, p. 93). Instead of using ICT to seclude oneself from the surrounding environment, such technologies could also be used to connect in a meaningful way with that place or with past, present, or future people nearby, or the digital appearances of their interactions.

We are interested in studying the potential of creating such connections by enabling urban dwellers to share non-privacy sensitive data such as current song choice, location-based text messages, or favourite locations within a city with collocated people in an anonymous way. The study’s assumption is that engaging urban dwellers in digitally mediated social user interactions could be achieved through mobile content, services, and digital augmentations that make the invisible data of our urban environment and our interactions therein, visible and accessible. The study is situated within the research field of Urban Informatics (Foth et al., 2011, p. 4), which is defined as “the study, design, and practice of urban experiences across different urban contexts that are created by new opportunities of real-time, ubiquitous technology and the augmentation that mediates the physical and digital layers of people networks and urban infrastructures.” One new opportunity to study, design, and practice the urban experience could be to facilitate urban dwellers’ ICT devices to augment the urban space with collective social data and provide private means for mobile mediated interactions.

The remainder of this paper presents our research agenda on influencing the experience of people in urban public places through mobile mediated interactions. We first define the research problem and state the research questions behind our investigation. Afterwards we explain why
this is important research and how this research might contribute to the field of pervasive social networking followed by introducing three design interventions which have been developed during this study. The paper concludes with an outlook and summarises the research efforts.

1.1.4 Research Problem

This research project investigates public urban places and the time we spend in such urban environments. Examples for public urban places are streets, parks, shopping centres, and public transport facilities. Some of these places have entry barriers like paying an admission fee or having a membership at a particular club. Others are completely unconstrained and everybody has free access. City dwellers spend their time at such places, sometimes for work, sometimes for pleasure. Research has shown that if urban dwellers intentionally spend time in public urban places, they prefer to stay in populated places where they have the ability to observe collocated people instead of spending time at empty places (Whyte, 1980).

This study focusses on selected public urban places; in particular, completely open environments such as an underground walkway linking two major train stations in the city of Sapporo, Japan, and semi-public places with small entry barriers, namely bus stations and bus journeys, a digital culture centre and a University campus. At all of the aforementioned places, people are waiting for a specific event to occur or spend their time for leisure or work.

At public urban places, ICT is widely used and available. People for example carry mobile phones on streets, shopping malls are equipped with public displays and Wireless LAN connectivity, gyms use optical barcode readers to register club members and displays for entertainment during workout, and airport lounges provide internet and computer access for business travellers. This technology enables new opportunities to enhance socialising and enjoyment at public urban places applying ICT as an icebreaker to stimulate mobile mediated interactions of nearby people. One example of research on applying public displays to stimulate interaction between strangers is discussed in (Rogers and Brignull, 2002), which shows that ICT can be used to stimulate “real” conversations in constrained environments. The aim of this research, to stimulate interaction between strangers, however, must be seen through a different lens. This project does not try to make strangers who are collocated in the same public urban place, talk
to each other. Instead, available ICT and non-privacy sensitive data shared by urban dwellers are utilised and for example visualised in an appealing way in order to bring about an enhanced social urban experience. One example for such a visualisation approach is History Lines (Klaebe et al., 2007) that allows urban residents to identify and digitally augment a map with places where they have lived before, which are then connected with lines. Through this approach a collaboratively created map with intersections of lines is created, which can be browsed by residents to get more information about collocated people.

Such an approach can support the curiosity of people in a digital way as a counterpart to William H. Whyte’s observations described in *The Social Life of Small Urban Spaces* (Whyte, 1980) that people tend to stay in populated places where they have the ability to observe collocated people. Furthermore, recent web services such as Facebook.com and Twitter.com are highly successful, because among other things they enable users to satisfy their curiosity about others. Whereas Facebook enables users to express their thoughts and activities on their personal profile and browse the profiles of their social circle for comparison, social awareness, and fun, Twitter is used for exchanging small pieces of information between friends and unknown followers. Additionally, “various augmentation and monitoring technologies add new dimensions to a 3-D physical space, making it multidimensional” (Manovich, 2006, p. 223). ICT can be used to create and browse such multidimensional spaces, which provide additional information to what we can see in an urban space. "CityFlocks” (Bilandzic et al., 2008) for example, digitally augments urban places like restaurants and bars. This research instead is interested in augmenting human beings in relation of their location, or to express it in Manovich’s words, an additional layer can be added to the physical human being resulting in a multidimensional urban dweller. Thus, this additional layer will be accessible through ICT devices visualizing this information and providing supplemental services on top.

Junglas and Watson (Junglas and Watson, 2008, p. 66) define Location-Based Services (LBS) as “any service[s] that takes into account the geographic location of an entity”. In their research they utilise a users’ geographical coordinates for location-tracking or location-aware content and service delivery. Furthermore, a research agenda on Mobile Social Software (MoSoSo) has been established, which is defined as “a class of mobile applications whose scope is to support social interaction among interconnected individuals” (Lugano, 2007, p. 1435). Lugano
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Figure 1.1: Building blocks of research project

(2007) further argues that social interaction can contribute to the positive development of society through self-organising, creating, and sharing of knowledge.

This research project aims to provide a contribution to the field of pervasive social networking by broadening the scope of MoSoSo from just appealing to interconnected individuals, to now also being utilised to facilitate interactions based on digital augmentations between unknown urban dwellers in public places. Figure 1.1 summarises the components of this research effort.

Based on the available technologies used by collocated urban dwellers who are available and receptive for digitally mediated “social-communication” and/or technologies provided within a public urban space while considering the social practices and characteristics of this particular place, the first research question (RQ) of this research project is:

RQ1: How can ICT in public urban places be applied to influence user experiences and in what ways?

User experience hereby refers to a more enjoyable and social feeling while spending time at different urban public places. One option may be for collocated users to interact with each other mediated through ICT devices. Therefore, the next more detailed question is:

RQ2: How does the establishment of ICT-mediated social interactions between collocated
users influence the experience of those users in particular urban spaces?

To answer these questions, design interventions deployed and used in a public urban spaces have to be studied which enable non-privacy sensitive data sharing with other collocated people utilising available and suitable ICT devices. Urban Social Technology (Pedersen and Valgård, 2004) - which defined as ICT used in urban environments for a social purpose that goes beyond phone calls and text messages - should align with current social practices and behaviour rather than creating new ones. The next two questions inform the design and development of design interventions within this research project:

**RQ3: What kind of non-privacy sensitive data can be utilised at a particular urban setting?**

**RQ4: How can the available data be utilised to deliver content and services to users collocated in the same urban setting in order to facilitate meaningful digitally mediated social user interaction?**

To enable and maintain digitally mediated social user interaction between collocated people in public urban places, digital content and services have to be carefully designed to not breach users’ privacy beyond what they volunteer to share, or make them feel uncomfortable. Therefore, the following research question is:

**RQ5: What are the criteria (such as comfort, sensibility, cautious, private, tact, etc.) that need to be met in order to establish and maintain digitally mediated interaction between collocated users?**

Finally, when ICT is used to mediate social interaction between collocated users in situ, the following question arises:

**RQ6: How can the success of ICT mediated social interactions be evaluated and measured and how does this change the social experience of a particular public urban place for different users?**

RQ1 and RQ2 are the main research questions of this research project. These questions will be answered through the three design interventions described in the remainder of this paper. To guide the design and development of content and services for ICT devices, RQ3 to RQ6 are
investigative questions that are used as a framework for conducting each design intervention.

1.1.5 Significance and Innovation

According to a United Nations report issued in 2008, more than half of the world’s population now lives in cities (UnitedNations, 2008). Attempts to contain the urban footprint lead to densification requiring people to live more closely together and share urban infrastructures such as streets, places, and parks within cities. However, “physical closeness does not mean social closeness” (Wellman, 2001, p. 234). Whereas it is a common practice to say “hello” to the people you cross paths with in small villages, urban life on the other hand is mostly anonymous and does not automatically come with a sense of community per se. Wellman (2001, p. 228) defines community “as networks of interpersonal ties that provide sociability, support, information, a sense of belonging and social identity”. While on the move or during leisure time, urban dwellers use their ICT devices to connect to their spatially distributed community while in an anonymous space. Putnam (1995) argues that available technology privatises and individualises the leisure time of urban dwellers. Furthermore, as stated above ICT is used to build a “cocoon” while in public (Bassoli et al., 2007, Crawford, 2008, Mainwaring et al., 2005). However, using ICT to create social capital can contribute to the positive development of society through creating, sharing, and self-organising of knowledge (Lugano, 2007).

To overcome this issue and support the creation of social capital in urban spaces, this research develops innovative mobile applications and services. These innovative mobile applications enable information sharing and mobile mediated interactions in a privacy-respecting way to digitally augment the urban space. The knowledge base within this research project will be advanced through augmentation and digitally mediated social interaction concepts for unknown collocated people in urban public places. Furthermore, the concept of information sharing and the resulting collective social data aggregation will answer the question how such an approach can change social experiences of place and contribute to the creation of valuable social networks. The envisaged outcomes are easy to use applications which align with current social practices and give the users an enjoyable and more social feeling while spending time in the city.
1.1.6 Design Interventions

During this study, three design interventions have been conducted to answer the previously stated research questions. All three projects add a digital layer to the physical urban environment, enabling collocated people to anonymously interact with each other and the specific information they share. All design interventions presented have been designed and developed by the author of this paper. The following subsections describe each project in more detail.

1.1.6.1 Capital Music

Capital Music is a mobile application enabling people to listen to their music as usual but also displaying the coverart of songs currently played in a users vicinity. Capital Music visualises the artworks of currently played songs in a mosaic of album artworks as visualised in Figure 1.2. Users can tap on artworks to receive more information and additionally anonymously exchange messages based on viewing the song choices of other people. Thereby Capital Music employs a completely anonymous approach only utilising nicknames without the need for user
subscriptions or profiles. To inform the design of Capital Music, a site observation and paper-based study has been conducted (see Section 4.1). An in-depth user experience study revealed that having anonymous digital representations in form of song choices of anonymous collocated people and adding social user interaction results in raised awareness and piquing the curiosity of users towards collocated people (see Section 4.2).
1.1.6.2 PlaceTagz

The PlaceTagz project investigates how physical artefacts in public urban places can be utilised and combined with mobile phone technologies to facilitate interactions. Inspired by street art and urban sticker culture, PlaceTagz are QR codes printed on removable stickers linking to a digital message board enabling collocated users to interact with each other over time resulting in a place-based digital memory. Each PlaceTagz sticker contains a unique QR-code linking to a mobile website stating a question related to location and/or the image printed next to the QR-code. PlaceTagz are deployed in micro places, public places which are occupied by only one person over a limited period of time. Examples for micro places for this study are public toilets, water fountains, bus stops, public workstations, or park benches. Figure 1.3 visualises PlaceTagz and a respective mobile website after scanning the QR code as well as PlaceTagz attached to various urban public spaces. These location-aware physical hyperlinks connect a particular urban space with a digital space enabling urban dwellers to read and participate in lightweight and mundane social user interaction. The project sets out to explore if PlaceTagz can create narratives about a particular space considering peoples context while using the space and how this influences the experience of a respective space (see Chapter 5).

1.1.6.3 Sapporo World Window

Sapporo World Window is an interactive social media mash-up deployed in a newly built urban public underground space in Sapporo, Japan. The project utilises ten public screens and mobile phones of urban dwellers.

Sapporo World Window enables users to share their favourite locations with locals and visitors through integrating various social media contents into a coherent screen presentation utilising audio, video, still images, and textual information. Figure 1.4 visualises one screen of the Sapporo World Window system with the respective mobile website providing additional information to the promoted location. The mobile website also enables urban dwellers to send messages to the respective screen.

An initial user study (see Section 6.8.2) revealed that social media displayed on urban screens is perceived as novel and that urban dwellers are attracted to interactive content that deals with
CHAPTER 1. INTRODUCTION

Figure 1.4: Sapporo World Window
subject matters of interest inviting to “play” with the provided technology in the urban public space.

1.1.7 Conclusion

This paper presented our work on influencing the experience of people in urban public places through mobile mediated interactions situated in the research field of urban informatics. We have illustrated our motivation to conduct research in the intersection of people, place, and technology and how digital augmentations can be utilised for mobile mediated interactions between unknown collocate people in urban public places. We aim to answer the research questions through the three design interventions described in this paper, which are deployed and used in urban public spaces.

While the Capital Music study provided promising insight into how such an application can influence the experience of an urban public place, further studies have to be conducted for the PlaceTagz and Sapporo World Window design interventions. We then hope to be able draw conclusions and provide guidelines how social pervasive content sharing and pervasive presence, awareness and anonymous social user interaction mediated through ICT devices can positively influence the user experience of people in urban public places.

1.1.8 Acknowledgements

This research was carried out as part of the activities of, and funded by, the Smart Services Cooperative Research Centre (CRC) through the Australian Government’s CRC Programme (Department of Innovation, Industry, Science and Research). We would also like to thank all study participants as well as Marcus Foth and Dian Tjondronegoro for their insightful comments towards this research project.

1.2 Structure of PhD Thesis

This PhD thesis is presented by published papers and consists of various research papers that have been published or submitted for review to relevant venues within this research.
CHAPTER 1. INTRODUCTION

The PhD regulations of Queensland University of Technology state:

§14.1.1 The Queensland University of Technology permits the presentation of theses for the degree of Doctor of Philosophy in the format of published and/or submitted papers, where such papers have been published, accepted or submitted during the period of candidature; and where the quality of such papers is appropriate to PhD-level research. For the purpose of this Regulation, papers are defined as journal articles, book chapters, conference papers and other forms of written scholarly works which are subject to a process of peer review similar to that of refereed journals.

§14.1.2 Papers submitted as a PhD thesis must be closely related in terms of subject matter and form a cohesive research narrative.

§14.2.1 The thesis may be comprised of published papers, manuscripts accepted for publication, manuscripts submitted for publication or under review.

There are 7 publications, some published some under review, which form this thesis. Figure 1.5 visualises the structure of the publications within this PhD thesis.

Chapter 1 introduces this PhD thesis through discussing the motivation behind this research project, the research problem containing the research questions, as well as the significance and innovation. This chapter has been published in the double-blind peer reviewed conference proceedings of the 3rd International Workshop on Pervasive Collaboration and Social Networking in conjunction with the IEEE International Conference on Pervasive Computing and Communications in 2012.

Chapter 2 contains the literature review and has not been published. The literature review positions the study within the respective fields of research. Additionally, Chapter 3, 4, 5, and 6 all contain literature reviews examining related work in the specific subject of the chapter.

Chapter 3 describes the methodological approach of this PhD thesis. Section 3.1 introduces the applied case study method and has not been published. Section 3.2 investigates the term user experience and how they can be designed and evaluated within this PhD thesis. Section 3.2 has been published as a chapter of the editorial reviewed Mobile Multimedia - User and Technology
1.2. STRUCTURE OF PHD THESIS

| Section 1.1: | Influencing the Experience of People in Urban Public Places through Mobile Mediated Interactions |
| Methodological Contribution | Section 3.2: Designing and Evaluating Mobile Multimedia User Experiences in Public Urban Places: Making Sense of the Field |
| Design Contribution | Section 4.1: Capital Music: Personal Expression with a Public Display of Song Choice  |
| | Section 4.2: The Sound of Music: Sharing Song Selections between Collocated Strangers in Public Urban Places |
| Chapter 5: No Cure for Curiosity: Linking Physical and Digital Urban Layers |
| Chapter 6: Content Sharing on Public Urban Screens: Real World Experiences through Iterating Social and Spatial Contexts |

**Figure 1.5:** Structure of publications within this PhD Thesis

*Perspectives* book.

Chapter 4 contains the first case study within this PhD research and describes the mobile application titled Capital Music. Capital Music enables colocated people to exchange song information with each other in an anonymous way also providing private means for social user interaction. Thereby, Section 4.1 presents the design process published in the double-blind peer reviewed conference proceedings of the 6th Nordic Conference on Human-Computer Interaction in 2010. Section 4.2 illustrates the user experience evaluation of Capital Music. Section 4.2 has been accepted for publication at the 11th International Conference on Mobile and Ubiquitous Multimedia (MUM 2012) and is currently in press.

Chapter 5 presents the second case study within this PhD study titled PlaceTagz. PlaceTagz are QR codes printed on stickers linking to digital message boards enabling colocated people to interact with each other over time. This chapter has been accepted for publication at the 7th Nordic Conference on Human-Computer Interaction (NordiCHI 2012) and is currently in press.

Chapter 6 describes the third case study within this PhD thesis illustrating the study on public
urban screen applications. This chapter describes the research on Sapporo World Window, Brisbane Hot Spots, and YourScreen investigating how content sharing on public urban displays utilising mobile phones can influence the user experiences in public urban places. This chapter has been accepted for publication at the Australian Computer-Human Interaction Conference (OzCHI 2012) and is currently in press.

Chapter 7 presents a synthesis of the three case studies in relation to the created and influenced urban experience drawing from the empirical findings from Chapter 4, 5, and 6 but also incorporating theories from urban sociology, psychology, and urban design. This chapter has been submitted to the International Journal of Human-Computer Interaction.

Chapter 8 concludes this thesis, discusses limitations, and provides an outlook towards future research in the area of mobile mediated interactions and digital augmentations between unknown collocated people in public urban spaces.

### 1.3 Research Questions

Figure 1.6 illustrates the research questions in relation to the structure and the outcomes of this PhD thesis. Thereby, research question 1 has been answered within Chapter 1, 4, 5, and 6. These chapters introduce and describe the design outcomes of this PhD thesis.

Research question 2 is concerned with the impact of ICT-mediated social interactions and digital augmentations between unknown collocated people (as described within the Chapter 4, 5, and 6) on the urban experience. Chapter 7 answers this question resulting in theoretically and empirically informed implications on the urban experience.

Research question 3, 4, 5, and 6 are investigative questions within this PhD research. Research question 3, 4, and 5 have been answered separately within each chapter describing a design contribution (Chapter 4, 5, and 6) and guided each case study. Research question 6 has been answered within Section 3.2 of the methodology chapter resulting in a framework for designing and evaluating user experiences for mobile mediated interactions and digital augmentations.
### Main Research Questions

<table>
<thead>
<tr>
<th>RQ1:</th>
<th>RQ2:</th>
</tr>
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<tbody>
<tr>
<td>How can ICT in public urban places be applied to influence user experiences and in what ways?</td>
<td>How does the establishment of ICT-mediated social interactions between collocated users influence the experience of those users in particular urban spaces?</td>
</tr>
</tbody>
</table>

#### Chapters

| 1, 4, 5, 6 | 7 |

#### Outcomes

| Design Artefacts: Capital Music, PlaceTagz, Sapporo World Window, Brisbane Hot Spots, YourScreen | Theoretically and empirically informed implications for the urban experience |

### Investigative Questions

<table>
<thead>
<tr>
<th>RQ3:</th>
<th>RQ4:</th>
<th>RQ5:</th>
<th>RQ6:</th>
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<tbody>
<tr>
<td>What kind of non-privacy sensitive data can be utilised at a particular urban setting?</td>
<td>How can the available data be utilised to deliver content and services to users collocated in the same urban setting in order to facilitate meaningful digitally mediated social user interaction?</td>
<td>What are the criteria (such as comfort, sensibility, cautious, private, tact, etc.) that need to be met in order to establish and maintain digitally mediated interaction between collocated users?</td>
<td>How can the success of ICT mediated social interactions be evaluated and measured and how does this change the social experience of a particular public urban place for different users?</td>
</tr>
</tbody>
</table>

#### Chapters

| 4, 5, 6 | 4, 5, 6 | 4, 5, 6 | 3, 4, 5, 6 |

#### Outcomes

| Design Artefacts: Capital Music, PlaceTagz, Sapporo World Window, Brisbane Hot Spots, YourScreen | User Experience methodology for mobile mediated interactions and digital augmentations |

*Figure 1.6: Research questions in relation to thesis structure*
1.4 Contributions

As illustrated in Figure 1.5 and Figure 1.6, this PhD thesis contains three different contributions: methodological contributions, design contributions, and theoretical contributions.

**Methodological contributions.** Previously published studies state the lack of a common definition, scope, and methods for the term user experience (Bargas-Avila and Hornbæk, 2011, Battarbee and Koskinen, 2005, Law et al., 2009). The urban informatics notions of people, place, and technology (Foth et al., 2011) have been utilised to recategorise existing elements of user experiences providing guiding questions within each category. Additionally, methods and standardised items to evaluate specific elements of user experiences are presented and discussed.

**Design contributions.** To answer research question 1 and to inform research question 2, several design interventions had to be created as data collection tools. Each design contribution described in Chapter 4, 5, and 6 presents the design and evaluation of a novel and innovative design intervention contributing to the research field of human-computer interaction. All three design contributions enable collocated people to share non-privacy sensitive data in an anonymous way and present a user experience evaluation of how users feel about interacting with the created application.

**Theoretical contributions.** The overall aim of this PhD thesis is to investigate how the urban experience might change if collocated urban dwellers are able to anonymously interact with each other and augment the urban space mediated through ICT devices. For this theoretical contribution, a discussion based on *The Presentation of Self in Everyday Life* (Goffman, 1959) and activities in public urban place (Gehl, 1987) illustrate how such design contributions can create a new presentation of self in public urban places. Additionally, the theoretical contribution includes a discussion on boredom, curiosity, and awareness in public urban places as well as an elaboration of anonymity and lightweight data in relation to the design interventions.
Chapter 2

Literature Review

This literature review situates the study within the influencing fields of research and also highlights the importance as well as the gap of knowledge that this thesis tries to fill. The study is situated within the research field of urban informatics and reviews literature in the intersection of people, place, and technology relevant for this study (see Figure 2.1).

The literature review is structured as follows. Section 2.1 provides definitions and reviews context, context-aware computing, location-based services, and how users perceive such services. Section 2.2 focuses on context-data sharing to improve social processes. Section 2.3 introduces the research field of urban informatics followed by a review of location-based social networking applications and mobile social software research in Section 2.4. This section has been further divided into research describing efforts to connect friends, connect strangers, and theoretical concepts to create connections. Section 2.5 reviews research in the area of public urban screens and mobile mediated interactions. Section 2.6 focuses on user experience research and how people feel while interacting with a device or an application followed by a review of urban sociology research in Section 2.7. As this research investigates in the intersection of people, place and technology as visualised in Figure 2.1, these seven selected research areas are guiding and influencing this study.

The PhD regulations of Queensland University of Technology for a thesis by published papers state:
Figure 2.1: Structure of Literature Review
2.1 From Context-Awareness to Location-Based Services

This section of the literature review presents and discusses research on context, context-awareness, location-based services, and how users perceive such services.

2.1.1 Context

A huge body of literature has been published in the area of considering the context of a user in human-computer interaction. Before reviewing literature in the area of context-aware computing, this section first introduces the notion of context.

Considering context in an application can improve human computer interaction (Dey, 2001). Dey defines context as “any information that can be used to characterise the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and application themselves” (Dey, 2001, p. 5). This definition of context is very broad and includes a vast variety of information concerning humans such as amount of collocated people, place such as what activities occur, and technology such as if a mobile device has sound switched on or not. Dourish (2004) argues that past and current research on context-aware computing builds on the positivist theories in social sciences, where simplified models try to reduce complexity. These kinds of applications assume that context is stable, delineable, can be encoded as information, and can be separated from an activity. Instead, Dourish argues that context-aware computing should build on the phenomenological theories...
in social sciences, where context is a subjective interpretation and cannot be separated from an activity. Context is what people do. Context is renegotiated when people perform actions and through this renegotiation further social behaviour or content can change the context in Dourish’s view dynamically. Context is seen as a result of social interactions with the world and not a fixed predefined activity.

Context describes the information around us that defines the situation (Dey, 2001) whereas the situation itself as well as the interactions with people, place, and technology dynamically changes this information (Dourish, 2004).

Tamminen et al. (2004) apply an empirical user-centred approach to understand highly mobile contexts, which are not fixed to a specific environment. As a result the authors describe five mobile contexts, which are specific to mobile environments, often recurring, and concrete enough to be supported through mobile context-aware applications.

1. Situational acts with planned one (e.g. main goal is buying shoes in the city, situational act could be having a coffee or chat with an old friend who is nearby).

2. Claiming personal and group spaces (e.g. personal: reading a newspaper while in public transport to demonstrate social unavailability. Group: building a circle around a map while travelling with friends through a city).

3. Social solutions to problems in navigation (e.g. using mobile phones to renegotiate a planed meeting).

4. Temporal tensions (e.g. when somebody is in a rush to catch a bus).

5. Multitasking (e.g. sharing attention to the street while writing a text message).

Tamminen et al. (2004) state that social acceptability of utilising context in human-computer interaction depends on supporting everyday processes. The claiming of personal space in mobile contexts mentioned by Tamminen et al. (2004) is of special interests in this study. “Public places are transformed to personal and group spaces by using the resources available” Tamminen et al. (2004, p. 138). This research tries to utilise further context information of users as a resource, to transform the claimed personal space through ICT usage while in public, into a digitally mediated group space.
2.1. FROM CONTEXT-AWARENESS TO LOCATION-BASED SERVICES

These examples highlight the diverse notions of context when used in human-computer interaction. Tamminen et al. (2004) describes five mobile contexts of mobile urban dwellers, which according to Dey (2001) characterise the situation of an entity, and according to (Dourish, 2004) change the situation while interacting with the world. Overall, each occurring context influences and creates new contexts that define the situation of a user.

2.1.2 Context-Aware Computing

Context-aware computing describes the research efforts of utilising context in human-computer interaction.

Schilit and Theimer (1994) published one of the earliest articles on context-aware computing and argue that mobile distributed computing is used in fast changing environments. Therefore, location is an important resource to get information about nearby devices and services such as tracking co-workers, finding nearby printers, and furthermore constantly updating this information according to changes in the environment. They define context-aware computing as, “the ability of a mobile user’s applications to discover and react to changes in the environment they are situated in” (Schilit and Theimer, 1994, p. 23). Dey (2001) defines context-aware computing as: “A system is context-aware if it uses context to provide relevant information and/or services to users, where relevancy depends on user’s task” (Dey, 2001, p. 5). The definition by Dey (2001) constrains the notion of context-aware computing to support the actual task of the user, but in contrast to Schilit and Theimer (1994) does not constrain the application domain to mobile devices.

The next section on location-based services demonstrates that much research in context-aware computing has been done which is utilising the location of entities as context information. However, Schmidt et al. (1999) argue that there is more context than just location. They subdivide context data into information about the physical environment and human factors. Sensor technology can be utilised to collect data, which provides more information about the user’s environment. Examples of physical environment context data are acceleration sensors, light sensors, audio sensors, temperature sensors, pressure sensors, and body sensors. Context data about human factors are describing the user (e.g. knowledge of habits, emotional state), social
environment (e.g. collocation of others, social interaction) and the task (e.g. spontaneous activities, general goals). The GUIDE prototype studied by Cheverst et al. (2000) is an early example of a context-aware tourist guide combining context data such as user interests, location, time, and opening hours of attractions to present tailored walking tours through a city and information about nearby attractions. Additionally, context data is used to present information to the user in a suitable way considering age, language, and technical background.

The work of Schmidt et al. (1999) and Dourish (2004) shows that context is a huge and powerful construct, which can include a variety of information about a user and his environment. Stetten et al. (2004) classified context data into hard (e.g. location, time, date) and soft criteria (e.g. intention, interests). Having Dourish’s work in mind, the hard criteria are those, which can be separated from an activity. For example, during everyday life, the time, date, or temperature mostly won’t influence an activity. The soft criteria on the other hand cannot be separated from an activity. For example, Tamminen et al. (2004) describes the mobile context of situational acts with planned one such as the intention to buy a new pair of shoes what could be influenced by spontaneously meeting a friend.

This research is mainly interested on the activity-based soft context criteria of users for urban digital augmentations and utilises the hard context criterions for purposes like location determination in public urban places.

Considering the human factors of context information such as emotional state or general goals as stated by Schmidt et al. (1999) in combination with the issue of encoding such information as stated by Dourish (2004), demonstrates the challenge of context-aware computing. While the introduction and widespread use of smart phones brought some sort of context-awareness (i.e. auto-rotating the screen content according to the rotation of the phone or adjusting the brightness of the screens display according to the surrounding light) to mobile phone users, the majority of context-aware applications are focusing on utilising geographical location within human-computer interaction.
2.1. FROM CONTEXT-AWARENESS TO LOCATION-BASED SERVICES

2.1.3 Location-Based Services

The geographical location of an entity is a widely used variable in the field of context-aware computing (Schmidt et al., 1999). Therefore, this section reviews selected research from the emerging field of location-based services as a subclass of context-aware computing.

“Location-based services are any service that takes into account the geographic location of an entity” (Junglas and Watson, 2008, p. 66). Examples for locations-based services are route guidance, friend locator, mobile dating, restaurant recommendation systems, location-based news, traffic radar alerts, and find nearest shop (e.g. gas station, pharmacy, post office, ATM) applications.

Junglas and Watson (2008) specify four characteristics of location-based services.

1. Involvement of an entity triggering location information.
2. Involvement of two or more entities, which are static or moving.
3. One of the involved entities’ geographical coordinates is recorded.
4. One of the involved entities receives the location information of the other involved entity.

An entity refers to a human or item in these specified characteristics. Junglas and Watson (2008) state the importance of separating location-based services into location-tracking services and location-aware services. Location-tracking services track the location of entities whereas location-aware services offer information according the entities location and surrounding content and services (Barkhuus and Dey, 2003). Junglas and Watson (2008) conducted an empirical study to measure the differences between both kinds of services concerning ease-of-use and perceived usefulness with the outcomes that location-tracking is perceived as useful but privacy issues raised user concerns. Location-aware applications instead, had not been seen as significantly valuable. Users had a tendency to reject these kinds of services. The following section specifically presents research in the area of how users perceive and adopt location-based services.

2.1.4 Adoption of Location-Based Services
Barkhuus and Dey (2003) studied privacy issues in relation to perceived usefulness of location-tracking and location-aware service. A case study with four hypothetical services has been conducted involving 16 participants. Two location-aware services and two location-tracking services have been evaluated. Outcomes are that privacy issues and level of intrusiveness are higher for location-tracking services, but less relevant if the service is perceived as useful. Barkhuus and Dey (2003) propose focusing on development of location-aware services.

Chang et al. (2007) conducted research in Taiwan to investigate why location-based services in general were not widely adopted and used. They tested if the following hypotheses have a negative impact on consumers’ adoption of location-based services:

(H 1) Cost

(H 2) Complexity of adoption process

(H 3) Worry of security and privacy issues

(H 4) Worry of quality of location-based service information

(H 5) Lack of cognition of location-based services

Except (H2), all hypotheses could be validated, whereas (H1) had the strongest significance. (H2), the adoption process itself, such as installing the service, is not a burden for technical savvy Taiwanese mobile phone users.

The work of Chang et al. (2007), Barkhuus and Dey (2003), and Junglas and Watson (2008) show that privacy is an important issue when designing location-tracking, as well as location-aware services. Privacy is especially important for this PhD study, because the design interventions enable mobile mediated interactions between collocated people.

Earlier research has tried to create models to investigate influences on users’ privacy perception, such as discussed below.

Junglas and Spitzmuller (2005) established a model to evaluate privacy issues concerning location-based services. The model tries to bridge the gap between privacy concerns and the intention to use location-based services. The validation and results are not described in this paper. Junglas
and Spitzmuller (2006) refined their model applying the personality traits framework (Goldberg, 1990) from psychology. The personality traits framework consists of five constructs as follows:

- Agreeableness (highly agreeable persons are less concerned about privacy),
- Extraversion (extroverted people have less privacy concerns),
- Emotional stability (unstable people will be concerned about privacy),
- Openness to experience, and
- Conscientiousness.

They found that only agreeableness, openness to experience, and conscientiousness influence privacy perception and therefore adoption. Interesting for this PhD project is the fact that “more agreeable individuals who are generally more likely to trust their social environment and who have a tendency to strive for harmony in their social relationships expressed fewer concerns about privacy invasion through LBS” (Junglas and Spitzmuller, 2006, p. 43-44).

As mentioned before, considering users’ privacy is essential and furthermore one key to successfully establish a trustworthy relationship between the user and the application. The applied privacy concepts within this PhD study must support the creation of a social environment between collocated strangers which supports agreeableness and besides enable the openness to experience possibilities of a social environment between collocated urban dwellers. These possibilities of an ICT established social environment in an anonymous urban public place must furthermore be useful as the construct of usefulness plays an important role in using location-based services. This is also supported by Chang et al. (2007) and the work of Kaasinen (2003). Kaasinen (2003) conducted an empirical user study on location-based services in Finland. Overall, 55 subjects subdivided in 13 evaluation groups participated in different scenario evaluations with follow-up semi-structured interviews. The scenarios contained location-based services such as pro-active advertising, route guidance, and Yellow Pages Wireless Application Protocol (WAP) services. One of the outcomes of these studies is that comprehensive and topical content must be provided to users, which in addition go beyond the current location information and add further value. The study participants had no privacy concerns, but were
not aware that their actual position was tracked during device usage. However, Kaasinen (2003) suggests that control over privacy should be given to users, as well as control about the degree of autonomous service instructions. Furthermore, a fully integrated chain of services, which seamlessly provides information concerning the different activities for e.g. a journey (route, hotel, tourist guide) or a shopping trip (route, shop assistant, cafe finder), should be provided without changing applications or interfaces.

Implications for this PhD study are that users should be able to choose what and how much information they share with others. Furthermore, additional content and services could be provided on top of the actual application such as in the example of Capital Music described in Chapter 4, enabling users to download music from iTunes, watch the music video on YouTube, or get similar music recommendations from lastFM.

2.1.5 Summary

This section on context, context-aware applications, and location-based services as well as their adoption and perception positioned this PhD study within its technological angle.

It can be summarised that current location-based services raise privacy issues by users (Barkhuus and Dey, 2003, Chang et al., 2007, Junglas and Watson, 2008). These issues have to be addressed through carefully designed services, which enable the anonymisation of sensitive data such as location in combination with user identity. Trustworthy applications should be designed through communicating privacy features and resulting implications to the user. Furthermore, the usefulness of such services is partially lacking what could be solved through adding additional content and services (Kaasinen, 2003). Usefulness and privacy are furthermore interrelating variables. Useful applications lower privacy issues such as receiving traffic updates while using a car navigation system is widely adopted (Junglas and Watson, 2008).

Location-based services are widely studied, but as a recent issue of the IEEE Pervasive Computing journal states, “location research isn’t finished” (Dey et al., 2010, p. 11). Furthermore, Dey et al. (2010) underline the importance of privacy issues and social implications concerning location-based services what will be addressed in this study.
2.2 Context Data Sharing

Instead of delivering content according to users’ current context as described in the previous sections, such information can also be communicated to others for various social purposes. “Context-aware technology should [...] be designed to consider not only one person’s doings, but also the doings of other relevant people” (Tamminen et al., 2004, p. 141).

Erickson and Kellogg (2000) describe an early theoretical approach of context data sharing. They created the concept of Social Translucence, “an approach to design digital systems that emphasizes making social information visible within the system” (Erickson and Kellogg, 2000, p. 61). They argue that physical communication is enhanced through visibility, awareness, and accountability, which creates a context whilst being in the physical space. Digital communication is lacking these characteristics. As an example, people regulate their voice and language based on the people collocated in the same space. It is visible and reasonable, who can be approached in the same space and who is currently engaged in other activities. In the digital world, e.g. while sending an email to a receiver, the sender never knows if the receiver can receive, read, or answer the email because the sender is unaware of the receiver’s current context. Augmenting digital communication with users’ context can enhance such a scenario.

The approach of ContextContacts (Oulasvirta et al., 2005) employs the concept of social translucence (Erickson and Kellogg, 2000). ContextContacts is a mobile application, which replaces the phone’s address book with an enhanced, context-aware contact list. The application visualises location, time spent in the current location, user-selected alarm profile, indication of last phone interaction, and the amount of known and unknown people in vicinity next to the contact’s name. This kind of context sharing enables the caller to be aware about the callee’s current availability for phone calls.

Research on context sharing between interconnected people has shown that such augmentations of human beings with context data enable shared experiences and support the strengthening of social ties. Bentley et al. (2006) use the term Ambient Mobile Communication to describe a new way of communication without explicit user interaction. The concept utilises users’ context and broadcasts the information to contacts with the aim to stimulate social interactions to follow. Motion Presence has been developed to broadcast if a user is currently moving or
not. Similarly, *Music Presence* broadcasts the recently played music playlists of mobile users. A broadcast receiver can easily comment on played music through sending a “thumbs up”, “thumbs down”, or a “!” message to communicate their opinion about the music selection. This kind of communication can inform the social circle of users’ and easily give a feeling of connectedness.

The projects described by Bentley et al. (2006) and Oulasvirta et al. (2005) have been designed for interconnected people. In regards to this PhD thesis the question remains if the sharing of contextual information between unknown collocated people in public urban places can create a feeling of connectedness with a public urban space and the people within.

As part of a side project within this PhD study, *DispoMaps* (Seeburger and Schroeter, 2009) has been developed to enable users to share their current location with selected others in a private way. *Google* introduced the context sharing service *Latitude* in 2009, enabling users to share their location on *Google Maps*. Users can send and receive location-sharing requests to add friends to their personalised *Google Map*, displaying their location. *Google Latitude* provides privacy levels for each added friend:

- share best available location,
- share only city level location, and
- hide location from this friend.

Furthermore, *Google Latitude* allows users to set different location-sharing settings for all of their friends:

- automatically detect your location,
- manually set your location (enables lying), and
- hide your location.

This approach adds a social component to *Google Maps*, enabling users to see where their friends are and communicate their own location in an always-on environment. Page and Kobsa (2009) state that people use *Google Latitude* for social planning and social connectedness,
but a critical mass is needed to connect with others. Additionally, *Google* launched the *Buzz* service for sharing information such as images, websites, videos, or status messages within the *Gmail* platform. The service utilises existing *Gmail* contacts from a user as a follower base who can read the shared information. The aim is to make the web more social through starting conversations based on shared content between friends. *Google Buzz* was heavily criticised by the media because “merging something designed for public broadcasting (Buzz) with something inherently private (Gmail) was just looking for trouble” (Wauters, 2010). In October 2011, *Google* announced that it will shutdown the *Buzz* service (Horowitz, 2011).

The remaining question for this research is if public broadcasting of digital content within a public urban place and unknown people raises similar privacy issues by users or if the fact that people don’t know each other and the shared content contains no personal information about users lowers such privacy issues.

### 2.3 People, Place, Technology - Urban Informatics

“[L]ocation-aware mobile technologies can change the way we experience both, physical and digital spaces by configuring a new hybrid space, which is composed by a mix of digital information and physical localities.” (Gordon and de Souza e Silva, 2011, p. 56)

Much research has been done in designing, deploying, and evaluating context-aware and location-based applications as well as context sharing applications in urban public places. The introduction and widespread use of smart phones such as the *iOS* based *Apple iPhone* in 2007 and the release of a software development kit for third party developers in 2008 paved the ground for location-based services being installed, used, and experienced by a vast amount of people. The GPS functionality of the *iPhone* enabled developers and researchers to attach longitudinal and latitudinal information of users to the occurring digital interactions. Gordon and de Souza e Silva (2011) elaborate the term net localities: “Net locality implies a ubiquity of networked information - a cultural approach to the web of information, as intimately aligned with the perceptual realities of everyday life” (Gordon and de Souza e Silva, 2011, p. 2-3). The research field of urban computing is interested in the intersection of networked information and the perceptual realities of everyday life in terms of urban environment and its citizens. Urban
Computing describes “the integration of computing, sensing, and actuation technologies into everyday urban settings and lifestyles” (Kindberg et al., 2007, p. 18). While urban computing research mostly focuses on the technology itself, the emerging research field of urban informatics is investigating the impact of technology on people in urban environments (Foth, 2011). Urban Informatics describes “digital information technologies [...] inextricably woven into the everyday social and economic life of dwellers in every city on the planet” (Townsend, 2008, p. xxiii). A more recent definition of Urban Informatics describes the research field as “the study, design, and practice of urban experiences across different urban contexts that are created by new opportunities of real-time, ubiquitous technology and the augmentation that mediates the physical and digital layers of people networks and urban infrastructures” (Foth et al., 2011, p. 4). On the other hand, Pedersen and Valgårda (2004) created the term Urban Social Technology, which is defined as information technology used in urban environments for a social purpose that goes beyond phone calls and text messages.

This study positions itself within the research field of urban informatics and its definition by Foth et al. (2011). Research Question 2 - How does the establishment of ICT-mediated social interactions between collocated users influence the experience of those users in particular urban spaces? - contains the three guiding notions of people, place, and technology and aligns with the definition by Foth et al. (2011). The literature review continues with presenting and discussing existing research within the intersection of people, place, and technology relevant for this PhD thesis.

2.4 Mobile Social Software and Location-Based Social Networks

In the last few years, social software such as Facebook, LinkedIn, and Twitter gained increased attention. Such platforms are used to virtually connect with friends, family, business contacts, and acquaintances for staying in contact, communication, and sharing multimedia data. Facebook reached 901 million mobile users in April 2012. These social networking applications are also used on mobile phones while on the move. Counts et al. (2006) state that the difference between social software and mobile social software is that the mobile counterpart utilises the physical context data of a user while on the move. The utilised context data is mostly the
location of a user or as Crawford states “the intersection of mobile and Internet technology has enabled the migration of ‘social software’ from the desktop computer to the streets” (Crawford, 2008, p. 80), known as mobile social software. This PhD project studies how ICT used on “the streets” can change the social experience of the likewise. Lugano (2007, p. 2) defines mobile social software as “a class of mobile applications whose scope is to support social interaction among interconnected individuals.” However, this PhD thesis focuses on anonymous collocated people and how HCI can enable and support mobile mediated social interactions with these Shared Encounters (Willis et al., 2010) during everyday urban life. Counts et al. (2006) argue that the physical and social environment gets expanded through new ways of socialising while communicating with mobile digital devices. These new ways will be explored with the hypothesis that context data shared in a private way between collocated strangers in public urban places can create ICT mediated social interaction. The next subsection reviews related research in the area of mobile social software and location based social networking applications and how it can be used between interconnected people.

### 2.4.1 Connecting Friends

Kjeldskov and Paay (2005) designed and studied the mobile application titled just-for-us, which was deployed at Federation Square in Melbourne. The application supports social indexicality, which refers in the context of HCI to the concept of providing relevant information according the users’ current social and physical surroundings. Therefore, they utilised social and physical context data such as time, place, and people nearby. Two studies have been conducted to gather information about application design and user requirements. The first study analysed the architectural space with the aim to explore the main characteristics of Federation Square. The second study focused on the visitors to find out how they socialise at Federation Square. Based on the findings, a mobile context-aware application prototype has been developed which incorporates location, vicinity of friends, activities of others, environmental conditions, and past social interaction. Just-for-us provides e.g. chat functionalities, maps showing what collocated people are doing, and an activity meter, which indicates familiar places and incorporates location, social context, and environmental conditions. Kjeldskov and Paay (2006) further report a user study with the just-for-us application utilising a high-fidelity prototype and test users. The
study participants enjoyed interacting with the digital representation of the physical space and were fascinated by having access to information about Federation Square and the people within. However, Kjeldskov and Paay (2006) also report that some study participants were baffled by receiving social context information from collocated urban dwellers and that mechanisms should be provided which enable people to modify and review the shared data. While *just-for-us* was deployed in a particular public urban place, *Dodgeball* on the other hand focuses on the city as a whole.

*Dodgeball* is a mobile social software utilising the location of a user to meet with nearby people they know. *Dodgeball* is available in selected cities in the United States and utilises web-based user profiles and friend lists including mobile phone numbers. To use the application, users have to log in through a text message in which they specify city and location. A message is then delivered to all friends and collocated friends of friends. Furthermore, a “crush” function is available, which enables application users to browse profiles, select people they would like to meet, and get notifications if the person is in their vicinity. *Dodgeball* is completely based on text messages and therefore, no additional application has to be installed on the mobile device (Ziv and Mulloth, 2006). Humphreys (2008) conducted a yearlong study concerning how people use *Dodgeball* and integrate it into their lives. One of the findings is that *Dodgeball* establishes loose social relationships with others making them feel more connected to their network. Real-time exchange of socially enriched location-based information - where are my friends at the moment - changes decisions of users according to their physical movements. This kind of indirect communication through location exchange between friends leads users to explore new places in their particular city. If e.g. five friends send messages that they are at a particular restaurant, study participants mentioned that this enticed them to try out this place in the near future. The indirect communication mode of Dodgeball is therefore used as indirect social navigation.

Google bought *Dodgeball* in 2005 and shut down the service in 2009. One of the co-founders of Dodgeball left Google and created a similar application called *Foursquare* (Siegler, 2009). *Foursquare* is a mobile service allowing a user to virtually check-in into physical places, share this information with friends, collect badges for check-ins, and compete over mayorships of places with friends and strangers. Similar services to *Foursquare* are *BrightKite, Gowalla,* and
Facebook Places, however Foursquare aims to increase application usage and encourage users to explore the city through the added game elements of mayorships and badges (Ebling and Cáceres, 2010).

Lindqvist et al. (2011) studied why and how people use Foursquare for location sharing and found that Foursquare is mainly used for fun, exploration, coordination with friends, signalling availability to others, and using the allocated data of visited places as a representation of self. One interesting finding of the authors in relation to this study is that over half of the study participants had Foursquare friends they did not know and never met in person. Lindqvist et al. (2011) speculate that these unknown friends are more like Twitter followers who are interested in learning about new places and where others go, even if they don’t know them. This is relevant for this PhD study as it seems that people are interested in the content an unknown user contributes rather than the user itself and also that this sort of digital knowledge exchange exists, even if there is no direct existing social relationship.

Similar to Foursquare is the Socialight application. Socialight enables users to leave a virtual note at a particular location for themselves, their social network within the application, or everyone. Through utilising the phone’s GPS, urban dwellers receive a notification on their phone if someone of their social circle or themselves left a note at a particular space. Humphreys and Liao (2011) study the everyday practice of urban dwellers using Socialight. The authors identified two themes from interviewing application users:

- Communication about place
- Communication through place

People used Socialight in everyday life to communicate about places in terms of recommendations for others, reminders for themselves, and social navigation resulting in a raised awareness of place through a digital representation. Additionally, Socialight has been used for the communication through place in terms of place-based storytelling and the representation of self through the virtual sticky notes. Both themes are not mutually exclusive. Humphreys and Liao (2011, p. 418) state that “participants in the study used Socialight to communicate about specific places and in doing so built and communicated social familiarity with urban places. Second, communication occurs in the context of place, that is, messaging through place became a means of
CHAPTER 2. LITERATURE REVIEW

communicating stories or expertise rather than information just about the place themselves.” As reported in the study conducted by Lindqvist et al. (2011) who speculate that some Foursquare users follow check-ins of unknown people to learn about new places, Humphreys and Liao (2011) state that virtual notes left by strangers can also influence Socialight users to explore new place. This kind of trust and information seeking is relevant for this PhD study and the exchange of lightweight information in urban public places because “people seek out new places based on evidence other people have been there and enjoyed it” (Humphreys and Liao, 2011, p. 414)

This section provided an overview of research on mobile social software and location-based social networking applications enabling users to connect with friends and exchange information in public urban places. The studies conducted by Lindqvist et al. (2011) and Humphreys and Liao (2011) show, that there is a general interest in the content contributed by unknown application users. The next section specifically looks into research efforts trying to connect strangers in public urban places.

2.4.2 Connecting Strangers

Bassoli et al. (2007) conducted an ethnographic study investigating the London Underground and the technology usage within. Personal ICT devices, books, or newspapers are used to create a “cocoon” to demonstrate personal social unavailability and are also used to communicate something about the own identity to collocated people. The results of the ethnographic study informed the design of undersound, a mobile music sharing application. Undersound has the following features:

- A mobile phone client to upload songs at specific upload points located at station ticket halls.
- The mobile client is used to download songs from download points located at train platforms, as well as from collocated undersound users.
- The exchange history of music files is stored as metadata to visualise the “music’s movement through the network”.

The music upload is constrained to one song to one specific underground station. Therefore,
artists are forced to choose upload locations carefully. Furthermore, the songs “travel” from upload locations to user device to further user devices. Tube travellers can browse undersound music playlist from nearby people and download desired songs (Bassoli et al., 2008).

This approach connects people to the urban environment through participating at the mobile social community and raises the awareness of people towards their collocated travellers. A scenario of application usage is described, but a comprehensive evaluation of undersound is missing because of absent permissions from Transport for London. The conducted ethnographic observations of urban dwellers in public transport and the process of cocooning are valuable for this PhD study, in particular for case study 1: Capital Music (see Chapter 4). Providing a mobile application deployed in public transport that aligns to the current practice of being demonstratively engaged “to avoid (or appear to avoid) looking at other people” (Bassoli et al., 2008, p. 40) but on the other hand support curiosity about collocated people through context sharing, hasn’t been developed and tested in the real world. Furthermore it is unclear, how such a mobile application changes the social experience of public transport.

Whereas the approach described by Bassoli et al. (2007) utilises music as the focus of interaction, Eagle and Pentland (2005) describe an approach to stimulate face-to-face interaction between unknown people utilising user profiles and social matching algorithms. Serendipity (Eagle and Pentland, 2005), a Bluetooth enabled Mobile Social Software applies an introductory service to connect collocated people who do not know each other. Serendipity is based on user profiles attached to unique Bluetooth IDs, which are stored in the application database. Serendipity scans the environment every five minutes for other Bluetooth devices. If a device was found, the respective ID is sent to a server. The server tries to match the ID with existing user profiles. If a profile exists, a social matching algorithm, based on user-interests similarity, is executed. Users can weigh different parts of their profile. If the similarity algorithm detects a similarity higher than both users defined as a minimum threshold, an introduction message with name, picture and possible discussion topics are sent to the users. Feedback from users at conferences and university campuses was primarily positive, but privacy concerns were stated as well. Furthermore, only one out of 150 students during the university evaluation had their mobile phone switched on to Bluetooth discoverable mode.
The study conducted by Eagle and Pentland (2005) showed, that users have privacy concerns with a service, that exchanges usernames and profile pictures with collocated strangers for situated introductions. Instead of introducing collocated strangers, Paulos and Goodman (2004) explore the relationship between familiar strangers in urban public places and how ICT can extend and visualise such relationships.

“Familiar strangers are individuals that we regularly observe but do not interact with” (Paulos and Goodman, 2004, p. 223). The authors conducted two studies. The first study investigated if the concept of the familiar stranger has changed since its introduction by Stanley Milgram in 1977 through the introduction of mobile phone technology. Paulos and Goodman (2004) took photographs of urban public places at a specific time and day and came back exactly one week later to show urban dwellers the photographs. Urban dwellers got asked if they recognise people in the photographs. The first study showed that the familiar stranger relationship is still prevalent with only minor differences in the amount of people recognised per study participant. In the second study the authors conducted walking tours with study participants involving 4 different urban public places to investigate the relationship of recognisable familiar strangers and the experience of place. Thereby Paulos and Goodman (2004) found that collocated people was ranked as the highest criteria (besides physical characteristics and environmental conditions of a place) in terms of perceived comfort. A participatory design exercise with the study participants revealed that having information about the social landscape of an public urban place is a desired feature for a design intervention. Therefore the authors designed the Jabberwocky system utilising Bluetooth to measure if familiar strangers, who have been encountered before, are in vicinity. How the visualisation of familiar strangers through the Jabberwocky system influences the experience of place has not been evaluated in the study.

Paulos and Goodman (2004) state that they are not trying to transform strangers into friends and that strangers are important for healthy cities. This statement aligns with the goals of this PhD study. However, this study argues that having a glimpse into the invisible information people are willing to share such as demonstrated by Bassoli et al. (2007), can create a sense of belonging and can positively influence the experience while spending time in urban public place.

Similar to the Jabberwocky system (Paulos and Goodman, 2004), Kostakos and O’Neill (2008)
describe *Cityware*, a system that tracks Bluetooth enabled mobile devices carried through everyday life. However, Kostakos and O’Neill (2008) provide possibilities to users to explore whom they encountered while traversing through the city. *Cityware* scanning nodes are placed in different urban places such as bars or shops and constantly scan for discoverable Bluetooth devices. Furthermore, a *Facebook* application has been developed, which enables users to register the Bluetooth IDs of their devices, or even install the scanning software on their mobile phones. This approach enables the *Cityware* server to measure if two or more Bluetooth IDs occurred at the same time, the same space, and for how long. In combination with *Facebook* friend connections, it is possible to “bridge the gap between physical and digital social networks” (Kostakos and O’Neill, 2008, p. 197). *Facebook* users, which are using *Cityware*, can explore whom they encountered during their way through the city. Through this approach it is possible to gather huge amounts of quantitative data from Bluetooth scans and qualitative data from Facebook user profiles, which can be used for further research. In the future, the authors want to measure encountering patterns. As Facebook friendships can be annotated with information about the relationship (e.g. housemate, work colleagues), it can be analysed how, where, and with whom people spent their time in the city. *Cityware* has been heavily criticised in the press (Derbyshire, 2008, Lewis, 2008) because it can constantly track the whereabouts of urban dwellers without their knowledge if their mobile phone’s Bluetooth is switched on. Even without an established *Facebook* link to the Bluetooth ID, the gathered data enables the tracking of travel patterns of urban dwellers. The bad press on public surveillance and privacy concerns implies that such urban technologies must provide an opt-in rather than opt-out mechanism as applied by *Cityware*.

Wilken (2010) theoretically investigates existing research where mobile phone technologies have been utilised to create connections between strangers. While reviewing two artistic approaches to connect strangers in the 1960s and 1990s he also reviews the work from Paulos and Goodman (2004) and Eagle and Pentland (2005) concluding that “[i]n each case, technology can be seen to provide a ‘scaffolding’ of sorts around and from which ‘community’ might emerge” (Wilken, 2010, p. 461). The author discusses the reviewed projects under the lens of “key (poststructuralist) philosophical deliberations on the notion of community, specifically by Jean-Luc Nancy, Giorgio Agamben and Alphonso Lingis” (Wilken, 2010, p. 459). Interesting
in relation to this PhD thesis is that Wilken (2010, p. 463) concludes that each of the reviewed research projects “explore fleeting and unstable forms of social interaction (Nancy); each speaks to the future possibilities and potency of communication (Agamben); and, each explores this issue of ‘exposure’, recognition and trust between strangers (Lingis) in ways that are simultaneously playful and thought-provoking”. Wilken (2010) further validate the significance of this PhD study through confirming that research on mobile mediated interactions and digital augmentations between strangers has been passed largely unnoticed by the research community.

After reviewing research on mobile social software and location-based social networks and how such systems can connect friends and strangers, the next section reviews approaches on how to create connection between strangers and how they can be introduced or how connections can be created.

### 2.4.3 Creating Connections

Bilandzic et al. (2008) explore with CityFlocks, how a mobile application can be utilised for direct and indirect social navigation enabling application users to call or send text messages to unknown urban dwellers. Direct social navigation refers to asking people directly whereas indirect social navigation refers e.g. to take clues from what other collocated urban dwellers are doing. An initial user study showed that both navigation techniques are used when in an unknown area. CityFlocks enables users to search a folksonomy while on the move and retrieve information they need. Searching for food, as an example, returns a list of suitable entries including comments of urban residents, ratings (indirect social navigation), and the opportunity to call or text them (direct social navigation). Through a web based interface, users can add and rate entities. The system was evaluated to find out, whether mobile users prefer direct or indirect navigation. The outcomes indicate that users did not prefer direct social navigation. Some users mentioned that they do not want to call a complete stranger who is maybe not available (e.g. driving a car) or busy at work. Furthermore, texting lacks the nature of asynchronous communication and can therefore cause a possible delay of a required response. Users preferred indirect social navigation and found it more useful to read uncensored opinions of others about places.
The employed opportunity to call a stranger for direct social navigation has been perceived as awkward by CityFlocks application users (Bilandzic et al., 2008). While the CityFlocks study was not aiming towards connecting strangers but rather to support direct and indirect social navigation in public urban places, the results from this study however further underline the importance to carefully design connections between strangers. Axup et al. (2006) on the other hand, studied the concept of a low-fidelity social matchmaking application for unknown backpackers in Australia. They conducted two studies to gather requirements for social matchmaking applications. Users’ past and future travel plans are used to provide potential social pairings between two backpackers:

- Past - Past: Conversation context: shared memories
- Past - Future: Conversation context: knowledge exchange
- Future - Future: Conversation context: same plans

The study showed that sharing memories and exchanging knowledge provided a possible foundation for conversations. Furthermore, Axup et al. (2006) state that personality and behavioural traits should be considered by social pairing systems, as well as reputation systems, which are evaluating possible future conversation partners.

Terveen and McDonald (2005) provide theoretical insights into social matching systems, as applied by Eagle and Pentland (2005) and Axup et al. (2006). According to Terveen and McDonald (2005), social matching systems can be described as recommender systems for personal contacts. In contrast to recommender systems, which recommend items to people, social matching systems recommend people to people for purposes like socialising, business, or information exchange. The authors review the field of first approaches to Social Matching Systems from the online domain. They also introduce different approaches from the social sciences, which can help to design successful social matching systems. Additionally, a simple model of social matching systems is provided, which consists of the following four steps:

- Model: A set of users who can be matched
- Match: Explicit matching algorithms or opportunistic approach
• Introduce: Suitable introduction mechanism to provide interaction

• Interact: Mediated or physically collocated interaction between introduced people

Furthermore, a feedback mechanism for informing the modelling step must be provided. The authors set a research agenda for Social Matching Systems, which consider eight claims, concerning user profiles, algorithms, egocentric social networks, introduction techniques, user base, context, feedback, and evaluation.

This PhD study constrains the model by Terveen and McDonald (2005) to collocated people and does not apply any matching algorithms. Users have to decide with whom they may interact based on shared information of the case study application.

While Terveen and McDonald (2005) provide a theoretical model for social match making, Raban et al. (2009) investigate user interfaces for introductory techniques. The user interfaces support private information revealing between unknown people at a university campus for introductory services and relationship establishment. A desktop-based application has been evaluated, using four different kinds of information disclosure.

Option 1: Free form chat only

Option 2: Request of specific user profile information (e.g. age, gender, hobbies) through clicking the respective field

Option 3: Free form chat and request of specific user profile information, whereas the user profile information disappeared after 10 seconds

Option 4: Free form chat and request of specific user profile information, whereas the user profile information didn’t disappeared after 10 seconds

Users were asked to accept profile information requests from others. Raban et al. (2009) used option 3 and 4 to find out if large data sets should be displayed on small mobile phone screens. Users preferred option 4, where they could see all revealed information. This is based on the fact that getting to know new people involves uncertainty. Option 4 reduces uncertainty because more information was visible on the screen. Furthermore, Raban et al. (2009) conclude that the different options did not have an impact on future relationships.
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The implications for this study are that no user profiles will be utilised in the developed applications. The results of Raban et al. (2009) show that option 4 was preferred because of the reduction in uncertainty for introductory services and relationship establishment. However, this PhD research is more interested in augmenting the urban space and making the invisible visible (Kjeldskov and Paay, 2006) rather than relationship establishment between unknown people. Uncertainty might be perceived as valuable and less privacy invading when sharing data with unknown collocated people.

2.4.4 Summary

This section of the literature review introduced and positioned this PhD thesis within the research field of urban informatics. Research on mobile social software and location based social networking applications has been presented which investigate within the intersection of people, place, and technology.

Previous research has studied, how such applications are used to connect friends and the studies conducted by Lindqvist et al. (2011) and Humphreys and Liao (2011) show, that there is a general interest in digital augmentations contributed by strangers. The studies conducted by Paulos and Goodman (2004), Kostakos and O’Neill (2008), Bassoli et al. (2007), and Eagle and Pentland (2005) presented various approaches to connect strangers in public urban places whereas Wilken (2010) concludes that mobile mediated interactions between strangers have been passed largely unnoticed by the research community. Furthermore, this section presented theories on matching algorithms Terveen and McDonald (2005), models for connecting stranger Axup et al. (2006), and examples of interface techniques to introduce (Raban et al., 2009) and connect (Bilandzic et al., 2008) unknown people.

This PhD thesis is interested in the intersection of the research presented by Paulos and Goodman (2004) and the concept of the familiar stranger also not trying to transform strangers into friends, and the work described by Bassoli et al. (2007) with their approach to exchange data in public urban places.

This section reviewed mobile applications (except the interface study described by (Raban et al., 2009)) investigating in the intersection of people, place, and technology relevant for
this PhD thesis. The next section presents research on public urban screens and mobile phone interactions.

2.5 Public Urban Screens and Mobile Mediated Interaction

More and more public urban places are equipped with urban screens that mostly display advertisements, TV programs, art installations, or public transport timetables. The research community has recognised the potential of such screen installations and this section of the literature review presents and discusses research on public screen applications, which go beyond the above-mentioned purposes, and particularly focuses on ways of enabling mobile mediated interactions.

Munson et al. (2011) conducted a study comparing two applications designed for a public display in a university setting. The first application, the *Thank You Board*, enables users to send structured thank you messages to a public display utilising a website containing a form for messages creation. The form contains three fields: one field to enter the name of the sender, one field to enter the thank you message, and one field to enter the name of the receiver of the message. The messages are then composed in form of “[sender] says thanks to [receiver] for [message]”. The second application, the *SI Display*, visualises *Twitter* messages directed to a specific *Twitter* username using the *@username* syntax. Munson et al. (2011) conducted a content analysis of the received messages of both applications and interviewed 14 study participants. The study revealed that people preferred the *SI Display* application due to the flexibility and openness of the system. On the other hand, the study also showed that users were uncertain about the purpose or intended usage of the *SI Display* and what messages are appropriate and should be send to the screen. While using *Twitter* removed the barrier of visiting a website for posting messages as utilised in the *Thank You Board*, users without a *Twitter* account could not participate in the system. Additionally, privacy conflicts of visualising one’s social media identity on a public screen with unknown others or professional colleagues could be discovered.

The fact that even abstract *Twitter* usernames visualised on a public display can raise privacy issues has to be considered for this PhD study. While Munson et al. (2011) enable users to
explicitly interact with a public urban screen utilising Twitter and a website, Jose et al. (2008) designed an application which enables implicit interactions utilising Bluetooth.

*Instant Places* (Jose et al., 2008) utilises a public display and a Bluetooth device scanner that periodically scans the surroundings for discoverable Bluetooth device names. The gathered device names are visualised on the public display whereas the system allows two modes for advanced screen interaction. First, users can specify tags in their Bluetooth device name. Second, users can specify a *Flickr* username in their Bluetooth device name which triggers the system to visualise the photo stream of the particular username or the specified tags. In their study, Jose et al. (2008) could clearly measure that people changed their device names more frequently after the introduction of the system and the visualisation of such data. The study showed that such a system facilitates situated messages regarding place and collocated people within. Jose et al. (2008, p. 57) state that the implicit interaction of visualising all captured Bluetooth device names “make people feel that [...] they were already ‘using’ the system [and] they might as well refine their presence” through changing their Bluetooth device names resulting in explicit interaction with the screen.

In contrast to the *Thank You Board* and the *SI Display*, the *Instant Places* project did not specify how to use the system or the purpose it was designed for. On the other hand, it seems that the employed place-based interaction in combination with anonymous interaction with Bluetooth device names removed the barrier of what is appropriate to share on a screen and “people found their own creative uses, particularly as a board for posting messages about the service or to other people in the room” (Jose et al., 2008, p. 57). In contrast, Brignull and Rogers (2003) emphasise the importance of stating the purpose of a public display system and what it has to offer to stimulate interaction with an interactive public display application. In their research, Brignull and Rogers (2003) describe the *Opinionizer*, a public display application enabling people to view and share opinions regarding a specific topic. To share an opinion, people had to type in their message together with an optional nickname into a nearby laptop computer. The *Opinionizer* has been deployed in two party settings, a book launch party at an academic conference and a welcome party for new postgraduate students at a university. Thereby the *Opinionizer* could successfully stimulate real world interactions through the congregation of people around the public display and social user interaction about the submitted comments and...
The *Opinionizer* described by Brignull and Rogers (2003) could facilitate real world social user interaction between unknown collocated people. However, this PhD research is interested in how mobile mediated interaction and digital augmentations can influence the experience of public urban places which does not necessarily include the aim to generate real world interactions. Additionally in contrast to this PhD study, the party settings described by Brignull and Rogers (2003) hosted people with more or less similar backgrounds such as being an academic in a specific field or a post graduate student at a specific university. This research is more interested in public urban places where a diversity of people congregates.

Schroeter (2012) developed, deployed, and studied a public urban screen application in various public urban places. The study around *Discussion in Space* (Schroeter, 2012) investigates how digital augmentations utilising mobile phones and public displays can enhance the experience of citizens in public urban places through providing accessible and easy to use means for citizen engagement in local urban planning issues. *Discussion in Space* is a public display application stating questions about local urban planning issues. The application allows users to respond to a question with text messages or *Twitter* tweets containing a specific hash tag as advertised on the screen. Received messages are visualised on the public urban screen through animated speech-bubbles. The aim of *Discussion in Space* is to engage citizens in a fun and easy way who usually wouldn’t participate in local government planning issues. Thereby Schroeter (2012, p. 235) found that the “fun element of the application turned out to be an element, which drew a lot of users’ attention to the screen, and eventually to the civic issue at hand.” While *Discussion in Space* facilitates mobile meditated interactions in regards to civic issues, the research aim of *Discussion in Space* goes into a different area as what this research project tries to achieve. However, the stated fun element could also be utilised in regards to collocated people rather than civic issues.

Overall this PhD study tries to influence the experience of people in a positive way. This section showed that public urban screen applications should state explicitly their purpose (Brignull and Rogers, 2003, Munson et al., 2011), the interaction should not result in visualising data which might breach users privacy beyond what they volunteer to share (Munson et al., 2011), and also contain a fun element to engage urban dwellers (Schroeter, 2012).
2.6 User Experience

The previous sections of this literature review presented and discussed research in the area of context-aware computing, location-based services, mobile social software, and public urban screen applications. This PhD thesis is interested in what user experiences such applications might create while interacting with them. This section presents and discusses previous work in the area of user experience (UX) research.

In the past, HCI research largely focussed on usability studies to evaluate activities such as task completion time and ease of use of software applications designed to fulfil given work tasks. The term “experience” is widely used to describe various aspects of HCI that go beyond the usability of work-related products and especially used when focusing on the UX concerning interactive consumer products. Garrett (2003) states that UX is not about how products tackle a problem to achieve a solution they were made for but rather, UX is about how products behave when people actually use and interact with them. While the ISO FDIS 9241-210:2009 norm on ergonomics of human system interaction defines UX as “a person’s perceptions and responses that result from the use or anticipated use of a product, system or service,” recently published studies highlight the lack of a common definition for UX, e.g. Bargas-Avila and Hornbæk (2011), Battarbee and Koskinen (2005), and Law et al. (2009).

Alben (1996, p. 12) defines experience as “all the aspects of how people use an interactive product: the way it feels in their hands, how well they understand how it works, how they feel about it while they’re using it, how well it serves their purposes, and how well it fits into the entire context in which they are using it.” Alben (1996) states six characteristics, which directly influence the quality of experience, and two characteristics, which indirectly influence the quality of experience through the product designers. Direct characteristics are needs, learnability and usability, appropriation, aesthetics, mutability, and manageability. Indirect characteristics are the understanding of users and an effective design process.

Hassenzahl and Tractinsky (2006) argue that UX research should go beyond the instrumental and address surprise, diversion, or intimacy. UX should consider emotions in terms of joy, fun, and pride as well as the experiential, which means that a product is used in a specific situation resulting in the experience. “UX is about technology that fulfils more than just instrumental
needs in a way that acknowledges its use as a subjective, situated, complex and dynamic encounter. UX is a consequence of a user’s internal state (predispositions, expectations, needs, motivation, mood, etc.), the characteristics of the designed system (e.g. complexity, purpose, usability, functionality, etc.) and the context (or the environment) within which interaction occurs (e.g. organizational/social setting, meaningfulness of the activity, voluntariness of use, etc.)” (Hassenzahl and Tractinsky, 2006, p. 95)

McCarthy and Wright (2004) developed a framework to analyse experience with technology. The framework consists of four threads:

1. Compositional: “How do the elements of an experience fit together to form a coherent whole?” e.g. narrative structure, action possibility, consequences and explanations of actions.

2. Sensual: “What does the design and texture and the overall atmosphere make us feel?” e.g. look and feel of an application.

3. Emotional: “What emotions color the experience for us?” e.g. fun, excitement, and frustration.

4. Spatio-Temporal: “What effects do place and time have on our experience?” e.g. time sped up or slow, space may open or close down.

Furthermore, it consists of six interrelated sense-making processes:

1. Anticipating: “We never come to technology unprejudiced.”

2. Connecting: “We make a judgement in an instant and without much thought.”

3. Interpreting: “We work out what’s going on and how we feel about it.”

4. Reflecting: “We examine and evaluate what is happening in an interaction.”

5. Appropriating: “We work out how a new experience fits with other experiences we have had and with our sense of self.”

6. Recounting: “We enjoy story telling and make sense of experience in stories.”
The emotional and spatio-temporal threads of the framework are especially interesting: how does technology change the experience of places and can technology open up public places and connect the urban dwellers within them to make the space more accessible in a digital way?

Forlizzi and Ford (2000, p. 420) state that “a singular experience is made up of an infinite amount of smaller experiences, relating to contexts, people, and products.” They created a framework to understand what influences experiences and dimensions of experiences. Prior experiences of users, their values, emotions and feelings all influence their experience. A product influences the experience through its usability, quality, aesthetics and so on. Additionally, some products are personal items that have specific meanings to particular users such as a specific golf ball that was used for a hole-in-one shot. The user-product interaction takes place in context influenced by social and cultural factors what requires the designers to “understand the users, products, contexts, and nature of interactions that may happen” (Forlizzi and Ford, 2000, p. 420). The authors describe four dimensions of an experience:

1. sub-conscious experiences that are fluent and automatic experiences such as using the coffee machine,
2. cognitive experiences that require users attention and problem solving skills such as interacting with an unfamiliar software,
3. narrative experiences that force people to think and formalise what they are doing and experiencing, and
4. storytelling experiences that are created through sharing experiences.

Forlizzi and Battarbee (2004) describe three types of user-product interactions:

1. fluent interactions enabling automated interactions such as riding a bike,
2. cognitive interactions requiring problem solving skills, and
3. expressive interactions creating a relationship with a product.

Additionally Forlizzi and Battarbee (2004) differentiate between three types of experiences:
1. experience, a constant stream of information while interacting with the world,

2. an experience, an interaction with the world which can be named, and

3. co-experience, which “reveals how the experiences an individual has and the interpretations that are made of them are influenced by the physical or virtual presence of others” (Forlizzi and Battarbee, 2004, p. 263).

Battarbee and Koskinen (2005) criticise that current UX research mostly focuses on the individual and does not consider experiences that are created together. The term co-experience is used “to describe experiences with products in terms of how the meanings of individual experiences emerge and change as they become part of social interaction” (Battarbee and Koskinen, 2005, p. 7).

The definitions show that emotional attributes such as enjoyment, contextual attributes such as place and environment, as well as the social setting have to be taken into account when conducting HCI research. Furthermore, existing definitions discuss products, services, or interfaces. While this research is interested in how people feel about interacting with the designed applications, this research is also interested in designing and influencing the UX in public urban places through digital place-based mobile multimedia augmentations and mobile mediated interactions. In a broader sense, this research creates applications that mediate the UX by augmenting the urban space rather than creating a UX isolated on the mobile device. This urban UX is influenced by people who are collocated in the past, present, or future and who are interacting with each other in an anonymous way mediated through their mobile device resulting in the creation of a digital layer on top of the geographical space. “People create, elaborate, and evaluate experiences together with other people, and products may be involved as the subject, object or means of these interactions” (Battarbee and Koskinen, 2005, p. 15).

The presented review of literature on UX highlights that various attempts have been made to define and scope diverse types of experiences when interacting with a device or service which go beyond usability studies. Additionally, having in mind that a variety of variables before, during, and after application usage can influence the experience of a user is further contributing to the challenge of systematically studying them. This PhD thesis further discusses the notion of UX in relation to urban informatics design interventions in Section 3.2.
2.7 Urban Sociology

This interdisciplinary PhD study investigates in the intersection of HCI research and urban sociology. As the previous section on user experience stated, this research is interested in the urban experience the applications described in this thesis might influence rather than the user experience itself of interacting with a product. Therefore, this section reviews research in the area of urban sociology.

The research field on urban sociology investigates the social life of urban dwellers in cities. In context of this PhD project, concepts and principles from the area of urban sociology inform the design and development of mobile place based applications and are used to analyse the experience such design interventions might create.

Lynch (1960) conducted a five-year study investigating how urban dwellers experience the form of a city. He classifies five physical elements that form the image of a city:

1. Paths: Urban dwellers move along paths such as streets, sidewalks, or railroads.
2. Edges: Boundaries such as walls, shores, or buildings.
3. Districts: Parts of the city, which can be distinguished and identified, form each other.
4. Nodes: Points are focal points of a city to or from which urban dwellers travel.
5. Landmarks: Unique physical objects as a point of reference such as buildings, mountains, or signs.

He furthermore created the term “imageability” which is defined as the “quality in a physical object which gives it a high probability of evoking a strong image in any given observer” (Lynch, 1960, p. 9). The work of Lynch (1960) is mainly focussing on the physical aspects of the city.

The fundamental work by Jane Jacobs (1992) originally published in 1961 titled Death and life of great American cities critiques the former prevalent Urban Renewal Theory led by Paul Moses who claimed that cities are for traffic. Jacobs however argues that cities are for people and states four principals for healthy cities:
1. The need for mixed primary uses: Increasing city life through different facilities like commercial buildings, houses, small industry, and parks in vicinity.

2. The need for small blocks: Increasing city life through avoiding the creation of main “traffic roads” and enabling a natural flow of city inhabitants.

3. The need for aged buildings: Mixing newer and older, cheaper buildings enables a variety of mixed primary use.

4. The need for concentration: A critical mass of people is required to enable cultural and economic communities.

The need for diversity to achieve healthy cities corresponds with this research in context sharing whereas it is hypothesised that a variety of shared information could enable a variety of interactions mediated through mobile devices.

The book *Life Between Buildings* (Gehl, 1987) looks at urban environments such as streets, places, and plazas, and how the design affects human beings. Gehl (1987) argues that the outdoor activities, which take place “between buildings”, are influenced by the physical environment. If places are well designed, people use them for optional activities such as doing some kind of sport or other recreational activities that in return result in more social activities within the respective place. According to Gehl (1987) the most widespread activities in urban environments are passive social activities, such as seeing and hearing other people. “A summary of observations and investigations shows that people and human activity are the greatest object of attention and interest. Even the modest form of contact of merely seeing and hearing or being near to others is apparently more rewarding and more in demand than the majority of other attractions offered in the public spaces of cities and residential areas” (Gehl, 1987, p. 31). In relation to this PhD research the question arises how this “seeing and hearing and being near to others” can be further supported and mediated through ICT devices to influence the experience of people in public urban places. Can this research enable urban dwellers to see and hear more and being nearer to others literally and/or symbolically through digital augmentations? Additionally, Gehl (1987) categorises activities that occur in public urban places as *necessary activities, optional activities, and social activities*. Necessary activities such as commuting to work or buying groceries do not depend on the physical characteristics of the urban environment
and take place all year long. *Optional activities* highly depend on the physical characteristics of the urban environment and include activities such as going for a walk or relaxing in a park. *Social activities* depend on collocated people and include activities such as greeting other people, conversations, or even just passive contacts. *Optional activities* will occur to a greater extent if the physical characteristics of a public urban space are inviting. *Social activities* are resultant activities because they evolve from *necessary* and *optional activities*. The more *optional activities* occur, the more *social activities* will occur. If a public place is perceived as inviting, people will allow more time for *necessary activities* and more people will use a public urban place for *optional activities*. *Social activities* often occur spontaneously out of the variety of other activities that take place. This categorisation of activities in public urban places is relevant in relation to the developed case study applications. The question arises how mobile mediated interaction can support and create *optional* and *social* activities while a *necessary* activity occurs during everyday urban life.

While Gehl (1987) provides a categorisation of activities in public urban places, Goffman (1959) describes a theoretical framework for social interactions in public urban places. Erving Goffman’s theory on *The Presentation of Self in Everyday Life* (Goffman, 1959) uses the metaphor of theatrical performances to describe the process of social interaction in public urban places. He describes how the actions of actors are based on social performances to *give* (explicit information such as the words spoken) and *give off* (implicit information such as body language and fashion) the right impressions to the audience, which in turn is also performing for the actor. *Fronts* are constructed through the *given* and *given off* impressions and define the situation for those involved in a face-to-face interaction or performance. The *back* describes the situation when no other performers are present and an actor can perform without the fear of losing his front. Additionally, Goffman (1966) describes human behaviour in public places when encountering collocated people. He defines public places as “any regions in a community freely accessible to members of that community” (Goffman, 1966, p. 9) and differentiates three different types of co-presence:

1. Gathering: two or more individuals who are in another’s presence.

2. Situation: occurs when “mutual monitoring” takes place in a gathering.
3. Social Occasion: many gatherings and situations occur, dissolve, and reform.

Furthermore, Goffman separates interaction into focused and unfocused interaction whereas the latter is the most common mode of interaction in public urban places between unknown collocated people. Body language, facial expression, or the clothes worn are scanned and analysed when encountering people. The work of Goffman is highly relevant from the urban experience perspective considering the interaction possibilities of the case study applications. How can mobile mediated interactions generate fronts through the given and given off information between anonymous collocated people?

Instead of investigating interactions in public urban places, Hampton and Wellman (2003) studied social relations and community offline as well as online in Netville an anonymous suburb in Toronto. Netville is a newly built district where every home is equipped with high-speed Internet access and also provided with digital services such as Internet access, computer desktop videophone, an online jukebox, entertainment applications, online health services, and local discussion forums. Results are that less than one quarter of all social relations are within the neighbourhood. “The car, telephone, and airplane are indispensible in the maintenance of contemporary social relations and in the provision of most companionship and emotional aid” (Hampton and Wellman, 2003, p. 466). However, Netville residents who were connected to these digital services had more social relationships than residents who were not connected. This is mainly based on the participation on the local email list for purposes such as sharing community information or invitations to social events. Therefore, it is interesting for this research that digital communication technology can help to establish social ties of physically collocated people. Furthermore, as stated in Hampton (2004, p. 261) “ICTs support the growth of social networks, social capital and community well-being”. However, the difference between the work of Hampton and Wellman (2003) and Hampton (2004) and this research is, that ICT will be applied for the growth of social networks, social capital and “urban public place well-being” instead of community well being in residential areas.

As stated in this section, “seeing and hearing or being near to others” are the greatest objects of attention in public urban places (Gehl, 1987, p. 31) where mostly unfocused interaction between collocated strangers occurs (Goffman, 1966). This PhD study tries to create an additional digital channel for supporting the process of unfocused interaction when a gathering occurs (Goffman,
2.8 Conclusion

The chapter positioned this PhD study within the research field of urban informatics (Foth et al., 2011) and presented a literature review of the influencing research fields of context-aware computing and location-based services, context sharing, mobile social software and location-based social networks, public urban screens, user experience research, and urban sociology.

Research has been conducted in the area of mobile social software and location-based social networking applications utilising mobile phone technologies to connect friends (Humphreys, 2008, Kjeldskov and Paay, 2005, Lindqvist et al., 2011), strangers (Bassoli et al., 2007, Kostakos and O’Neill, 2008, Paulos and Goodman, 2004) and public urban screen installations (Brignull and Rogers, 2003, Jose et al., 2008, Munson et al., 2011, Schroeter, 2012). However, Wilken (2010) states that mobile social software and location-based social networking applications used to connect strangers have been passed largely unnoticed by the research community. Additionally, research on mobile social software and location-based social networks used between interconnected individuals showed that shared content from unknown people is of general interest to application users (Humphreys and Liao, 2011, Lindqvist et al., 2011). Therefore, research question 1 of this PhD thesis - How can ICT in public urban places be applied to influence user experiences and in what ways? - investigates mobile mediated interactions and digital augmentations between unknown urban dwellers and provides examples in Chapter 4, 5, and 6.

Section 2.7 presented research in the area of urban sociology. Research question 2 - How does the establishment of ICT-mediated social interactions between collocated users influence the experience of those users in particular urban spaces? - further addresses the literature presented in providing an analysis of mobile mediated interactions and digital augmentations in Chapter 7, utilising the frameworks and theories form Gehl (1987) and Goffman (1959).

Section 2.1.1 of this chapter reviewed literature around the notion of context. Context characterises the situation of an entity (Dey, 2001) and changes while interacting with the world (Dourish, 2004). Investigative research question 3 - What kind of non-privacy sensitive data can be utilised at a particular urban setting? - is further interested in context data of urban dwellers.
in particular public urban places and Chapter 4, 5, and 6 present the respective utilised context within each case study.

The concept of social translucence (Erickson and Kellogg, 2000) describes how sharing context information with other can enhance communication and Bentley et al. (2006) and Oulasvirta et al. (2005) provide examples of sharing contextual information with interconnected people. Investigative research question 4 - How can the available data be utilised to deliver content and services to users collocated in the same urban setting in order to facilitate meaningful digitally mediated social user interaction? - addresses social translucence between unknown collocated people through sharing contextual information in Chapter 4, 5, and 6.

The literature review revealed that location-based services have to be carefully designed to not breach users privacy beyond what they volunteer to share (Barkhuus and Dey, 2003, Chang et al., 2007, Junglas and Watson, 2008). Investigative research question 5 - What are the criteria (such as comfort, sensibility, cautious, private, tact, etc.) that need to be met in order to establish and maintain digitally mediated interaction between collocated users? - addresses these issues and is answered in the case study Chapters 4, 5, and 6.

The literature review on user experience research presented in Section 2.6 highlights the various attempts that have been made to define and scope the diverse types of UX. However, recently published studies highlight the lack of a common definition for UX (Bargas-Avila and Hornbæk, 2011, Battarbee and Koskinen, 2005, Law et al., 2009). Investigative research question 6 - How can the success of ICT mediated social interactions be evaluated and measured and how does this change the social experience of a particular public urban place for different users? - is concerned with the UX of the design artefacts of this research and Section 3.2 provides a UX framework based on the presented literature. The UX framework has been applied in Chapter 4, 5, and 6 to inform and evaluate the design artefact within each case study.
Chapter 3

Methodology

This methodological chapter is divided into two major sections. Section 3.1 describes the overall research methodology applied for this study. Section 3.2 describes the construction of a framework used to design and evaluate user experiences within each single case study.

3.1 Case Study Methodology

Following the approach described by Yin (2003), this research project applies an exploratory multiple case study methodology. The next paragraph defines the case study method:

“A case study is an empirical inquiry that:

- investigates a contemporary phenomenon within its real-life context, especially when
- the boundaries between phenomenon and context are not clearly evident.

The case study inquiry

- copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result
- relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result
According to the definition, a case study methodology seems suitable considering that the increasing ICT usage while being in public, especially Internet enabled mobile devices, is a contemporary phenomenon within a real life context. Furthermore, the boundaries between ICT usage and context are not clear, as the example of the “cocooning” in section 1.1.3 highlights. As this research tries to answer the overall research question, how can ICT in public urban places be applied to influence user experiences and in what ways, the comprehensive multiple case study methodology offers - according to Yin (2003) - a tool to handle such a complex question that is more suitable than survey or experimental strategies.

To develop a rich theoretical framework for answering the above stated question, a holistic multiple case study approach has been chosen. Three case studies seem to be feasible for this PhD thesis and furthermore seem to be suitable to test and deploy different solutions at different public urban places. Furthermore, multiple case studies are more robust than single case studies and support the external validity of this research Yin (2003).

3.1.1 Research Design for the Case Study Methodology

The overall case study methodology is guided by Yin (2003) who lists the five components of the research design as follows:

1. a study’s questions;
2. its propositions, if any
3. its units of analysis
4. the logic linking the data to the propositions
5. the criteria for interpreting the findings

Section 1.1.4 states the six research questions whereas research question 1 and 2 are the case study’s relevant questions, which will be answered with the multiple case study methodology. The relevant research questions are:
3.1. CASE STUDY METHODOLOGY

RQ1: How can ICT in public urban places be applied to influence user experiences and in what ways?

RQ2: How does the establishment of ICT-mediated social interactions between collocated users influence the experience of those users in particular urban spaces?

The proposition for all case studies in general is that digital augmentations considering users’ context and delivering digital content and services to urban dwellers in particular urban spaces can influence the experience in those spaces. Therefore, the unit of analysis is the individual urban dweller within the investigated urban public place. The design interventions presented in this thesis are research instruments to help collect data, rather than the unit of analysis of the case studies per se. The linking of the data will be related to the theoretical proposition of the case study, which also will be the criteria for interpreting the findings. Evidence will be collected through multiple sources, in particular existing literature, artefacts, user-studies, and interviews.

Each case study will be a literal replication of the predecessor case study. However two variables will be changed in every case study: public urban place and the technological intervention. This is due to the fact that each public urban place has unique characteristics. These characteristics influence the technological intervention and the available context data. For example, in public transport people can focus on the screen of their mobile phone and interact with it whereas in a gym public displays are more suitable than small handheld devices. Furthermore, the advantage of the multiple case study methodology is that a redesign of the data collection methods can take place after an important discovery has been made (see dotted line in Figure 3.1). Additionally, Yin (2003) states that even a reconsideration of the theoretical proposition is possible.

Figure 3.1 visualises the multiple case study methodology and the phases in which the activities occur. The next section looks specifically at each case study phase and describes how the remaining research questions will be answered and how case studies will be selected and conducted.
3.1.2 Each Case Study Approach in Detail

Research question 1 and 2 are the main research questions of this study, which can be answered after all three case studies have been conducted. The remaining questions are investigative questions and are based on a single case study and direct the selection of the urban public place, artefact development and available features, as well as the evaluation. Each case study tries to investigate the user experience in terms of how people feel about interacting with the developed artefacts and how they impact everyday urban life. A detailed review of methodological approaches to evaluate user experiences as well as tools to evaluate them is presented in Section 3.2. A case study starts with research question 3:

**RQ3: What kind of non-privacy sensitive data can be utilised at a particular urban setting?**

Each urban public place offers unique and distinctive features describing the activities of the urban dwellers within. These activities can answer research question 3. The following list illustrates this with a few examples:

- People in public transport are using mobile phones, read books, and listen to music. Non-privacy sensitive data: destination of bus, currently consumed media.
3.1. CASE STUDY METHODOLOGY

- People in airport lounges are waiting for their flight. Non-privacy sensitive data: destination of plane, past destinations, and future travel plans.

- People are waiting in a grocery shop for paying goods. Non-privacy sensitive data: purchased goods, meal to be cooked.

- People sitting in a café. Non-privacy sensitive data: loyalty and frequency of café visits.

- People working out at a gym. Non-privacy sensitive data: exercises that have been conducted and accumulated amount of the weight being lifted.

To answer investigative research question 3, urban dwellers at a particular urban public place had to be studied. A pre-selection of suitable urban public places was undertaken through everyday observations by the PhD candidate. Once a suitable public urban place was identified, deeper observations were conducted. An ethnographic approach helps “to develop a thorough understanding of current work practices as a basis for the design of computer support” (Simonsen and Kensing, 1997, p. 82). Furthermore, ethnography aims “to see activities as social actions embedded within a socially organised domain and accomplished in and through the day-to-day activities of participants” (Hughes et al., 1995, p. 58). In this context of research, work practice refers to how people use ICT devices during day-to-day activities. Day-to-day activities refer in this research to the idle time humans spend at public urban places. As there was not enough time to conduct a complete ethnographic study for each case study, a “quick and dirty” ethnography had to be conducted, which applies “short focused studies to quickly gain a general picture of the setting” (Hughes et al., 1995, p. 61). This general picture as a result of the ethnographic approach also informed research question 4.

**RQ4: How can the available data be utilised to deliver content and services to users collocated in the same urban setting in order to facilitate meaningful digitally mediated social user interaction?**

To answer this question, results of the ethnographic observations were analysed. The results informed system development, which utilised the available context and locational data as well as available ICT devices. This was a creative process and involved the researcher as well as the research team brainstorming technological possibilities. Chapter 4, 5, and 6 show, how available
data has been utilised for each case study. The second part of the question was answered by involving users during the development process. A user-centred design methodology has been applied to involve the user during application development. This approach ensured that each technological intervention met the needs of the users (Kangas and Kinnunen, 2005). After application development, the analysis of evaluation data helped to answer research question 5.

**RQ5: What are the criteria (such as comfort, sensibility, cautious, private, tact, etc.) that need to be met in order to establish and maintain digitally mediated interaction between collocated users?**

Each case study enables users to interact with each other mediated via ICT devices. These interaction possibilities had to be carefully designed to not breach users’ privacy while collocated in the same urban public place. Each application was designed at first so the mechanisms for interaction are absolutely anonymous. Possibilities to reveal parts of the identity are given, but it is up to the users to decide what they volunteer to share. To answer investigative research question 5, urban dwellers used the respective application either in real-world deployments or field studies followed by a suitable data collection method to get insights into privacy issues. The data collection method varied from case study to case study depending on the nature of the application and technologies involved.

The last investigative research question is concerned with the evaluation of the chosen approach and what kind of social changes or impact the deployment and availability of such an application has.

**RQ6: How can the success of ICT mediated social interactions be evaluated and measured and how does this change the social experience of a particular public urban place for different users?**

To answer the first part of this question, the application had to be deployed and made available to the real world and used in real urban public places. Each software application was also used as a data collection tool, logging data about software usage and interaction. This kind of data logging enables conclusions e.g.: how often, how long, and to what extend has the application been used. Furthermore, investigative research question 6 was answered with the help of the
3.1. CASE STUDY METHODOLOGY

Same data collection method that was used to answer investigative research question 5.

Figure 3.2 visualises the general methodological approach within each case study. The methods employed for data collection and analysis vary from case study to case study due to the varying nature of the studied technological intervention. The Capital Music study presented in Chapter 4 includes a paper-based experiment, a user trial, a Wizard of Oz evaluation, semi-structured interviews, and a paper-based survey. The PlaceTagz study presented in Chapter 5 includes a content analysis and semi-structured interviews. The case study involving public urban screens and mobile phone interactions presented in Chapter 6 employs semi-structured interviews, observations, and an online survey. The collected qualitative data has been analysed through arranging data around recurring themes followed by searching patterns and connecting threads (Seidman, 2006). Quantitative data has been analysed using basic statistical methods.

The next section describes in more detail how the influenced user experiences has been designed and evaluated within this PhD thesis. The user experience framework described in the next section also helped to answer investigative research question 6.
3.2 User Experience Framework


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3.2.1 Statement of Contribution

This paper is co-authored with my principal supervisor Assoc. Prof. Marcus Foth and my associate supervisor Assoc. Prof. Dian Tjondronegoro. I’m responsible for the entire draft of this publication. The supervisory team provided editorial guidance, feedback, and advice. Therefore, the intellectual contribution of the supervisory team is acknowledged and reflected through the co-authorship of this paper.

3.2.2 Preamble

The purpose of the following paper is to describe and discuss the construction of a user experience framework, which has been applied within the case studies presented in Chapter 4, 5, and 6. This paper is a response to the missing common definition of the term user experience as well as its scope and methods to study them (Bargas-Avila and Hornbæk, 2011, Battarbee and Koskinen, 2005, Law et al., 2009). The framework recategorises the existing elements of user experiences under the urban informatics notions of people place and technology and proposes guiding questions while designing applications to be used in public urban places as well as providing an overview of existing tools to evaluate certain elements of the experience such application might create.
3.2. USER EXPERIENCE FRAMEWORK

3.2.3 Introduction

The majority of the world’s population now lives in cities (UnitedNations, 2008) resulting in an urban densification requiring people to live in closer proximity and share urban infrastructure such as streets, public transport, and parks within cities. However, “physical closeness does not mean social closeness” (Wellman, 2001, p. 243). Whereas it is a common practice to greet and chat with people you cross paths with in smaller villages, urban life is mainly anonymous and does not automatically come with a sense of community per se. (Wellman, 2001, p. 228) defines community “as networks of interpersonal ties that provide sociability, support, information, a sense of belonging and social identity.”

While on the move or during leisure time, urban dwellers use their interactive information communication technology (ICT) devices to connect to their spatially distributed community while in an anonymous space. Putnam (1995) argues that available technology privatises and individualises the leisure time of urban dwellers. Furthermore, ICT is sometimes used to build a “cocoon” while in public to avoid direct contact with collocated people (Bassoli et al., 2007, Crawford, 2008, Mainwaring et al., 2005). Instead of using ICT devices to seclude oneself from the surrounding urban environment and the collocated people within, such devices could also be utilised to engage urban dwellers more with the urban environment and the urban dwellers within.

Urban sociologists found that “what attracts people most, it would appear, is other people” (Whyte, 1980, p. 19) and “people and human activity are the greatest object of attention and interest” (Gehl, 1987, p. 31). On the other hand, sociologist Erving Goffman describes the concept of civil inattention, acknowledging strangers’ presence while in public but not interacting with them (Goffman, 1966). With this in mind, it appears that there is a contradiction between how people are using ICT in urban public places and for what reasons and how people use public urban places and how they behave and react to other collocated people. On the other hand there is an opportunity to employ ICT to create and influence experiences of people collocated in public urban places.

The widespread use of location aware mobile devices equipped with Internet access is creating networked localities, a digital layer of geo-coded information on top of the physical world
CHAPTER 3. METHODOLOGY

(Gordon and de Souza e Silva, 2011). Foursquare.com is an example of a location based social network (LBSN) that enables urban dwellers to virtually check-in into places at which they are physically present in an urban space. Users compete over ‘mayorships’ of places with Foursquare friends as well as strangers and can share recommendations about the space. The research field of Urban Informatics is interested in these kinds of digital urban multimedia augmentations and how such augmentations, mediated through technology, can create or influence the UX of public urban places. “Urban informatics is the study, design, and practice of urban experiences across different urban contexts that are created by new opportunities of real-time, ubiquitous technology and the augmentation that mediates the physical and digital layers of people networks and urban infrastructures” (Foth et al., 2011, p. 4). One possibility to augment the urban space is to enable citizens to digitally interact with spaces and urban dwellers collocated in the past, present, and future. “Adding a digital layer to the existing physical and social layers could facilitate new forms of interaction that reshape urban life” (Kjeldskov and Paay, 2006, p. 60).

This methodological chapter investigates how the design of UX through such digital place-based mobile multimedia augmentations can be guided and evaluated. First, we describe three different applications that aim to create and influence the urban UX through mobile mediated interactions. Based on a review of literature, we describe how our integrated framework for designing and evaluating urban informatics experiences has been constructed. We conclude the chapter with a reflective discussion on the proposed framework.

3.2.4 Subject of Study

During a three-year study, three software applications have been developed aiming to create and influence the experience of collocated people in urban public places through digital place-based mobile multimedia augmentations and anonymous mobile mediated interactions between collocated urban dwellers who congregate in the past, present, or future.

Capital Music (see Chapter 4) is a mobile application designed for iOS, enabling collocated people to listen to their music as usual but also sharing a patchwork of the coverart of the songs currently played in the vicinity. Users can anonymously exchange messages based on viewing
other people’s song choices. Figure 3.3 visualises the user interface of Capital Music.

Sapporo World Window (see Chapter 6) is an interactive social media mash-up deployed in a newly built urban public underground space in Sapporo, Japan. The project utilises ten public screens and mobile phones of urban dwellers. Sapporo World Window enables users to share their favourite locations with locals and visitors through integrating various social media contents into a coherent screen presentation. Figure 3.4 visualises one screen of the Sapporo World Window system with the respective mobile website providing additional information to the promoted location.

The PlaceTagz project (see Chapter 5) investigates how physical artefacts in public urban places can be utilised and combined with mobile phone technologies to facilitate interactions. PlaceTagz are QR codes printed on stickers linking to a digital message board enabling collocated users to interact with each other over time resulting in a place-based digital memory. PlaceTagz are deployed through removable stickers placed on the walls of public toilets as a digital alternative to toilet graffiti. Figure 3.5 visualises PlaceTagz and a respective mobile website after scanning the QR code as well as PlaceTagz attached to various public urban spaces.
Figure 3.4: Sapporo World Window
Figure 3.5: PlaceTagz
All three projects add a digital layer to the physical urban environment, enabling collocated people to anonymously interact with each other and the specific information they share. These projects are in response to the question ‘how can ICT be applied to create and influence the UX in public urban places?’. The study requires a methodology that assesses how the UX is influenced by these applications and their specific interaction qualities.

3.2.5 Review of the User Experience Literature

HCI research largely focussed on usability studies to evaluate activities such as task completion time and ease of use of software applications designed to fulfil given work tasks. The term “experience” is widely used to describe various aspects of HCI that go beyond the usability of work-related products and especially used when focusing on the UX concerning interactive consumer products. Garrett (2003) states that UX is not about how products tackle a problem to achieve a solution they were made for but rather, UX is about how products behave when people actually use and interact with them. While the ISO FDIS 9241-210:2009 norm on ergonomics of human system interaction defines UX as “a person’s perceptions and responses that result from the use or anticipated use of a product, system or service,” recently published studies in UX research highlight the lack of a common definition for UX, e.g. Bargas-Avila and Hornbæk (2011), Battarbee and Koskinen (2005), Law et al. (2009).

Alben (1996, p. 12) defines experience as “all the aspects of how people use an interactive product: the way it feels in their hands, how well they understand how it works, how they feel about it while they’re using it, how well it serves their purposes, and how well it fits into the entire context in which they are using it.” Alben (1996) states six characteristics, which directly influence the quality of experience, and two characteristics, which indirectly influence the quality of experience through the product designers. Direct characteristics are needs, learnability and usability, appropriation, aesthetics, mutability, and manageability. Indirect characteristics are the understanding of users and an effective design process.

Hassenzahl and Tractinsky (2006) argue that UX research should go beyond the instrumental and address surprise, diversion, or intimacy. UX should consider emotions in terms of joy, fun, and pride as well as the experiential, which means that a product is used in a specific situation
resulting in the experience. “UX is about technology that fulfils more than just instrumental
needs in a way that acknowledges its use as a subjective, situated, complex and dynamic
encounter. UX is a consequence of a user’s internal state (predispositions, expectations, needs,
motivation, mood, etc.), the characteristics of the designed system (e.g. complexity, purpose,
usability, functionality, etc.) and the context (or the environment) within which interaction
occurs (e.g. organizational/social setting, meaningfulness of the activity, voluntariness of use,
etc.)” (Hassenzahl and Tractinsky, 2006, p. 95)

McCarthy and Wright (2004) developed a framework to analyse experience with technology.
The framework consists of four threads: (1) Compositional: “How do the elements of an ex-
perience fit together to form a coherent whole?” - e.g. narrative structure, action possibility,
consequences and explanations of actions. (2) Sensual: “What does the design and texture and
the overall atmosphere make us feel?” - e.g. look and feel of an application. (3) Emotional:
“What emotions color the experience for us?” - e.g. fun, excitement, and frustration. (4) Spatio-
Temporal: “What effects do place and time have on our experience?” - e.g. time speed up or
slow, space may open or close down. Furthermore, it consists of six interrelated sense-making
processes: (1) Anticipating: “We never come to technology unprejudiced.” (2) Connecting: “We
make a judgement in an instant and without much thought.” (3) Interpreting: “We work out
what’s going on and how we feel about it.” (4) Reflecting: “We examine and evaluate what is
happening in an interaction.” (5) Appropriating: “We work out how a new experience fits with
other experiences we have had and with our sense of self.” (6) Recounting: “We enjoy story
telling and make sense of experience in stories.” The framework is designed for interactive
products. However, this research is interested in influencing the UX of public urban places
through digital place-based augmentations and mobile mediated interactions and therefore the
emotional and spatio-temporal threads of the framework are especially interesting: how does
technology change the experience of places and can technology open up public places and
connect the urban dwellers within them to make the space more accessible in a digital way?

Forlizzi and Ford (2000, p. 420) state that “a singular experience is made up of an infinite
amount of smaller experiences, relating to contexts, people, and products.” They created a
framework to understand what influences experiences and dimensions of experiences. Prior
experiences of users, their values, emotions and feelings all influence their experience. A product influences the experience through its usability, quality, aesthetics and so on. Additionally, some products are personal items that have specific meanings to particular users such as a specific golf ball that was used for a hole-in-one shot. The user-product interaction takes place in context influenced by social and cultural factors what requires the designers to “understand the users, products, contexts, and nature of interactions that may happen” (Forlizzi and Ford, 2000, p. 420). The authors describe four dimensions of an experience: (1) sub-conscious experiences that are fluent and automatic experiences such as using the coffee machine, (2) cognitive experiences that require users attention and problem solving skills such as interacting with an unfamiliar software, (3) narrative experiences that force people to think and formalise what they are doing and experiencing, and (4) storytelling experiences that are created through sharing experiences. Forlizzi and Battarbee (2004) describe three types of user-product interactions: (1) fluent interactions enabling automated interactions such as riding a bike, (2) cognitive interactions requiring problem solving skills, and (3) expressive interactions creating a relationship with a product. Additionally Forlizzi and Battarbee (2004) differentiate between three types of experiences: (1) experience, a constant stream of information while interacting with the world, (2) an experience, an interaction with the world which can be named, and (3) co-experience, which “reveals how the experiences an individual has and the interpretations that are made of them are influenced by the physical or virtual presence of others” (Forlizzi and Battarbee, 2004, p. 263). Battarbee and Koskinen (2005) criticise that current UX research mostly focuses on the individual and does not consider experiences that are created together. The term co-experience is used “to describe experiences with products in terms of how the meanings of individual experiences emerge and change as they become part of social interaction” (Battarbee and Koskinen, 2005, p. 7).

The definitions show that emotional attributes such as enjoyment, contextual attributes such as place and environment, as well as the social setting have to be taken into account when conducting HCI research. Furthermore, existing definitions discuss products, services, or interfaces. However, this research is interested in designing and influencing the UX in public urban places through digital place-based mobile multimedia augmentations and mobile mediated interactions. In a broader sense, this research creates applications that mediate the UX by
augmenting the urban space rather than creating a UX isolated on the mobile device. This urban UX is influenced by people who are collocated in the past, present, or future interacting with each other in an anonymous way mediated through their mobile device resulting in the creation of a digital layer on top of the geographical space. “People create, elaborate, and evaluate experiences together with other people, and products may be involved as the subject, object or means of these interactions” (Battarbee and Koskinen, 2005, p. 15).

The literature review highlights that various attempts have been made to define and scope diverse types of UX. Additionally, having in mind that a variety of variables before, during, and after application usage can influence a user’s experience is further contributing to the challenge of systematically studying them. This methodological chapter integrates the various attempts of previous research into a unified framework providing guidelines for researchers to design and evaluate the UX of digital place-based mobile multimedia augmentations and mobile mediated interactions.

3.2.6 Framework Construction

Given the lack of a common definition of UX and how to design or evaluate them, we integrated the findings from the literature review in order to create our own framework to guide the design and evaluation of Urban Informatics interventions enabling mobile mediated interactions.

The Urban Informatics definition highlights three influential factors to study, design, and practice the urban experience: real time ubiquitous technologies, people networks, and urban contexts and infrastructures (Foth et al., 2011). Place and location are playing a central role in Urban Informatics research and are the focal point of investigation. The aim is to create and influence the urban UX through technological interventions used in public urban places. Rather than focusing on the technological intervention itself, we are interested in how the combination of people, place, and technology can form new UX in an integrated way. Therefore the framework utilises the people, place, and technology notions of urban informatics as a starting point of investigation. Some of the existing UX definitions use similar categories whereas in our approach we specifically use the term place as context of interaction:

- User’s internal state, characteristics of the designed system, context within the interaction
Figure 3.6: Aggregated elements of UX (Alben, 1996, Arhippainen and Tähti, 2003, Forlizzi and Ford, 2000, Hassenzahl and Tractinsky, 2006, McCarthy and Wright, 2004) recategorised under the people, place, and technology categories occurs (Hassenzahl and Tractinsky, 2006)

- Contexts, people, products (Forlizzi and Ford, 2000)
- People and technology (McNamara and Kirakowski, 2006)
- People, products, context (Alben, 1996)

The place category investigates the possibilities of digital layers and augmentations of the particular place. Is the deployed application suitable for a specific public urban place and do the interaction possibilities align to current norms and practices of that place? What possibilities for digital augmentations and mobile mediate interactions does the place offer? How do other collocated people and the used technology influence the perception of place? Gordon and de Souza e Silva (2011) state that experiences of urban spaces always have been mediated through technologies such as buildings, cars and streets but new ubiquitous and location aware technologies add additional possibilities to influence this experience. The technology section is about the characteristics, functionality, and usability of the deployed urban informatics interventions. The people section focuses on how people feel about the technology used in a specific place. Does the application enable sociality, support positive emotions, and what kinds of feelings are triggered?
3.2. USER EXPERIENCE FRAMEWORK

The various elements of UX mentioned in literature have been collected and recategorised under the people, place, and technology notions of Urban Informatics. This approach is visualised in Figure 3.6 and shows a wide variety of elements within each category. Figure 3.6 also illustrates that the existing UX frameworks emphasise the user and the technology. Place or context of use is not always considered in the existing literature. However, in having a technological intervention in a public urban place with the aim to create and influence an experience, people are the object of interest while place is the focal point of investigation whereas technology is the mediator of the experience.

The elements visualised in Figure 3.6 are very broad in nature. An Urban Informatics intervention will most likely not require all of them to be considered during a study. For example, having a mobile application as the technological subject of study, the researcher will not be able to influence or be interested in investigating how the size or weight of the mobile device resonates with the UX. Therefore, the next step in the construction of the framework is the elimination of elements irrelevant for our study. Table 3.1, Table 3.2, and Table 3.3 in the following subsections list the remaining elements after the elimination process, categorised within the people, place, and technology notions.

The following subsections further discuss each category in more detail through proposing investigative questions for each element within the category while suggesting some methodological tools and frameworks for study.

3.2.6.1 Place

A starting point for an Urban Informatics study should begin with its context of use, the place following an observation of how people use the location. An ethnographic approach can help “to develop a thorough understanding of current work practises as a basis for the design of computer support” (Simonsen and Kensing, 1997, p. 82). Furthermore, ethnography aims “to see activities as social actions embedded within a socially organised domain and accomplished in and through the day-to-day activities of participants” (Hughes et al., 1995, p. 58). In the context of Urban Informatics research, work practice refers to how people use ICT devices during day-to-day activities. Day-to-day activities refer in this research to the time people spend at urban public
It is important to identify what kinds of activities take place in the analysed space and of what kind of nature the activities are. For example, are people just using the place to traverse through the city or as a third place to meet friends or strangers between home and work? Are people mostly alone or accompanied by people and during what time(s) is the place mostly used? Table 3.1 lists the relevant elements in the place category providing guidelines to use while observing the space. The elements and questions stated in Table 3.1 should be considered to inform the design and purpose of the application. After application development, the elements mentioned in the framework design by McCarthy and Wright (2004) should be considered to investigate the spatio-temporal influence of the experience of people in the public urban place.

Answering the questions stated in Table 3.1 will help to design applications supporting mobile mediated interactions suitable to a specific public urban place. Urban Informatics intervention should align to current social practices and behaviour of people in public urban places rather than creating new ones (Pedersen and Valgård, 2004). Therefore, studying the place and the applications’ context of use are vital factors in influencing the UX. The overall aim of answering the questions while studying the place is, what kind of data can be collected by urban dwellers and utilised in an Urban Informatics intervention.

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meaningfulness of the activities in the place</td>
<td>Are the activities in the place in the nature of business, pleasure, idling, or other settings?</td>
</tr>
<tr>
<td>Organisational/social setting</td>
<td>What kinds of activities are accomplished in the organisational and/or social setting?</td>
</tr>
<tr>
<td>Fashion</td>
<td>What is ‘in fashion’ according to the place?</td>
</tr>
<tr>
<td>Habits</td>
<td>What are the habits in the place?</td>
</tr>
<tr>
<td>Norms</td>
<td>What are the norms in the place?</td>
</tr>
<tr>
<td>Time of mobile mediated interaction</td>
<td>When does the interaction between urban dwellers occur? Are they synchronous, asynchronous, or both</td>
</tr>
<tr>
<td>Place of mobile mediated interaction</td>
<td>Where does the interaction take place? What kind of place is it? What are the entry barriers? (if any)</td>
</tr>
<tr>
<td>Accompanying persons</td>
<td>Do other persons usually accompany people or are people rather by themselves?</td>
</tr>
</tbody>
</table>

Table 3.1: Elements in the place category
### 3.2. USER EXPERIENCE FRAMEWORK

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>What is the purpose of the application? Why should someone use it?</td>
</tr>
<tr>
<td>Functionality</td>
<td>Is the functionality sufficient to fit its purpose?</td>
</tr>
<tr>
<td>Complexity</td>
<td>Is the software complex enough to fulfil its task without hindering usability?</td>
</tr>
<tr>
<td>Usability</td>
<td>Is the software easy to use?</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>Is the designed technology visually pleasing? Does the design support usability?</td>
</tr>
<tr>
<td>Acceptance</td>
<td>Does the application suit the place and support current social practices?</td>
</tr>
</tbody>
</table>

Table 3.2: Elements in the technology category

#### 3.2.6.2 Technology

After analysing the place and its elements as listed in Table 3.1 the technology section provides guidelines for developing an application deployed in the analysed location. Table 3.2 lists the elements in the technology section.

First of all, the results of the ethnographic observations need to be analysed. The results should inform system development, which utilise the available data and location information as well as available ICT devices used in the place. For the Capital Music application, we observed public transport users and selected music listeners’ song choices and their mp3-players and mobile phones for an Urban Informatics intervention.

To ensure that the purpose, functionality, characteristics, and complexity of the proposed application align with the needs of the users, they have to be involved during the development process. A user-centred design methodology will ensure that the mobile application meets the needs of the users (Kangas and Kinnunen, 2005). For example we evaluated the concept of sharing of song choices through a paper-based study reported in Section 4.1.

During and after application development, usability studies have to be conducted. Thereby Tractinsky (1997, p. 121) found that “perceptions of interface aesthetic are closely related to apparent usability and thus increase the likelihood that aesthetics may considerably affect system acceptability.” This implies that the visual design of the studied intervention has to be sufficient enough to not hinder usability. Lavie and Tractinsky (2004) developed a measurement
instrument for evaluating perceived aesthetics of computer interfaces. They subdivided aesthetics into “classical aesthetics,” emphasizing clear and ordered designs as well as “expressive aesthetics,” emphasizing designers’ creativity and originality to break common design rules.

The acceptance element in Table 3.2 has been derived from the usefulness element mentioned in Arhippainen and Tähti (2003). Traditional research on technology acceptance models includes perceived usefulness and ease of use of an information system as predictors of how likely a system will be used. Perceived usefulness has been defined as “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989, p. 320). As this research is focusing on hedonic information systems rather than utilitarian systems, “perceived usefulness loses its dominant predictive value in favor of ease of use and enjoyment” (van der Heijden, 2004, p. 695). We added acceptance instead of usefulness to the technology category for this framework consisting of perceived usefulness, ease of use, and enjoyment. Validated items are researched to investigate these variables (van der Heijden, 2004).

### 3.2.6.3 People

“When users are confronted with a product, a process is triggered: First, an apparent product character is constructed. It is a user’s personal reconstruction of the designer’s intended product character. Second, the fit of the apparent character and the current situation will lead to consequences, such as a judgement about the momentary appealingness of the product, and emotional or behavioural consequences.” (Hassenzahl, 2005, p. 33)

Following the observation and analysis of the place and involvement of the user during the design process of the software application, people have to be further considered to generate insights into the quality of the experience created through using the designed application.

A survey on current UX research by Bargas-Avila and Hornbæk (2011) states that the most researched dimensions of UX are emotions and affect, enjoyment, and aesthetics (aesthetics in this framework has been re-categorized into the technology category). Additionally, the authors state that new dimensions such as enchantment, engagement, tangible magic, aesthetics of interaction, and relevance have been proposed to research (Bargas-Avila and Hornbæk, 2011).
3.2. USER EXPERIENCE FRAMEWORK

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements</td>
<td>What are the technological requirements people must master to use the technology?</td>
</tr>
<tr>
<td>Motivation</td>
<td>What motivates people to use the technology? What need does it fulfil?</td>
</tr>
<tr>
<td>Prior Experiences</td>
<td>How do prior experiences influence technology usage?</td>
</tr>
<tr>
<td>Feelings</td>
<td>How do people feel about using the technology?</td>
</tr>
<tr>
<td>Affect</td>
<td>How does the technology affect the user?</td>
</tr>
<tr>
<td>Emotions</td>
<td>What kinds of emotions are created through using the technology?</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>Do people enjoy using the technology?</td>
</tr>
<tr>
<td>Likeability</td>
<td>Do people like the technology?</td>
</tr>
<tr>
<td>Social Interaction</td>
<td>How does the technology support sociability? What kind of social interaction takes place?</td>
</tr>
</tbody>
</table>

Table 3.3: Elements in the people category

This framework proposes a three-fold process to investigate how people experience the technology. First, the application has to be made available in the designated place and be used by real users. The software application itself can be used as a data collection tool, logging data about software usage and interaction. This kind of data logging enables conclusions, for example, how often, for how long, and to what extent has the application be used. Second, as UX is subjective, semi-structured interviews with users is a promising approach to collect qualitative data about how users feel about the application. Thereby, we propose to ask application and place specific questions about how using the developed system influences, changes, and possibly enhances the experience. After the semi-structured interview, a paper-based survey for collecting basic demographic data as well as getting insight into various elements of the UX using the validated items should be applied.

To measure emotions, Huisman and Van Hout (2008) selected eight emotion terms such as joy and sadness, desire and disgust, fascination and boredom, and satisfaction and dissatisfaction to evaluate interactive digital systems. These eight emotion terms are also related to different concepts such as aesthetics or usability. The AttrakDiff (Hassenzahl, 2008) questionnaire provides insights into the pragmatic (effectiveness, efficiency) and hedonistic (e.g. stimulation, identification) qualities of an interactive product. Hassenzahl (2008, p. 322) argues that “[u]sing a product with a particular product character in a particular situation will lead to consequences,
such as emotions (e.g., satisfaction, pleasure), explicit evaluations (i.e., judgements of appeal, beauty, goodness), or overt behavior (approach, avoidance).” Watson et al. (1988) developed and validated two mood scales with 10 items to measure positive affect (interested, distressed, exited, upset, strong, guilty, scared, hostile, enthusiastic, proud) and negative affect (irritable, alert, ashamed, inspired, nervous, determined, attentive, jittery, active, afraid) of peoples’ mood. Watson and Clark (1994) extended the positive affect and negative affect scale and added fear, hostility, guilt, and, sadness as basic negative emotion scales, joviality, self-assurance, and attentiveness as basic positive emotion scales as well as shyness, fatigue, serenity, and surprise as other affective states.

Table 3.3 lists the elements in the people category and the main questions behind each element. We also added social interaction to the framework as this framework is designed to evaluate systems enabling mobile mediated interactions. Battarbee and Koskinen (2005, p. 15) state that “user experiences are created together and are thus different from the user experiences people have alone” and suggest to analyse the interactions which occur between users. The three software applications described in this chapter enable mobile mediated interactions with collocated people who congregate in the past, present, or future. Having interactions in real-time with collocated people rather than over-time with people who have been or will be at the same place might further impact the UX in various ways. Additionally, analysing the interactions is especially important in the field of mobile mediated interactions between collocated people in urban public places as the experience of using such an application is heavily dependent on other application users. For example, a user utilising an application enabling information sharing with collocated people such as Capital Music, the user will have a significantly different experience through using the system if they open the application and no one else is in their surroundings rather than when plenty of users are available with which to interact. Conversely, scanning a PlaceTag with a mobile phone and being the first one to leave a message provides a different UX then finding a stream of messages and joining an existing conversation.

Figure 3.7 summarises the UX framework for designing experiences and investigating the quality or impact of the experience presented in this chapter. As described in this section, the framework proposes to start with an observation of the place following the utilisation of the gathered knowledge to design a technology suitable for the place. All three applications
3.2. USER EXPERIENCE FRAMEWORK

Figure 3.7: User experience framework overview

described in this chapter were used as place-based design interventions and were deployed and made available to users in the designated location followed by in situ user studies and observations. Additionally, logging mechanisms were added to the applications in order to get insights into the co-created experiences of collocated users. Through following the steps described in this section researchers are able to study and explore the quality of the created experience.

3.2.7 Discussion

The chapter proposed steps and guidelines in terms of what kind of research activities should be undertaken in the software design, development, and evaluation phase. However, we do not propose that each single question stated in the people, place, and technology categories have to be strictly followed. Designers have to consider which steps are necessary and valuable for their particular investigation.

The PlaceTagz project, which is deployed in public toilets, does not necessarily require an observation of the place and an analysis of the activities within the place, as usage is obvious. Additionally, usability studies are not necessary as the underlying system uses the commonly known and extensively used Wordpress weblog system. The Sapporo World Window project, which does not necessarily require user interaction with the system itself to be useful and appealing to onlookers, does not necessarily require an in-depth analysis of the meaningfulness of the activities within the place as content is mainly presented to by-passers. Additionally
the acceptance element - how does the application fit into the place and support current social practices - in the place category is not highly relevant as urban screens and displays are more and more commonly used in urban spaces. The Capital Music project, designed for public transport, does not require rich aesthetics studies as the visual component of the application mainly focuses on the album artworks of the songs currently played in users’ vicinity.

Additionally, the methods used in the people section can vary from case to case. In general, all applications enabling mobile mediated interactions in public urban places should be evaluated in the real world environment they have been designed for. However, this can be crucial for some Urban Informatics applications.

For Example Capital Music relies on multiple users using the application at the same time in the same space and preferably should not know each other. Enforcing such conditions in a lab environment might not result in realistic results. One way to gather reliable data from users in such conditions could be the utilisation of the Experience Sampling Method (Consolvo and Walker, 2003), adding self-reporting mechanisms into the deployed application. Additionally the Wizard of Oz (WoZ) method (Höysniemi and Read, 2005) could be utilised whereas the researcher is simulating other application users in a lab environment. This approach has the benefit that participants are available for semi-structured interviews after application usage. Furthermore, using an early prototype in combination with a WoZ study can closely simulate a contextual evaluation (Reilly et al., 2005).

Sapporo World Window on the other hand is deployed in a busy urban space. Time-lapse observations of the public urban space (Whyte, 1980) in combination with log files of screen interaction and follow-up structured interviews or questionnaires can help to get a deeper understanding of the impact of the created UX, for example in Brynskov et al. (2009).

As already mentioned above, the PlaceTagz study, which is deployed in public toilets, does not allow observations or interviews due to the nature of the place. People using the place and the technology are difficult to access without making them feel uncomfortable. On the other hand each PlaceTag collects text-based messages left by users, varying in context and content. Furthermore, during the data collection period some users left their email address in the form provided for writing comments. Conducting a content analysis in combination with
interviewing people who left their contact details can give further insights into the quality of the created experience.

### 3.2.8 Conclusion

This chapter presented our framework for creating and evaluating UX under the umbrella of Urban Informatics. We are aware that much theoretical research has been done in researching UX. However, given the lack of a common definition, elements, scope, and methods for creating and evaluating them, we reviewed the relevant literature in UX and recategorised them into the people, place, and technology notions of Urban Informatics.

This chapter has focused on a methodological approach for the study of UX in urban public spaces. It is written as a response to the inconsistent use and the intangibility of the term ‘user experience’ and the resulting questions such as what is part of an experience, how to design, influence and how to assess a UX. Having three applications aligned and tailored along this framework we hope to inspire other researchers to practically study, design, and evaluate UX in such an interconnected approach of people, place, and technology.

### 3.2.9 Acknowledgment

This research was carried out as part of the activities of, and funded by, the Smart Services Cooperative Research Centre (CRC) through the Australian Government’s CRC Programme (Department of Innovation, Industry, Science and Research).
Chapter 4

Case Study 1: Capital Music

The introduction in Chapter 1, the literature review in Chapter 2, and the methodology in Chapter 3 set the stage for this PhD thesis. This case study chapter presents the first design intervention titled Capital Music. Capital Music has been designed for being used while spending time in public transport and enables users to listen to their music as usual on their music players, but also visualises the album artworks of currently played songs in vicinity. Users are also given the opportunity to digitally interact with each other in form of sending ‘like’ and text messages in an anonymous way.

The investigative questions (see Chapter 3) that guide each case study have been answered as follows. Investigative research question 3 is interested in what kind of non-privacy sensitive data can be utilised at a particular urban setting. Ethnographic observations revealed that music currently played on the mobile devices of urban dwellers could be utilised in the public transport scenario due to the fact that many people listen to music while commuting.

Investigative research question 4 is concerned with how the available data can be utilised to deliver content and services to users collocated in the same urban setting in order to facilitate meaningful digitally mediated social user interaction. People who are using public transport are sharing a confined space for a specific amount of time. Therefore, Capital Music augments this confined space and its inhabitants through sharing the song selections of individuals and aggregating them in the application user interface.

Investigative research question 5 is related to what criteria need to be met in order to establish
and maintain digitally mediated interaction between collocated users. Capital Music employs a completely anonymous approach only utilising a nick name and the currently played song and therefore is focussing on the data which is shared rather then the user.

And finally, investigative research question 6 asks how the success of ICT mediated social interactions can be evaluated and measured and how does that change the social experience of a particular public urban place for different users. A user study has been conducted utilising the Wizard of Oz method to simulate a real world study scenario for the user experience evaluation. Thereby the study revealed that Capital Music raises the awareness towards collocated people and piques users curiosity as well as enabling users to share, discover, and recommend music to others in an anonymous way.

This chapter presents in Section 4.1 how the concept and design of Capital Music has been evaluated through a paper-based study. Section 4.2 describes the user experience evaluation and discusses the results applying the framework described in Section 3.2.
4.1 Designing Capital Music


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**Status:** Published

4.1.1 Statement of Contribution

This paper is co-authored with my principal supervisor Assoc. Prof. Marcus Foth and my associate supervisor Assoc. Prof. Dian Tjondronegoro. I’m responsible for the entire draft of this publication. The supervisory team provided editorial guidance, feedback, and advice. Therefore, the intellectual contribution of the supervisory team is acknowledged and reflected through the co-authorship of this paper.

4.1.2 Preamble

The following paper has been accepted, presented, and published at 6th Nordic Conference on Human-Computer Interaction (NordiCHI 2010) and presents the motivation behind Capital Music, an ethnographic immersion, as well as an initial user study evaluating the concept of sharing music with collocated people.

4.1.3 Abstract

Using information and communication technology devices in public urban places can help to create a personalised space. Looking at a mobile phone screen or listening to music on an MP3 player is a common practice avoiding direct contact with others e.g. whilst using public transport. However, such devices can also be utilised to explore how to build new meaningful
connections with the urban space and the collocated people within. We present findings of work-in-progress on Capital Music, a mobile application enabling urban dwellers to listen to music songs as usual, but also allowing them to announce song titles and discover songs currently being listened to by other people in the vicinity. We study the ways that this tool can change or even enhance people’s experience of public urban spaces. Our first user study also found changes in choosing different songs. Anonymous social interactions based on users’ music selection are implemented in the first iteration of the prototype that we studied.

**Keywords:** Context Sharing, Music, Public Places, Urban Informatics

### 4.1.4 Introduction

Life in the city is busy. We travel from one place to another and meet people at different locations for social, business, or entertainment purposes. Thereby, city dwellers cross streets, places, buildings, and other public and anonymous urban places using cars, public transport, or even just walk to their destination usually accompanied by Information and Communication Technology (ICT) devices. Urban dwellers use ICT devices such as mobile phones or music players as “cocooning” items in public urban places to create their own personal space and therefore avoiding direct contact with surrounding strangers (Mainwaring et al., 2005). Even without a signal, such as in underground railways, people tend to use their devices for different purposes such as playing games, listening to music, or deleting old text messages (Bassoli et al., 2007). While travelling to work, during idle time, or on the way home, people listen to songs to get into the desired mood, create a soundtrack for an activity, or just relax after a hard day at work.

Human beings are naturally curious about their surrounding social environment as well as the urban space and the collocated people within. Street cafés arrange their chairs and tables in a way to enable better observations of passing people and the actions which take place on the streets. On the other hand, recent web services such as Facebook.com and Twitter.com are highly successful, because they enable users to express thoughts and activities on their personal profile and in turn browse profiles of other people in their social circle for comparison, social awareness, and fun.
4.1. DESIGNING CAPITAL MUSIC

This study sets out to explore if the sharing of “lightweight information” (such as song choice) in the physical space, mediated through location-aware ICT devices, can enhance the experience of people in public urban places. We explore if the collected data can be used to infer on how a location can affect the mood of its visitors, or on how its visitors can influence each other’s music selection. Instead of secluding oneself from the surrounding environment, personal mobile devices could then be used to connect - or simply associate - with other people in space utilising music as a common ground of interaction. We would like to support the process of “finding sameness in a sea of otherness and connecting like with like” (Crawford, 2008, p. 89).

Our study seeks to foster people’s connection to place by visualising real-time context data of collocated people and providing an opportunity for digitally mediated social user interaction based on this non-privacy-sensitive information. According to Pedersen and Valgård (2004), Urban Social Technology - which is defined as IT used in urban environments for a social purpose that goes beyond phone calls and text messages - should align with current social practices and behaviour rather than creating new ones. Therefore, Capital Music follows a simple approach to enhance the experience of people in public places while listening and interacting with their devices. Capital Music enables urban dwellers to listen to their songs as usual, but the application furthermore visualises the songs currently played in the user’s vicinity in a “mobile music cloud.” Additionally, users are offered anonymous and private means for social interaction based on currently played songs of collocated people.

The remainder of this paper describes the design process of Capital Music including our first user study. The analysis of our preliminary findings informs the first prototype. An outline of future research work concludes the paper.

4.1.5 Design Process

The design and development of Capital Music has been influenced by a “quick and dirty” ethnographic approach (Hughes et al., 1995) and a paper based evaluation of the application concept.
4.1.5.1 Site Observation

Our university offers a free shuttle bus for staff and students to travel between two campus locations. The shuttle busses leave every 10 minutes during the semester and the travel time is around 15 minutes. To gain a general picture of how people spend their time on the bus, what kind of devices they use, and if social interaction occurs, we observed 63 people in 4 busses over 2 days using the bus service provided by the university.

This basic site observation revealed that university staff and students either listen to music on mobile phones or music players using headphones, interact with their mobile phones doing tasks such as writing text messages or playing games, read some kind of newspaper or textbooks, or just stare out of the window if they don’t interact or use any devices. Furthermore, most of the observed people switched their focus from their device they are engaged with to the bus window back and forth. We saw that only as the bus stops and people get off their seats, do people for the first time look around, explore their environment and sometimes discover other people on the bus. Some of the music listeners sub-communicated their mood through moving their feet or hands according to the rhythm of their currently played song. Others listened to music that loud that collocated people could at least guess the genre. Some of the students openly displayed their music taste through their personal appearance and choice of clothing.

Social user interaction mainly took place when people travel in groups. We could observe only one case in which two passengers interacted with each other who didn’t know each other. One student carried a large architectural model, which another student used as an icebreaker to start a conversation. He commented on the model, but the other student stalled the conversation with a single word response.

Mobile music listeners are an attractive user group for this study, because “music also plays a role in our social lives - talking about, displaying, swapping and sharing music are all ways through which we express who we are and interact with others” (O’Hara and Brown, 2006, p. 3). Furthermore, research on music psychology has shown that “the social functions of music are manifested in the [...] management of self-identity, interpersonal relationships, and mood in everyday life” (Hargreaves and North, 1999, p. 79). With Capital Music, we try to address the question, how and to what extent the collective visualisation of songs currently played in
a user’s vicinity, can digitally augment the public space with lightweight social data, and how this changes people’s social experience of public spaces.

4.1.5.2 Initial User Study

We conducted a first user study to test the concept of Capital Music and the sharing of currently played songs with unknown collocated urban dwellers. To inform the design of the application we conducted an experiment with 6 participants, 5 university students and 1 university staff member aged between 23 and 36, 5 male and 1 female.

Participants brought their own music player containing their personal music library to the study. We then introduced the scenario that they are travelling with the shuttle bus to the university’s other campus. Participants got the task to select a song from their music library and listen to it with their headphones as they usually would when they are using the bus. After two minutes the participants were given post-it notes and pens and were instructed by a sign placed in the middle of the desk to write down the artist and title of the currently played song without showing others. We collected the notes, and stuck them in random order on a whiteboard visible for everyone (see Figure 4.1). After all participants reviewed the whiteboard display, we asked them...
to select another song and write it down. These notes were stuck on top of the previous ones. We conducted another round of song selection with anonymously announcing song choices and then conducted a group discussion with semi-structured interviews.

Participants said that their first song selection was either based on mood, musical preferences, or they just continued the last played song in their music playlist. We asked them how they felt when their first song selection was publicly displayed on the whiteboard without prior knowledge while selecting the song. One participant summarised it as

“You do feel like oh my music is up there. What’s going on maybe I should chose a different song. [laughs] What are all those people thinking about my song.”

We then wanted to know if and how the fact that other people could see what they are listening to influenced their second and third song selection. Three participants said, they simply played the songs they like. The other participants explained that they wanted to select a good song or a song they can recommend to others. One participant mentioned:

“It didn’t really influence me. It did a little bit. I think the third time it did because [...] I can share my music with these other people. Maybe something they haven’t heard. So the third song was something they might not have heard before so I put it up there [whiteboard] so we can see it.”

The participants also discussed that the title of a song would influence their song selection when sharing with others, because they assumed that someone else who doesn’t know that particular song would judge their music choice based on the available textual information. A graphical representation of music in terms of album artworks has not been considered during this paper trial. However, the answers show how the participants felt more responsible about the music selection they share with collocated people.

We asked the study participants if they would feel comfortable sharing their currently played song with unknown collocated people. Two people didn’t feel comfortable enough to share, because they are not used to such an approach or don’t feel comfortable in general interacting with complete strangers. The remaining study participants were keen to share, as long as it is a song they feel is appropriate to share. Two participants from overseas mentioned that they would not share music from their home country as they feel that would be inappropriate in a
4.1. DESIGNING CAPITAL MUSIC

different cultural context. Thereby they expressed interest that they would like to decide which song they share and which not. Additionally one participant mentioned:

“I think it would be fun trying to work out who’s listening to what.”

Furthermore we asked if they would like to comment on song selections of unknown collocated people if they could do that in an anonymous way without revealing who they are. Surprisingly, the person who didn’t feel comfortable about sharing, because he was not used to it, said he would comment on song selections if the artist is not that well known. Other participants mentioned that they would send “I like” messages such as those on Facebook. Asked how he would feel if he received a “Like” message, one participant said he wanted to talk to that person if he listened to a less well known artist. Other participants mentioned that they would like to extend the song choice sharing to social networking sites:

“Yeah 10 people liked my song while I was on the bus. That’s cool. I mean I would share it that way.”

At this stage of the discussion we presented the concept of Capital Music. Participants concordantly acknowledged that Capital Music would be a useful and fun application to enhance their enjoyment of bus rides.

“It’s a nice interaction which has been added to it [listening to music]. And a lot of people listen to music today and the portability of such music devices and taking it to a next level and creating a social network around it about what you listening to is kind of nice.”

“I’d like to be able to listen to a section of a song because I think it is something really nice about listening to something at the same time as someone else.”

After we introduced the Capital Music concept, we asked the participants if they would purposefully select certain songs in order to showcase their music taste in public and thus express parts of their identity. Participants mentioned that their music selection would be based on the received feedback from other application users. One participant summarised it as follows:

“I think we all want to share the most popular song that most people in the bus would like.”

We asked if there was an occasion where they would like to reveal parts of their identity while interacting with Capital Music. Participants confirmed that they would like to reveal e.g., their
email address or a photo, only to a particular person, if they had an ongoing interaction based on their music. However, one participant also mentioned:

“I think I wouldn’t. The beauty lies in the anonymity.”

The paper-based evaluation revealed that participants are more aware of their own music selection in terms of appropriateness of sharing, recommendations for others, and popularity to receive social reactions from collocated people.

4.1.6 Designing Capital Music

The outcomes of the initial user studied influenced the design and development of the first prototype iteration of Capital Music. The application has been developed for iPhone, iPad and iPod Touch devices using the Apple iPhone SDK. For the visualisation of songs currently played in the user’s vicinity, we applied a visual approach displaying a mosaic of album cover artworks as shown in Figure 4.2 (a). We assume that the visualisation of album cover artworks instead of textual information stimulates interaction with the application and the discovery of new music. Additionally considering the outcomes of the initial evaluation, we believe that adding a visual component to the textual metadata allows users to get a better glimpse about an unknown song. Application users can tap on an artwork in the main screen to get more information about this song as shown in Figure 4.2 (b). This detailed view also allows users to send a ‘Like’ message or a text message to the respective collocated person. Capital Music enables social user interaction in a completely anonymous way. The application does not require any user subscriptions or profiles. Figure 4.2 (c) shows the text messaging screens after pressing the green speech bubble in the application’s main screen.

To group interactions visualised in the messages view, Capital Music utilises the device name assigned by the owner. However, this could breach users’ privacy beyond what they volunteer to share, or make them feel uncomfortable. Therefore a possibility to specify a nickname has been given. If messages have been exchanged between two users, as shown in Figure 4.2 (d) the specific album artwork is visualised next to the message on which the interaction was based on.
4.1. DESIGNING CAPITAL MUSIC

Figure 4.2: Capital Music user interface
4.1.7 Outlook

Capital Music has been designed as an application to enhance the experience of public urban places. The initial paper based evaluation confirmed that such an approach can change the social experience of a bus trip and influenced the first iteration of Capital Music.

Whilst still under development, setting up a real world situation to test the prototype system is difficult, because the number of study participants for an authentic scenario exceeds a typical lab setup. Additional complexity is added by the need to ensure study participants remain unknown to each other. Therefore, the next evaluation will utilise the Wizard of Oz (WoZ) method simulating other application users to gather usability data followed by semi-structured interviews after application usage to gather insights about the social implications. The realised prototype system in combination with the WoZ method enables us to closely simulate a contextual evaluation (Reilly et al., 2005). Thereby, the wizard will simulate other application users through a web-based interface also monitoring the screen status of the mobile device. After incorporating the outcomes of the WoZ study into a second prototype iteration, a functionality and performance study will be conducted with more simultaneous application users. This study will be conducted in a lab setting to assess the functionality of Capital Music. The final iteration will then be submitted to Apple’s App Store for review and real world application usage, generating a user base, and collecting rich data sets of place based music consumption.

4.1.8 Acknowledgements

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4.2 Evaluating Capital Music


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4.2.1 Statement of Contribution

This paper is co-authored with my principal supervisor Assoc. Prof. Marcus Foth and my associate supervisor Assoc. Prof. Dian Tjondronegoro. I’m responsible for the entire draft of this publication. The supervisory team provided editorial guidance, feedback, and advice. Therefore, the intellectual contribution of the supervisory team is acknowledged and reflected through the co-authorship of this paper.

4.2.2 Preamble

The following paper describes an in-depth evaluation of Capital Music aiming to provide insights into the created user experience of anonymous mobile music sharing with collocated people in public urban places. The study applies a mixed approach of collecting and analysing qualitative and quantitative data applying tools and methods described in Section 3.2. The paper provides first insights into how mobile mediate interactions can influence the experience of people in public urban places.

4.2.3 Abstract

This paper presents Capital Music, a mobile application enabling real-time sharing of song choices with collocated urban dwellers. Due to the real-time, location-based peer-to-peer approach of the application, a user experience study was performed utilising the Wizard of Oz
method. The study provides insight into how sharing non-privacy sensitive but personal data in an anonymous way can influence the user experience of people in public urban places. We discuss the findings in relation to how Capital Music influences the process of “cocooning” in public urban places, the practice of designing anonymous interactions between collocated strangers, and how the sharing of song choices can create a sense of commonality between anonymous users in the urban space. The outcomes of this study are relevant for future location-based social networking applications that aim to create interactions between collocated strangers.

**Keywords:** Context Sharing, Music, Public Places, Urban Informatics

### 4.2.4 Introduction

While spending time in public urban places, urban dwellers may use their Information and Communication Technology (ICT) devices as a way to “cocoon” to create their own personal space (Crawford, 2008). Whether purposefully or not, this can lead to avoiding direct contact with surrounding strangers (Mainwaring et al., 2005). Even without a mobile phone reception, such as in underground railways, people tend to use their devices for different purposes such as playing games, listening to music, or deleting old text messages (Bassoli et al., 2007). “Mobile engagement of this sort is so clearly about (among other things) occupying a cocoon of private space while in public that the mobile phone can function in many cases as [...] effectively closing off interaction with anyone not already on one’s contact list” (Crawford, 2008, p. 93). The recent success of social media such as Facebook and Twitter are contributing to this trend of “cocooning” through mobile versions of their services. This form of engagement while in public enables users to connect to their existing social circle rather than engage with people in close physical proximity. However, human beings are naturally curious about their surroundings and the collocated people nearby. For example, some street cafés arrange their chairs and tables in such a way as to enable their customers better observations of pedestrians and the actions that take place on the streets. Even passive contact with strangers is perceived as rewarding and attractive when spending time in public urban places (Gehl, 1987, Whyte, 1980), or as Aristotle stated in *Politics*: “Man is by nature a social animal.” The fact that people sometimes tend to use ICT devices as cocooning items while being in public but also occasionally use public urban places to be near other people inspired this investigation into ways that ICT can be utilised to
combine both processes: being able to create a cocoon but also provide possibilities to be in contact with collocated people.

In 1979, Sony introduced the Walkman®, a portable cassette player allowing people to listen to their music while on the move. In *The Walkman Effect* Hosokawa (1984) describes how the invention of the portable music device enables people to escape the urban soundscape and create their “individual zone of listening” while being in public. These days, people listen to songs on mobile devices to suit their mood or get into a desired mood, create a soundtrack for an activity, or just to relax, while commuting, during idle time, or exercise at the gym. More than 20 years later and after the invention of the mp3 format and the iPod, Bull (2007, p. 29) argues that “iPod culture represents a world in which each person is locked into their own interiority, moving to their own rhythm and motivated by their personalised auditory soundtrack to urban life.” Hosokawa (1984, p. 177) describes that “[u]ntil the appearance of the walkman, people had not witnessed a scene in which a passer-by ‘confessed’ that he had a secret in such a distinct and obvious way. They were, in fact, aware that the user was listening not only to something secret but also to the secret itself, a secret in the form of mobile sound: an open, public secret.”

Instead of secluding oneself from the surrounding environment, portable music devices can also be used to connect - or simply associate - with other people in space utilising music as a common ground for interaction. The widespread use of location-aware and internet enabled devices creates unique opportunities for urban dwellers to listen to their music as usual while being in public and “zone out” of the urban environment but also publish and share one’s song choices with collocated people and thereby augment the urban space with such data disclosing the “open, public secret” in a digitally mediated manner.

This study seeks to create a more social and enjoyable feeling while spending time in a public urban place by visualising real-time song choices of collocated people and providing an opportunity for digitally mediated social user interaction based on non-privacy-sensitive data. Urban Social Technology (Pedersen and Valgård, 2004) - which is defined as ICT used in urban environments for a social purpose that goes beyond phone calls and text messages - should align with current social practices and behaviour rather than creating new, potentially artificial ones. Therefore, this design intervention follows a simple approach to influence the experience of people in public places while listening to music and interacting with their devices. The approach
taken by our application, Capital Music, enables urban dwellers to listen to their songs as usual, all the while the album artworks of songs currently played in the user’s vicinity are visualised in a “mobile music cloud” (Figure 4.4 and 4.5). Users are also offered anonymous and private means for social interaction based on currently played songs of collocated people.

With this study, we try to address the question, how and to what extent the visualisation of songs currently played in a user’s vicinity can digitally augment the public space with collective social data, and how this influences the social experience of public urban spaces.

The remainder of this paper is structured as follows. The next section reviews related research on the subject. Afterwards, we briefly illustrate the design process that led to Capital Music including a description of the prototype system followed by a presentation of an initial user trial. The next section describes the methodology of an in-depth user experience (UX) study utilising the Wizard of Oz method to simulate a realistic usage setting. We then present and discuss the results, followed by concluding remarks on the impact of sharing personal but non-privacy sensitive information in public urban spaces.

### 4.2.5 Related Work

There are commercial approaches for music sharing such as *iTunes Home Sharing* (Voida et al., 2005), *Spotify*, or *last.fm*. However, various research projects have been conducted investigating music applications and the sharing of music related data in urban environments. For example, the ethnographically informed project *Undersound* (Bassoli et al., 2007) supports the social phenomena of unspoken exchange, demonstrative engagement, curiosity, and mnemonic narratives in the London Underground providing a mobile application for music exchange. *Undersound* allows artists to upload songs at specific upload points whereas one song can only be uploaded once. Users can download songs from these upload points or from collocated users, browse profiles of users in vicinity, and send messages. While the research is grounded in ethnography, no implementation or evaluation of the *Undersound* concept was conducted.

The *tunA* project (Bassoli et al., 2006) is a Personal Digital Assistant (PDA) application utilising peer-to-peer wireless network connectivity for ad hoc music sharing. *TunA* enables users to listen to their own playlist and display a list of collocated people with their user profiles.
Furthermore, a user can browse playlists of collocated people, tune into music currently played on collocated devices with the ability to bookmark songs, and exchange instant messages for social user interaction. A user study with six study participants who partly knew each other showed that sharing music with tunA could be a fun experience with friends and an icebreaker to interact with new people. However, mobile mediated message exchange was not evaluated in the reported study. BluetunA (Baumann et al., 2007) is the successor project of tunA, utilising Bluetooth instead of wireless network connectivity. BluetunA enables users to select a list of favourite artists or songs and discover who else within proximity shares their music taste. In addition, users can search for other collocated people and explore their specified musical preferences and favourite artists. Furthermore, it is intended that users can exchange messages and obtain recommendations from Web 2.0 online services. The impact of BluetunA has not been evaluated.

The Compass (Tanaka et al., 2007) project utilises mobile phones to exchange music with collocated people. It applies a compass metaphor for the mobile user interface to visualise nearby networks, people, and music. The social network for music exchange is based on the phone’s address book and friends of friend’s connections. If a friend is in close proximity, the Compass displays the direction and distance to walk on the mobile phone’s screen. If both users are within Bluetooth or wireless network transmission range, the application is able to exchange music.

Push!Music (Hakansson et al., 2007) is a mobile application which autonomously exchanges music files with collocated people in the same wireless network based on similar music tastes. Users are also given the opportunity to manually send songs. A two-week user study with five subjects was conducted to measure user satisfaction. Participants enjoyed the exchange of music and had a positive experience while using the system, but were also concerned about receiving too many songs from the autonomous exchange.

The Social Playlist (Liu and Reimer, 2008) is a mobile application enabling friends to create a user-generated radio based on selected songs from different data sources. Based on current mood or activity, user selected music is transferred to a server that generates a music playlist which is streamed to a group of friends. The research conducted has shown that the selection and sharing of songs can create anchor points for follow-up social interactions.
In contrast to Capital Music, all of these projects are either designed for or have been evaluated within a group of friends (Bassoli et al., 2006, Hakansson et al., 2007, Liu and Reimer, 2008, Tanaka et al., 2007), require the creation of user profiles (Bassoli et al., 2007, 2006, Baumann et al., 2007) for collocated music discovery and interaction, or have not been evaluated (Bassoli et al., 2007, Baumann et al., 2007, Tanaka et al., 2007). Capital Music focuses on the music rather than the listeners. It visualises songs that are currently played in the vicinity of users, rather than a visualisation of users themselves.

4.2.6 Designing Capital Music

In addition to a review of other music applications, the design of Capital Music was informed by an initial phase of ethnographic immersion (Hughes et al., 1995). It revealed that music listeners are an attractive user group for this study, because “music also plays a role in our social lives - talking about, displaying, swapping and sharing music are all ways through which we express who we are and interact with others” (O’Hara and Brown, 2006, p. 3). Additionally, research on music psychology has shown that “the social functions of music are manifested in the [...] management of self-identity, interpersonal relationships, and mood in everyday life” (Hargreaves and North, 1999, p. 79).

The ethnographic immersion was followed by a paper-based study in which study participants were gathered in a room and were asked to write down songs that they were listening to on post-it notes. These were then shared with other users in the room by sticking them on the wall. Users then understood that their post-it notes would be shared with others. They were asked to listen to another song and share again. This was found to change the approach to selecting a song. The ethnographic immersion and paper-based study that inform the design and development of Capital Music have been reported elsewhere (see Section 4.1).

4.2.6.1 Prototype System

The mobile application has been developed for iPhone, iPad and iPod Touch devices using the Apple iOS software development kit. Capital Music’s ad-hoc data exchange between collocated people has been realised employing a decentralised peer-to-peer architecture. The Extensible
Messaging and Presence Protocol (XMPP) has been utilised to enable near real-time XML message exchange and presence management for Capital Music users congregating in the same public urban space. After starting Capital Music, the geographical position (longitude and latitude) of the iOS device is sent to a location repository. We currently utilise the location repository of Foursquare.com returning landmarks of various types such as restaurants, bars, bus stops, or parks nearby a user. The results from querying the Foursquare API also contain the distances in meter from the landmarks to the users. If the distance of the landmark is below a specified radius set by the user in the interface, the respective landmarks will be used as a XMPP multi user room. The Capital Music application sends an XMPP message to the server to create the XMPP room, or join it if already existent. The server and its XMPP room standard implementation manages the presence of user sending presence messages as well as sending song updates to the joined multi user rooms. These presence messages and song updates are automatically delivered to all other XMPP room participants whereas the protocol has been extended to fit the purpose of sending song information. While on the move, significant location updates of a user result in repeating the above-described steps of querying the location repository, leaving outdated XMPP rooms, and creating or joining new ones.
Capital Music exchanges metadata such as song title, artist, album name, and genre as well as the artwork of the currently played song. This information is sourced from the iPod library of a user. The album artwork of a song gets uploaded to an image server whereas the respective URL is send together with the song meta data as a XMPP message to the joined XMPP rooms. Figure 4.3 visualises the architectural approach of Capital Music.

For the visualisation of songs currently played in the user’s vicinity, we applied a visual approach displaying a mosaic of album cover artworks as shown in Figure 4.4 and 4.5. Each artwork visualised in the top part of the application represents one collocated user currently using Capital Music. The device owner’s song selection is visualised in the bottom part of the application. Users can tap on album artworks to get more detailed information about the played song as well as send text messages or like messages. If a user presses the like button, the application sends a text in form of “[nickname] likes [song title] from [song artist].” Capital Music enables social user interaction in a completely anonymous way. The application does not require any user subscriptions or profiles, and only a nickname has to be specified to use the application.

### 4.2.6.2 User Trial

A user trial has been conducted to test functionality, gain insights into how the current implementation of Capital Music can be improved, and get first indicators about how people experience the application. Altogether 5 participants, 4 university students and 1 university staff aged between 23 and 36, 4 male and 1 female participated in the initial user trial. According to research in usability studies, 5 study participants are sufficient to discover 80 percent of all usability problems (Virzi, 1992).

The trial took place in a university meeting room and participants were asked to bring their own devices containing their personal music library. Capital Music has been installed on all devices, altogether on four iPhones and one iPad. Participants were briefed on how Capital Music works, in particular how to set a nickname and how to access the music library. Afterwards the participants were asked to use the application. Figure 4.6 illustrates the user trial setup. In contrast to the designed application scenario (anonymous public urban places) for Capital
Figure 4.4: Screenshots of the final iteration of Capital Music viewed on the iPhone. The screenshot on the top left shows the main user interface visualising collocated songs in the top part of the application and the own played song in the bottom part above the media player controls. The next screenshot shows details about a song after tapping on the artwork in the previous screenshot with options to send messages to the respective user. The screenshot on the bottom left shows the messaging overview after tapping the green speech bubble in the right bottom part in one of the previous screens. The messaging overview lists all users with whom the user has exchanged messages. The screenshot on the bottom right visualises the exchanged messages after tapping a nickname in the previous screenshot.
Figure 4.5: Screenshots of the final iteration of Capital Music viewed on the iPad. The screenshot on the left shows the main user interface visualising collocated songs in the top part of the application and the own played song in the bottom part of the application. Additionally, this screenshot shows detailed information about a tapped song. The next screenshot shows the messaging overview after tapping the Messages button in the right bottom part of the application. The last screenshot visualises the exchanged messages after tapping a nickname in the previous screenshot.

Music, all study participants were aware of who the other application users were.

This user trial was the first opportunity for the research team to test the application with real users and multiple devices. One of the authors of this paper also participated during the application test using an iPad. However, the researcher only participated during the collective music sharing session. After 15 minutes of sharing artworks of currently played songs we engaged participants in a semi-structured group discussion in order to reveal usability flaws and develop first insights into participants’ experience about using the application. The discussion with the study participants revealed three usability issues.

First, participants mentioned that they would like to see their album artwork next to the artworks listened to by collocated people. They were unsure if their music was really being shared with others and wanted to be part of the community of shared artworks. Second, despite the introduction on how to set a nickname, all study participants did not do it the first time and Capital Music used the device name of each study participant. After the first set of messages were exchanged and the iOS device names instead of anonymous nicknames appeared in the messaging view, participants started setting nicknames. The discussion revealed that the participants did not
understand the purpose of the nickname feature. Third, in the evaluated implementation all exchanged messages were deleted after the user quits the application. Participants explained that they would like to archive these messages and delete them manually or set a specific time interval for automatically deleting messages. Furthermore, by having only the nickname displayed in the messaging overview, it was perceived as difficult to identify which nickname belonged to which song.

Besides gaining insights into the usability and functionality we were also interested in getting first impressions into the UX of Capital Music. While using the application and setting nicknames after exchanging the first messages, study participants repurposed the nickname feature using statements such as “I have awesome artwork <3” or using emoticons as a nickname. In the follow-up discussion, participants explained that they wanted to further describe their motivation, mood, or activity behind their music choices by repurposing the nickname functionality.

Capital Music allows users to change nicknames while using the application. However, messages sent under a previously set nickname are still displayed in the thread of messages and only the nickname itself is updated. One participant was concerned about the public’s opinion of his song choice: “I don’t want that people know what I listened to previously. So I listened to this song and it was really bad and no one likes it and people start hating me for it. So now I’m listening to this [new] one and also want to change my name.” Other participants did not share this opinion and asked him about his concern about what others say: “Of course. Even

*Figure 4.6: Study participants using Capital Music*
if I’m anonymous I don’t want people to know I’m that person. I want to listen to the songs people like.” This aligns with the results of the paper-based study (see Section 4.1) that the song choices of some people might be influenced by the fact that other collocated people can see and comment on their song selections.

Participants were excited about receiving messages from other Capital Music users. One participant explained, “the most exciting thing is finding new messages. It’s like being on Facebook.” All participants stated that they had fun and enjoyed the application. We posed the question: how could such an application change the experience of a bus ride? Participants replied that it would be fantastic and would make their public transport experience more fun (Foth and Schroeter, 2010). One participant explained: “I probably would miss my bus stop because I’m too busy sending messages to everyone else and I’m so distracted. No but it is cool and I like it as it just adds this extra level of community and engagement to what you listening to which is nice. And it’s fun because you are interacting with people around you.”

The results of the user trial led to further development of Capital Music. A start screen has been implemented so that users are asked to set a nickname before using the application. The start screen also explains how the nickname is used for exchanging messages. The currently played song information has been added to the message overview, providing contextual information in form of artist name, song title, and album artwork next to the nicknames of collocated users. Additionally, Capital Music stores all exchanged messages in a database enabling users to manually delete message threads utilising commonly known iOS touch gestures.

The user trial provided general insight into how people might perceive Capital Music and how it might influence the experience while using such an application in a public urban space. An in-depth user study in real world conditions was the next step required to gather more insights into the UX of Capital Music.

4.2.7 User Experience Methodology

To evaluate the designed UX and the impact of Capital Music, we conducted a user study involving 13 participants recruited through multiple electronic mailing lists utilised at our university. As Capital Music is an application designed for anonymous interaction in public urban places,
and it heavily depends on other application users who are in the same place at the same time running the application, creating a realistic study scenario is challenging. This challenge has also been reported in previous research efforts on mobile music sharing (Bassoli et al., 2006). Additionally, in this user study we wanted to conduct an evaluation where participants would not be known to each other, nor would they be directly recognisable to other application users. 

The Wizard of Oz (WoZ) method allows for the evaluation of mobile systems that are still in development stages. It means that parts of the functionality of an application are simulated through a human being called the Wizard to gather insights about usability and effects of the software (Read, 2008). To create a realistic study environment, we applied the WoZ method to evaluate Capital Music. The Wizard simulated other Capital Music users without the knowledge of the study participants. With the WoZ approach we could focus on one study participant at a time while having the most realistic application usage scenario: one user interacting with the system while spending time in a public urban place with collocated strangers, and the Wizard simulated other application users.

We invited single participants to a university meeting room where the application was installed on the participant's device which already contained their own personal music library. After the application installation, participants were briefed on how Capital Music works and its main functions such as selecting songs from the library, retrieving song information, and the nickname feature. The study participants were asked to leave the university building and go to an adjacent outdoor area where students congregate to receive song updates from collocated people. We asked the participant to come back to the meeting room after using Capital Music for 15 minutes. While participants were using Capital Music in the field, the Wizard stayed in an adjacent office space where 20 iPods and 4 iPads were running the Capital Music application, broadcasting song updates to the study participant. To be ethically responsible during the WoZ study, the researcher only sent ‘like’ messages or emoticons to the study participant when receiving a message. This decision was based on the fact that the study participants were not aware that they interact with a researcher rather than an anonymous application user. Through only sending “like” messages and emoticons we were able to simulate a realistic application scenario without compromising what meant to be a private message of a study participant. Figure 4.7 visualises the WoZ setup on the left side and a study participant using Capital Music.
outdoors on the right side. After using the application in the field, study participants partook in a semi-structured interview followed by a paper-based survey. We did not reveal to the study participants that the researchers simulated the other application users to ensure authentic and realistic responses during the semi-structured interview.

Each semi-structured interview took approximately 30 to 45 minutes and study participants were posed questions regarding their user experience, the music sharing, and the social interaction in relation to collocated people, place, and Capital Music. The semi-structured interviews have been audio recorded and all recordings were transcribed for analysis purposes. The paper-based survey was based on the AttrakDiff questionnaire (Hassenzahl, 2008), items to evaluate perceived ease of use and enjoyment (van der Heijden, 2004), a mood scale developed by Watson and Clark (1994), and items to measure emotions (Huisman and Van Hout, 2008). The methodological framework utilised for evaluating the UX of digital place based augmentations and mobile mediated interactions has been reported in more detail elsewhere Seeburger et al. (2012). Participants received a $10 coffee shop voucher after completing the paper-based survey.

4.2.8 Results

This section presents and discusses the results of the UX study utilising the WoZ method. We first present the quantitative data collected through the paper-based survey following a
discussion based on the qualitative interview data.

All data scales collected through the paper-based survey are based on a 7-point Likert scale where 1 is the lowest value and 7 is the highest. The survey contained questions from the Technology Acceptance Model (Davis, 1989). Research has shown that perceived enjoyment and perceived ease of use are stronger determinants towards technology adoption than perceived usefulness when evaluating hedonistic information systems (van der Heijden, 2004). Perceived usefulness is “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989, p. 320). Perceived ease of use is defined as “the degree to which a person believes that using a particular system would be free of effort” (Davis, 1989, p. 320). Perceived enjoyment has been defined as “the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated” (Davis et al., 1992, p. 1113). The following results are presented as mean values. The participants rated the perceived usefulness with 5.77 (Standard Deviation (SD) 1.01), perceived ease of use with 5.75 (SD 1.16), perceived enjoyment with 5.60 (SD 0.96), and the behavioural intention towards using Capital Music with 5.23 (SD 1.54). Items evaluating aesthetics have been added to the paper-based survey. Research has found that “perceptions of interface aesthetic are closely related to apparent usability and thus increase the likelihood that aesthetics may considerably affect system acceptability” (Tractinsky, 1997, p. 121). This implies that the visual design of Capital Music has to be sufficiently appealing to not hinder usability. Lavie and Tractinsky (2004) developed a measurement instrument for evaluating perceived aesthetics of computer interfaces. They subdivided aesthetics into “classical aesthetics,” emphasizing clear and ordered designs as well as “expressive aesthetics,” emphasizing designers’ creativity and originality to break common design rules. Classic aesthetics has been rated with 5.60 (SD 1.17) implying that the design is clear and well structured. Expressive aesthetics has been rated with 5.46 (SD 1.02).

The AttrakDiff (Hassenzahl, 2008) questionnaire provides insights into the pragmatic (effectiveness, efficiency) and hedonistic qualities (stimulation, identification) of an interactive product. The pragmatic quality of Capital Music has been rated with 5.00 (SD 1.10), which indicates an average score for usability and that users can successfully achieve their goals. However, room for improvement exist. The hedonic quality of the application has been rated with an above
average score of 5.12 (SD 0.98) for identification and 5.09 (SD 0.91) for stimulation whereas the overall attractiveness has been rated with an above average score of 5.43 (SD 0.97). According to the AttrakDiff framework, the overall impression of Capital Music is very attractive.

The survey contained the PANAS-X scale (Watson and Clark, 1994) to enable participants to report relevant emotional states after interacting with Capital Music. The PANAS-X scale consists of 60 items describing positive and negative emotions. We asked participants to select suitable emotional items and allocate points towards the perceived intensity on a scale from 1 (very slightly or not at all) to 5 (extremely). On average a participant selected 8.92 emotional terms (SD 3.78) from the PANAS-X scale allocating 30.69 points (SD 13.71) to the selected items. Altogether participants allocated 399 points towards 33 emotional items. Figure 4.8 visualises a tag cloud of the 33 emotional items.

While we do not have values for direct comparison, the results of the paper-based survey are sufficient. All tested items have been rated at least with 5 in a 7-point Likert scale. Additionally, given the emotional states visualised in Figure 4.8, using Capital Music resulted in a positive experience.

Excerpts from transcribed interview recordings were arranged around reoccurring themes followed by searching patterns and connecting threads within the data (Seidman, 2006). This process revealed four themes around the UX of Capital Music: (1) sharing, discovering, and recommending music; (2) social interaction with collocated application users; (3) curiosity, perceptions and voyeurism, as well as (4) entertainment and fun. The following subsections discuss each theme in more detail presenting a coherent overview of the subjective user experiences.
(Hassenzahl and Tractinsky, 2006) that each individual reported.

4.2.8.1 Sharing, Discovering, and Recommending

After using the application, we asked the study participants if they felt comfortable sharing their currently played songs with collocated people. All participants felt comfortable; however, we could distinguish three groups of users. The first category of users was “all for sharing music” or in general “like sharing things.” The second category consists of users who are comfortable sharing song selections due to the anonymity of the application. One participant explained that, “all they get from me is a nickname and my song selection. I don’t feel like I'm giving too much information away.” The last category of users consists of people who felt comfortable with limitations on sharing. These limitations are either related to their own song selections in terms of how “embarrassing your music is” or if the song has been illegally downloaded before the official release date.

We ask participants how they felt about other people seeing what they are listening to and if that influenced their song selection. A group of participants explained that other songs currently played in the same space would influence their own song choice. “Some of the things that were showing up in electronic were more in my taste so I found myself navigating in my own library towards electronic. Even though in the main I tend to be more on the other side, more into the rock side of music.” Two participants explained that they would select songs based on their opinion what other application users might like, so they would receive more comments from them. Another group of participants would “go for the edgier or the cooler tracks,” select songs that have an artwork, or select songs they really like as a recommendation for others. This partly aligns with results from the tunA study (Bassoli et al., 2006) where participants also reported that they would select songs based on their opinion of what others might like so that more people would tune-in and listen to ones’ song choice. In the case of Capital Music the adoption of music taste however is based on social reactions from and interactions with collocated people what has not been evaluated by the tunA study (Bassoli et al., 2006).

Three participants were not influenced in their song selection but would play “less horrible music” or were worried about the perception of people towards their own song choices. Only
one participant explained that she is proud of her music taste and would not be influenced at all.

Surprisingly, even though users are not able to listen to the song choices of other people, participants explained that they would use such an application to get recommendations and discover new music. “The thing I liked about it was that there was a lot of music that I hadn’t heard before.” Another participant describes that “even there is no opportunity to listen to it you can at least see the album art, know who the artist is and kind of be reminded of that. I think it’s a good little musical education thing to see what else is out there.”

4.2.8.2 Social Interaction

Capital Music contains features to enable users to anonymously exchange text messages as well as simple ‘like’ messages through the applications user interface. Participants explained that music is suitable as an icebreaker and especially the ‘like’ feature was perceived as an easy way to interact.

We asked participants what they thought about exchanging messages with unknown people who are close by. One participant explained: “I liked it. I mean it’s fun. It’s sort of weird. It’s strange to send off a message to somebody to really just an album...to a song. You know it represents someone but there is little information about that person beyond what they are listening to.” Another participant enjoyed “the idea of making music listening a more social thing.” Sharing the same taste of music discovered through Capital Music can lead to mobile mediated interactions. For example, another participant describes the following scenario: “If I was on a train and saw somebody listening to something that was definitely one of my favourite tracks or favourite artists or something, I would say I would message them and hopefully start a conversation.” Participants explained that they would mostly exchange additional information about one’s song choices such as favourite songs of an artist, similar artists, or tour dates. Two participants however stated that “you can make some friends” based on the same interests and “build a community.”

In 10 out of the 13 evaluations, users started to exchange messages. To be ethically responsible, the Wizard only replied with ‘like’ messages or with emoticons sent as a text message. If a study participant did not initiate social interaction, the wizard sent a ‘like’ to simulate the real
world experience. Participants stated that mobile mediated interactions based on song selections have “the potential to crossover from virtual interaction to real interaction.” Another participant explains that depending on the exchanged messages she would reveal parts of her identity and this “might spark up a conversation.”

The anonymity of Capital Music was mostly perceived as beneficial for mobile mediated interactions in urban public spaces. “You don’t have to sign up or use personal information. That’s quite good. I would love to have it like this to just chat with other people who I don’t know without losing my personal information.” Another participant explains that “the more information I have to give the less inclined I would be to interact with these people.” However, some participants were slightly concerned about anonymous interaction in public urban places. One participant mentioned that she was afraid to receive offending messages and did not want to be asked for her whereabouts by other application users. In contrast, a different participant explained that it would be fun to “start a flame war” if he would receive abusing messages based on his song selections. Another study participant was concerned that her children would use such an application and exchange messages with collocated people who could potentially harm them.

In general, study participants enjoyed the anonymity of the mobile mediated interactions but security mechanisms such as blocking users should be implemented in the next iteration of Capital Music. One participant explained that he would “potentially [be] more social because you have limited ice breaking opportunities” in public urban spaces. Another participant said that he enjoyed the lightweight interaction to kill some time in public urban places. “The best bit was of course the kind of interaction with other people. If you bother to kind of like a song, then someone sends something back and you reply and they say something else. That’s nice. That’s a nice part of sort of interacting with people about the music.”

### 4.2.8.3 Curiosity, Perceptions, and Voyeurism

Our interviews revealed that Capital Music stimulates curiosity and voyeurism. Participants were curious about other application users. We asked participants if they tried to figure out who the other application users were with whom they exchanged song choices and messages. All
participants were curious about who the persons behind the song choices were except two. One participant stated that he was focusing on the application’s user interface instead. The other participant reportedly did not try to figure out who the other application users were while being in public, but could imagine playing games trying to identify people who are in the same urban space: “It’s a bit boring when you are playing with yourself but you could bet with your mate. I bet this guy is listening to that. Go and ask him if he is listening to that.”

The participants reported that they were scanning the environment occasionally. Others were looking around and wondering where were the other application users. Capital Music raised the awareness towards collocated people through augmenting the urban space. One participant reported his experience of a social encounter while on his way back to the interview room after using Capital Music in a public space: “I didn’t see anyone sitting with headphones or with an iPhone but as I was walking back there was a girl who was walking towards me. She stopped and just asked where the markets are. But when she stopped and said excuse me, for a second I was like...you just don’t know you know there are people around, you know they are interacting but there is no indication beyond what they are listening to, who these people actually are.” The anonymity of Capital Music clearly contributes to this curiosity of who belongs to the “invisible bunch of people.” A participant reports that the other application users are “either students or staff on this campus who share the same geographical location or place and now there is a different layer. I might not know them but I might possibly know them already.”

Participants mentioned that Capital Music is a tool that makes them more conscious about the people around them. One participant explained that she tried to match music genres to people collocated in the same space based on their appearance. Another participant explained that Capital Music would make him reconsider his perceptions in terms of not “judging a book by its cover.” This aligns with a statement of a different study participant describing an occasion when she would be interested in having such an application: “If I was in a place that was out of my comfort zone. Let’s say I went out in the city and there were heaps of people around that are very different to me I would be curious about how they would fit in with the kind of music I’m listening to. They look very different, maybe the music similarities are still the same.” Additionally, a participant mentioned: “It’s a sociological experiment to see how you have perceptions of people and you can see what somebody looks like and you would be like: ‘they totally would listen to
One participant compared the anonymous sharing between collocated people with “peeking into other people’s habits.” Capital Music enables users to browse their surroundings on a digital layer, however directly related to the actual people in the same space at the same time. “That feeling of just walking anonymously through a crowd of strangers and having a little tiny glimpse into what the crowd is currently doing I think is quite interesting.” Another participant states: “It’s sort of almost in that voyeuristic space of people watching. The same sort of thing that you do when you sit down in the city while you have a cup of tea just to find yourself staring into the crowd and just watching strangers for a couple of minutes. It’s almost the same sort of thing in that you see what people are listening to. It gives you a little insight into complete strangers even you can’t see them or anything.” The last two statements indicate how the interaction with Capital Music gives users a tool to satisfy their curiosity towards collocated people during everyday urban life or as urban sociologists state it that “what attracts people most, it would appear, is other people” (Whyte, 1980, p. 19) and “people and human activity are the greatest object of attention and interest” (Gehl, 1987, p. 31).

### 4.2.8.4 Entertainment and Fun

Through utilising music and the sharing of song choices as the central focus of the application, Capital Music has been perceived as a “fun app” with high entertainment value. Listening to music is in general an entertaining activity and adding social user interaction and piquing a user’s curiosity about collocated people adds another level of enjoyment. Participants explained that using Capital Music in a public urban space such as public transport would make them feel less bored and more entertained. “I guess talking to people makes the bus ride to appear shorter because you have a bit more fun while you are on the bus.” Additionally participants mentioned that the application was easy to use and they enjoyed watching the interface because “as you walk things drop out and things come in. I enjoyed doing that. I enjoyed watching the interface as I was walking along seeing how it changed what people went from listening to next.” Figure 4.9 shows two screenshots of the user interface during the WoZ study captured within a timeframe of 30 seconds and demonstrates the activity
of changing artworks while using Capital Music. As described in the previous subsections, sharing, discovering, and obtaining music recommendation as well as anonymous social user interaction with collocated people based on their music selection is an entertaining and fun activity which piqued users’ curiosity. The French term voyeur translates to “one who looks” and Capital Music enables this voyeurism in a digital way in an urban environment regarding the music choices of collocated people but adds the uncertainty of which artwork represents which person in the actual physical space. This results in an entertaining and fun experience as demonstrated with the presented interview data as well as backed up through the quantitative survey data.

4.2.9 Discussion

This paper set out to explore how and to what extent the visualisation of songs currently played in a user’s vicinity can digitally augment the public space with collective social data, and how this influences the social experience of public urban spaces. The results of the presented UX study show that the digital augmentations consisting of collective social data can establish
social interactions in public urban places mediated through ICT devices. Location-Based Social Networking (LBSN) usage in public urban spaces has been criticised for mostly connecting people with people already known to each other, friend-of-a-friend connections, or utilising user profiles for matchmaking that result in homogeneous interactions (Crawford, 2008, Humphreys, 2010). This study tried to broaden the scope of LBSN from interconnected individuals to now also being utilised to facilitate interaction based on digital augmentations between unknown urban dwellers in public places.

The presented findings show that music has been perceived as an ideal icebreaker for ICT mediated social interactions. Music is an art of personal expression and self-identity (Ballantine, 1984, Hargreaves and North, 1999, O’Hara and Brown, 2006) but on the other hand represents non-privacy sensitive information. Sharing song selections with Capital Music and the resulting digital augmentations push the boundaries of anonymity in public urban places and incorporates the identity and performance of music. Capital Music interactions therefore result in heterogeneous interaction through connecting strangers based on their song selection. A Capital Music user might only interact with song selections they like, but the person who listens to this song might be different to them in their demographics (e.g. age, gender, occupation). Focusing on the shared content of a LBSN application rather than the user or a respective user profile fosters heterogeneous interactions in public urban places mediated through ICT devices.

Focusing on the content also aligns with the concept of anonymity during everyday life. Urban life is mostly anonymous (Milgram, 1970) and the only information that people - in Goffman’s term - give off about themselves or is accessible to others is visual appearance such as the clothes one is wearing, body language, or for example the book one is reading while on the bus (Goffman, 1959). Having this in mind it seems appropriate to design LBSN applications for unknown people in an anonymous way through focusing on the exchanged content without utilising user profiles or subscriptions and let users decide for themselves how much information they want to reveal about themselves. Thereby, the exchanged data of a LBSN application can provide additional given off information, besides body language or clothes, shared and accessible through the application user interface. Although the additional given off information available in the application user interface can not be directly assigned to a collocated urban dweller, this study showed that the anonymity of the application and the resulting uncertainty
is contributing to a positively influenced experience in the public urban space. The curiosity towards who in the physical space is listening to what visualised in the application user interface is based on this anonymisation and the resulting uncertainty.

This study also showed that sharing song selections with collocated application users in an anonymous way influences the social experience of public urban spaces. A LBSN application such as presented in this paper can influence the practice of cocooning while spending time in public urban places. Our site observation (see Section 4.1.5.1) as well as the literature about cocooning showed that using technology on public transport is sometimes utilised to “zone out” and create your own personal space while in public (Bull, 2007, Crawford, 2008, Hosokawa, 1984, Ito et al., 2008, Mainwaring et al., 2005). “Cocoons are micro-places built through private, individually controlled infrastructures, temporarily appropriating public space for personal use. They involve a complex set of negotiation that take into account the presence of others in vicinity, while also working to shut them out” (Ito et al., 2008, p. 74). This study showed that digital augmentation and non-privacy sensitive information exchange can be utilised in an experiential way that urban dwellers can continue the practice of cocooning in their established micro-place while in public and shut out the physical presence of collocated people in their vicinity. The digital augmentations, however, enable new opportunities of negotiating and taking into account the presence of others. While one might just listen to music as usual, the possibilities exist to digitally open up their built micro-place while physically still cocooning.

Conversely, sharing new kinds of information in public urban spaces can result in a rearrangement of social and spatial practices in a particular space and can transform public realms into parochial realms through parochialisation (Humphreys, 2010): “Parochialization can be defined as the process of creating, sharing and exchanging information, social and locational, to contribute to a sense of commonality among a group of people in public space” (Humphreys, 2010, p. 768). By exchanging social information such as song choices with collocated people, the invisible data of the urban environment is made visible, accessible and interactive. This visibility of previously invisible layers of information enables urban dwellers to explore commonalities as well as differences in the exchanged information between unknown collocated people. “[L]ocation-aware mobile technologies can change the way we experience both, physical and digital spaces by configuring a new hybrid space, which is composed by a mix
of digital information and physical localities” (Gordon and de Souza e Silva, 2011, p. 56). Our user study showed that exchanging such new kinds of information gives people a tool to better connect with the actual place and the people within. The sharing and discovering of exchanged information stimulates urban dwellers to reconsider their perceptions and preconceptions towards the variety of people they cross paths with while traversing through public urban spaces. Again, due to the anonymity of our approach, application users still do not know for sure who of the collocated people are associated with which digital representation in the user interface. However, providing this additional layer of information in combination with mechanisms for social user interaction can create a sense of commonality in the anonymous urban space. Anonymous physical presence coupled with anonymous digital presence is thereby the driving force behind the UX created by Capital Music. Therefore, we emphasise the need to carefully design digital augmentations and mobile mediated interactions between collocated strangers in a way that aligns to the anonymity of everyday urban life.

4.2.10 Conclusion

This paper presented the design, development, and UX evaluation of Capital Music, a mobile application for sharing and discovering song choices of collocated people. Capital Music demonstrates that the anonymous sharing of song choices between collocated people in urban public spaces can positively influence the experience of urban dwellers. Through carefully designed digital augmentations and mobile mediated interactions, Capital Music enables in-situ social user interaction without breaching users’ privacy beyond what they volunteer to share. Thereby, song choices of collocated people and music in general are perceived as an ideal icebreaker for mobile mediated interactions. The sharing and discovering of music as well as getting music recommendation in combination with anonymous social user interaction with collocated people based on their music selection is perceived as an engaging activity resulting in piquing users curiosity about people in vicinity.

This paper discussed how the approach of Capital Music influences the social experience of public urban places. The digital information presented in the application user interface provides new additional information about collocated strangers congregating in a public urban space. The anonymous approach of Capital Music is resulting in application users trying to connect
physical presence with digital representations in the user interface. The digital anonymity in combination with place-based information and possibilities for mobile mediated interactions enables application users to still physically create a cocoon while in public. The digital augmentations, however, enable new opportunities of negotiating and taking into account the presence of others with further opportunities for digital interactions. Providing these digital augmentations in combination with mechanisms for social user interaction can create a sense of commonality in the anonymous urban space mediated through mobile devices.

Evaluating LBSN applications such as Capital Music is crucial due to the amount of resources needed to conduct studies that involve the amount of users required to create a realistic experience for study participants over an extended period of time. The WoZ method helped to simulate a realistic setting for the UX evaluation, and it was successful in that participants believed that they interacted with real people. However, the findings presented in this paper are based on study participants who interacted with the application for 15 minutes. Therefore, the reported findings represent a snapshot of the UX after initially interacting with Capital Music. This UX might change in different ways for different application users over time. Although the findings are limited in regards to the temporal scope of the reported UX, they contribute to a better understanding of LBSN applications that try to facilitate interactions between unknown urban dwellers. A real-world data collection by releasing Capital Music to the general public is aspired in order to gain insights into how the crafted UX changes over time. This, however, is a challenging task due to the critical mass of people needed that are at the same time and same place interacting with Capital Music.

4.2.11 Acknowledgements

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4.3 Epilogue

The first case study of this PhD thesis, Capital Music, provided insights into how ICT can be applied in public urban places to influence user experiences. Additionally, the Capital Music study confirms that mobile mediated interaction can create a more social and enjoyable feeling while spending time in public urban places. Application users enjoyed the anonymous interactions enabled through Capital Music and the sharing and discovering of music. Capital Music enables application users to be social and curious in a digital way while also being private in the physical space. The relationship between the private physical appearance of an application user in public urban places and the created digital identity through selecting and sharing music is further discussed in Chapter 7. Chapter 7 is a response to research question 2 - How does the establishment of ICT-mediated social interactions between collocated users influence the experience of those users in particular urban spaces? - and discusses the wider impact on the urban experience influenced through mobile mediated interactions.

Capital Music has not been released to the general public. During this PhD candidature, significant time had to be allocated to develop Capital Music to a stage, where the application could be used for study purposes. The PhD candidate started software development and interface design in October 2009 and conducted the user study presented in Section 4.2 in September 2011. The complexity of the architectural requirements to enable in-situ and ad hoc peer-to-peer data exchange between collocated people is beyond the means of the PhD candidate due to technical challenges of scalability and the time constrains of this PhD study. However, in the future, mechanisms and concepts created and applied to Capital Music will be repurposed and adapted towards supporting emotional well-being and mood regulation for teenagers (see Section 8.3).
Chapter 5

Case Study 2: PlaceTagz

The first case study described in Chapter 4, Capital Music, focuses on people who are at the same time at the same place utilising mobile devices to enable mobile mediated interactions in real-time utilising a peer-to-peer approach. The second case study described in this chapter, PlaceTagz, focuses on people who spend time at the same place but in contrast to the first case study, enable mobile mediated interactions between successive users of a space over time. Printed on stickers, PlaceTagz are QR codes linking to a digital message board enabling collocated users to interact with each other over time resulting in a place-based digital memory.

The investigative questions that guide each case study have been answered as follows. Investigative research question 3 is interested in what kind of non-privacy sensitive data can be utilised at a particular urban setting. PlaceTagz have been attached to small public urban places where people usually spend a short period of time by themselves waiting for an event to occur. Examples are park benches, elevators, counters at coffee shops, and public toilets. In these varying urban settings, information about the place, activities, or the people within could be shared.

Investigative research question 4 is concerned with how the available data can be utilised to deliver content and services to users collocated in the same urban setting in order to facilitate meaningful digitally mediated social user interaction. People who spend time in the above mentioned places are sometimes bored and are waiting for a specific event to occur. PlaceTagz ask location-based questions or statements encouraging urban dwellers to leave text comments
in regards to the PlaceTag content. Therefore, text comments in regards to the user's context are utilised within this case study. Additionally, PlaceTagz have been designed in a way, that they do not reveal its purpose or digital destination through their contextless appearance. The mobile mediated interactions enabled through PlaceTagz are based on the combination of the contextless appearance and the location-based content enabling users to contribute and leave a comment. The received comments are aggregated and visualised for successive interactions.

Investigative research question 5 is related to what criteria need to be met in order to establish and maintain digitally mediated interaction between collocated users. PlaceTagz enables users to leave a comment without the need to leave identifiable personal information. While each website encoded behind a PlaceTagz enables users to specify a name and an email address, this information is not mandatory to leave a comment. PlaceTagz align to the metaphor of toilet graffiti where anonymous people add annotations to a wall.

And finally, investigative research question 6 asks how the success of ICT mediated social interactions can be evaluated and measured and how does that changes the social experience of a particular public urban place for different users. A content analysis of the received comments has been conducted as well as semi-structured interview with people who left comments on PlaceTagz. This approach revealed that the employed QR codes, which do not contain any contextual information, piqued users’ curiosity about the linked web location. The location awareness of PlaceTagz and the interactive content was perceived as novel, interesting, and intriguing by urban dwellers. The collected and analysed data showed that people shared information about people, place, and technology and that the initial content plays a major role in what sort of comments might be received.
5.1 Preamble

The purpose of this paper is to present further evidence that mobile mediated interactions between unknown collocated people can positively influence the experience of people spending time in public urban places. The paper presents a study of how mobile phones and QR codes deployed in public urban places can be utilised to create mobile mediated interactions over time. As the second case study of this PhD thesis, the PlaceTagz study demonstrates how urban dwellers can be inspired to engage with their physical surroundings and the people within. The findings presented in this chapter are further analysed and discussed in Chapter 7 in conjunction with the findings presented in Chapter 4 and Chapter 6.

5.2 Abstract

Although mobile phones are often used in public urban places to interact with one’s geographically dispersed social circle, they can also facilitate interactions with people in the same public urban space. The PlaceTagz study investigates how physical artefacts in public urban places can be utilised and combined with mobile phone technologies to facilitate interactions. Printed on stickers, PlaceTagz are QR codes linking to a digital message board enabling collocated users to interact with each other over time resulting in a place-based digital memory. This exploratory project set out to investigate if and how PlaceTagz are used by urban dwellers in a real world deployment. We present findings from analysing content received through PlaceTagz and interview data from application users. QR codes, which do not contain any contextual information, piqued the curiosity of users wondering about the embedded link’s destination.
and provoked comments in regards to people, place and technology.

**Keywords:** Mobile Interaction, QR Codes, Mobile Phones, Public Places, Urban Informatics, Urban Experience

### 5.3 Introduction and Motivation

In everyday life urban dwellers commonly engage with Information and Communication Technology (ICT) devices such as mobile phones while spending time in public urban places. These ‘mundane’ technologies are seamlessly integrated into the everyday life of people and can support a persistent sense of community (Dourish et al., 2010). The uptake of social media services such as Facebook and Twitter in combination with Internet-enabled smart phones enables people to browse and explore the news updates of their social circles in addition to ordinary text messages or phone calls. Furthermore, global positioning systems (GPS) built into more and more smart phones enable new kinds of mobile services, which take the location of a user into account. These location-based services (LBS) provide additional digital information according to a user’s whereabouts such as nearby restaurants, ATMs, or gas stations. A subsection of LBS are location-based social networks such as Foursquare, Yelp, and Gowalla, enabling urban dwellers to share their location and additional information about a place with their friend list on the respective service. On the other hand, the widespread adoption of such services and the widespread use of Internet-enabled mobile devices open up new opportunities to investigate novel kinds of mobile mediated interactions and digital augmentations.

In the urban environment, people leave visible traces in the physical space such as garbage on the train or scribbles on public toilet stalls providing insights into previous activities or usages of the particular space. Instead of using mobile phones to connect to one’s social circle while spending time in public urban places, such devices could also be utilised to connect more to the actual urban space and the people within. This study explores how this could be achieved through augmenting public urban places by providing an online space for leaving digital traces mediated through physical artefacts.

This paper describes our exploration into how physical artefacts attached to public urban places in combination with mobile phone technologies can enable mobile mediated social exchanges
over time. Our approach, PlaceTagz, utilises QR codes printed on stickers linking to a digital message board enabling collocated users to interact with the space and each other over time resulting in a place-based digital memory. Like urban probes, which introduce physical artefacts into urban landscapes “to understand how our future fabric of digital and wireless computing will influence, disrupt, expand, and be integrated into the social patterns existent within our public urban landscapes” (Paulos and Jenkins, 2005), PlaceTagz are attached to urban public places to investigate if such an approach can stimulate and create digital conversations and narratives about a particular place. This paper reports on our experience of having PlaceTagz deployed in the field and used by real people.

PlaceTagz is situated within the research field of urban informatics, which is defined as the “study, design, and practice of urban experiences across different urban contexts that are created by new opportunities of real-time, ubiquitous technology and the augmentation that mediates the physical and digital layers of people networks and urban infrastructures” (Foth et al., 2011, p. 4). This design intervention is part of a larger study investigating how ICT can be employed to create a more social and enjoyable experience while spending time in urban public places, and how this might influence the perceptions towards collocated strangers and place (see Section 1). It employs QR codes to mediate the physical and digital layer of the urban environment enabling people to browse and leave digital augmentations in a particular place. This study was driven by the question whether urban dwellers are curious enough to scan QR codes when they find them in unusual locations without contextual information what the encoded information is about. Additionally we wanted to explore if, how, and why people interact with PlaceTagz.

The remainder of this section is structured as follows. We first review the relevant literature in regards to this project and then introduce PlaceTagz, our approach to link physical places to interactive digital resources followed by describing the data collection and the procedure employed for analysing the received comments. We then present our findings drawing from the content analysis and incorporating results from semi-structured interviews.
5.4 Literature Review

QR codes provide means to connect the physical with the virtual and provide a gateway between atoms and bits (Gordon and de Souza e Silva, 2011). However, QR Codes are mainly used for advertisement encoding physical hyperlinks to access a mobile web site. They are usually placed next to an URL on a product or advertisement poster. Various research projects have utilised QR codes to explore their usage beyond the above-described scenario. For example, QR codes can be used in libraries for various purposes such as encoding mobile phone numbers to provide support, encode additional text for way finding and navigation within libraries, or encode URLs linking to additional content (Walsh, 2009). The City of Manor in Texas deployed fixed QR codes printed on street sign poles for citizen engagement and information pull of government decisions (Haisler and Tate, 2010). Urban planners integrate QR codes as part of media-enhanced street furniture (Kim and Cho, 2010) to link digital infotainment contents to physical locations. QR codes have been utilised to enable users of the location-based social network Foursquare to virtually check-in into a physical location (Büttner et al., 2010). The Semapedia1 initiative and the QRPedia2 project both utilise QR codes to connect physical objects to their digital entries in Wikipedia. Researchers have studied visual codes attached to advertisement posters in urban public places and the possibilities for context-aware service provisioning (Rukzio et al., 2004).

Some studies have been conducted where physical hyperlinks or location determination methods have been utilised to also being able to contribute to the digital content encoded. Three applications have been described utilising 2D barcodes linking digital resources to the urban space (Hansen and Grønbæk, 2008). TagBlogger has been deployed during the Aarhus Festival in Denmark linking specific locations with event, concert, and location-based information enabling users to browse and comment on the content. AudioMove is a location-based audio theatre invoking sound files through scanning 2D barcodes across the city of Aarhus. The Struer application links local heritage information to 2D barcodes enabling browsing as well as contributing to the local history of the city of Struer in northern Denmark.

The Tales of Things (Barthel et al., 2010) project investigates how physical hyperlinks can

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1http://www.semapedia.org/
2http://qrpedia.org/
contribute to sharing experiences with things. Things, in this study, are everything from objects such as a soccer ball, painting, photograph to places and locations. User can create a *Tale of Things* for an object through a website specifying metadata such as title and description as well as integrating data from social media services such as *Flickr* and *YouTube*. The authors want to further investigate how the creation of a social history associated with an object can mediate perceptions towards the object.

The *GeoNotes* (Persson et al., 2003) project describes a digital alternative to analogue annotations in public spaces such as posters, graffiti, or post-it notes. While employing location determination through wireless Internet networks, a *GeoNotes* user can create a digital annotation with a custom label for exact location (e.g. blue door, grey park bench) specification. *GeoNotes* enables users to express views, opinions, and concerns in public space while also raising awareness of other people’s opinions through their annotations and custom labels for location specification. Over a one-month trial, 78 users published 283 GeoNotes. The application trial found that users preferred to exchange notes about the social space and the activities within rather than the physical space and corresponding objects (Persson and Fagerberg, 2002).

The *MobiTip* (Rudström et al., 2004) mobile phone application allows users to share opinions about the physical environment employing Bluetooth technology for peer-to-peer opinion exchange.

While not employing QR codes, the *Dead Drop*[^3] art project utilises USB sticks in the urban environment for anonymous peer-to-peer file sharing in urban public places. USB sticks are interwoven with the urban environment by for example using cement plastering the storage device directly into a brick wall leaving only the pluggable part of the USB stick accessible. The visible, pluggable part of the USB stick symbolises to urban dwellers that there is a digital layer on top of the physical layer leaving it up to urban dwellers curiosity to plug in a suitable device.

*PlaceTagz* is situated at the intersection of *Tales of Things*, *GeoNotes* and the *Dead Drop* project. In contrast to these projects, *PlaceTagz* utilises visible, physical artefacts in the form of QR codes without contextual information to symbolise that digital information is available at a particular urban space piquing urban dwellers’ curiosity to scan, read, and contribute to

[^3]: http://deaddrops.com/
PlaceTagz in an open and anonymous way without the need for user profiles.

5.5 PlaceTagz

The PlaceTagz system consists of two components, the sticker with the QR code and the website containing the digital content. Each single PlaceTag has exactly one digital representation on the PlaceTagz website.

Wordpress, an open source weblog software, has been repurposed and modified according to the needs of PlaceTagz. Each sticker represents one unique post in the weblog. The commenting functionality of the weblog system has been utilised to enable urban dwellers to leave a comment on the respective PlaceTag. Most of the additional weblog features such as hyperlinks navigating to other entries in the system or the search functionality have been removed to present a clean and minimalistic user interface. Figure 5.1 shows a PlaceTag and the mobile website behind the URL encoded in the QR code.

While each sticker only consists of an image next to the QR code, the mobile website contains a headline as well as additional text and the image shown on the sticker. The headline and the text contain location or activity-based information, questions, or statements encouraging interactions. Received comments are visualised underneath the content followed by a form for submitting new comments. The name and email text field are optional allowing users to comment anonymously on a scanned PlaceTag. Submitted comments are not moderated and are visualised underneath existing comments instantaneously.

Figure 5.2 shows a variety of different designs for PlaceTagz. In the studied iteration of PlaceTagz, only the researchers were able to generate new stickers and their respective digital representations. (We are considering a DIY interface to allow users to create their own stickers in the future.)

The process of creating a new PlaceTag involves adding a new weblog post to the system and therefore creating a unique URL. The URL can then be used to create a QR code with a QR code generator. For printing the stickers we use transparent easy to peel address labels, which can be removed without leaving any traces on the object where they have been placed. The
Figure 5.1: PlaceTagz sticker and respective mobile website
CHAPTER 5. CASE STUDY 2: PLACETAGZ

Figure 5.2: PlaceTagz designs

majority of PlaceTagz have been printed on 2” x 3.75” labels. A few stickers have been printed on an A4 paper format.

All submitted comments are centrally stored on the weblog system and accessible on the website or administration panel. The lightweight software architecture behind PlaceTagz enables us to easily create, manage, and analyse comments submitted via PlaceTagz.

5.6 Deployment

PlaceTagz have been deployed at two locations in Brisbane, Australia: (1) at two University campus locations and (2) at The Edge, the digital culture centre of the State Library of Queensland which promotes knowledge exchange at the intersection of digital arts, technology, science and enterprise. Altogether we placed 150 PlaceTagz at those locations. Figure 3 shows four examples where PlaceTagz have been attached to various objects in the urban public space. Selected urban public places all fulfil one or more of the following criteria: (1) Usually people are occupying the space by themselves, (2) the place is mostly used for a short period of time,
and (3) people are usually resting or waiting for a specific event to occur. Figure 5.3 shows PlaceTagz at the counter of a coffee shop, in a public toilet, in the waiting area in front of an auditorium, and a park bench. At the university location, the majority of stickers have been placed in public toilets (101). A few stickers have also been placed in elevators (2), benches (8), water fountains (5), a shared office space (8), and at a bus stop (3). In total 127 PlaceTagz have been deployed in the university setting.

The Edge in Brisbane provides facilities such as workstations, window bays with couches and tables, and workshop rooms allowing visitors to work and collaborate on their projects in a creative environment. At The Edge, stickers have been placed onto the coffee machine at the
coffee shop (1), toilet cubicles (8), window bays (11), the outside glass door (2), and at a water fountains (1). Altogether 23 PlaceTagz have been deployed at The Edge.

By placing the stickers in the urban environment, user comments can be received throughout the life span of the stickers. However the life span depends on various external factors such as cleaners or urban dwellers removing the stickers and cannot be easily influenced. In this paper we consider comments which have been submitted between December 2010 and February 2012.

5.7 Method

The content analysis method has been selected and applied to analyse the submitted comments of PlaceTagz attached to urban public places. The content analysis method provides a toolkit to code, examine, and interpret various kinds of qualitative research data (Berg, 2007). As each sticker collects text comments left by urban dwellers, content analysis seems to be the starting point of investigation into how PlaceTagz have been used and perceived by urban dwellers. Two major attributes have been addressed through the coding of PlaceTagz comments: the content of the comment and the general notion or experience reported in each comment. Each comment has been analysed in regards to whether or not it belongs into one or more of the following ten categories: reply to previous post, reply to PlaceTagz content, use of emoticons and abbreviations such as “LOL”, humour, asking a question, referencing the PlaceTagz system, information sharing in regards to the sticker location, referencing other people in space, off topic comments or comments which are not related to previous comments or the sticker content, and information sharing regarding activities in the sticker’s location.

Additionally PlaceTagz comments were coded according to the general tone of the reported experience. The following three categories have been established: positive, neutral or descriptive, and negative experiences. Text comments within the positive experience category have a positive notion in general or contain words, abbreviations, or emoticons which indicate a positive experience. Text comments within the neutral or descriptive experience category either describe the activity of the user while interacting with PlaceTagz or are commenting directly on the question asked within the PlaceTag not using any words indicating emotions. Text comments within the negative experience category have a negative notion in general or containing
words, emotions, or abbreviations indicating a negative experience. However, these negative experiences are not necessarily directly related to interacting with PlaceTagz but rather sharing a negative experience within the physical space with other users. Following this method of coding each comment was assigned exactly one of the general notion or experience categories as well as all applicable content categories describing the comment. The content analysis required 1573 decisions to be made by the coding team for the 121 PlaceTagz comments.

Two researchers coded the PlaceTagz comments independently and compared the results afterwards. In the case of a disagreement, both researchers discussed the content and recoded it towards the agreed categories. In general, agreement between both coders was high with $\kappa$ ranging from 0.72 to 1 testifying meaningful categories (Freelon, 2010). One exception was the humour category with a $\kappa$ value of 0.52. This midrange value can be explained due to the subjective nature of humour and how the location of the PlaceTag, activity, or collocated people while submitting the comment generated inside jokes not directly visible to the researchers. Overall, 74 disagreements between both coders have been discussed and recategorised according to the results. Table 5.1 lists the $\kappa$ values of the content analysis as well as how often a comment has been categorised into the respective category. Table 5.2 shows examples of comments and how

<table>
<thead>
<tr>
<th>No.</th>
<th>Category</th>
<th>$\kappa$</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Positive Experience</td>
<td>0.85</td>
<td>69</td>
<td>57</td>
</tr>
<tr>
<td>2</td>
<td>Neutral or descriptive experience</td>
<td>0.87</td>
<td>39</td>
<td>32</td>
</tr>
<tr>
<td>3</td>
<td>Negative Experience</td>
<td>0.80</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>Reply to previous post</td>
<td>1.00</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Reply to PlaceTagz content</td>
<td>0.83</td>
<td>85</td>
<td>33</td>
</tr>
<tr>
<td>6</td>
<td>Emoticons/ abbreviations</td>
<td>1.00</td>
<td>28</td>
<td>11</td>
</tr>
<tr>
<td>7</td>
<td>Humour</td>
<td>0.52</td>
<td>19</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>Asking a question</td>
<td>1.00</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>Referencing PlaceTagz System</td>
<td>1.00</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>Information sharing re sticker location</td>
<td>0.85</td>
<td>33</td>
<td>13</td>
</tr>
<tr>
<td>11</td>
<td>Referencing people in space</td>
<td>0.76</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>12</td>
<td>Off-topic and unrelated</td>
<td>0.72</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>13</td>
<td>Information sharing re activity in sticker location</td>
<td>0.76</td>
<td>40</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 5.1: Categories for content analysis
they have been categorised.

In addition to the content analysis, semi-structured interviews have been conducted in order to get richer insights into the motivation of using PlaceTagz and the user experience. To recruit study participants a simple web form has been displayed to users after they left a comment on a PlaceTag. The web form, which has been set up in November 2011, asked users to leave an email address to participate in an interview. However, due to the real world deployment of PlaceTagz and since many of the PlaceTagz were deployed in public toilets, the response rate was low. We assume that many people who left a comment would not feel comfortable talking about their interaction with PlaceTagz while using a public toilet. Nonetheless three participants were interviewed who left comments at PlaceTagz deployed at The Edge. Participant 1 (P1) is a 21-year-old male university student. During the interview, P1 revealed that he also scanned a toilet sticker at the university campus. Participant 2 (P2) is a 36-year-old male communication advisor who also left a comment at The Edge. Participant 3 (P3) is a 43-year-old male project officer who left four comments and scanned various PlaceTagz around The Edge. Each interview took between 15 minutes to 20 minutes and each participant received an AU$10 coffee shop voucher.

5.8 Findings

The 121 PlaceTagz comments have been assigned 258 categories in addition to the three general categories in regards to the overall experience or notion.

As shown in Table 5.1, more than half of the submitted comments (57%) had a positive notion and communicated a positive experience towards the overall PlaceTagz system. As an example, the simple and short comments such as “made my day :-)”, “lol”, “very inspired”, or “Bahaha” clearly show that content discovered behind the scanned QR was perceived as fun and entertaining.

Nearly one third of the received comments had a neutral notion in their response and mostly directly replied to the PlaceTagz content (54%) or either described the activity (33%) or place (15%) within the PlaceTagz context.
<table>
<thead>
<tr>
<th>Location</th>
<th>PlaceTagz Content</th>
<th>Reply No.</th>
<th>User Comment</th>
<th>Coding Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Toilet</td>
<td>Feeling better now?</td>
<td>1</td>
<td>Highly recommended device, overall a good experience. The sensor for the lights is on the fritz though, but the darkness merely added to the relaxing environment.</td>
<td>1, 5, 10</td>
</tr>
<tr>
<td></td>
<td>There is no other place where you could be more concentrated and relaxed at the same time...</td>
<td>2</td>
<td>Yeah the lights in here are farked! Love pooping in the dark!</td>
<td>1, 4, 7, 10, 13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>At least it’s clean, some of the toilets here are filthy, seriously if you screw around in a toilet you shouldn’t be at university. What does the writing on the door mean? Also how good is laying a cable/backing one out before an exam...good strategy I think.</td>
<td>2, 4, 7, 8, 10, 11, 13</td>
</tr>
<tr>
<td>Public Toilet</td>
<td>Feeling better now?</td>
<td>1</td>
<td>Awesome idea :-D</td>
<td>1, 6, 9</td>
</tr>
<tr>
<td></td>
<td>There is no other place where you could be more concentrated and relaxed at the same time...</td>
<td>1</td>
<td>I do feel much better. Also, it’s Friday, which helps. Where does my message go by the way?</td>
<td>1, 5, 8, 9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>It’s time we ladies stopped putting up with scratchy toilet paper!</td>
<td>3, 10, 11, 13</td>
</tr>
<tr>
<td>Coffee Machine</td>
<td>Have you rinsed the milk frother?</td>
<td>1</td>
<td>I’m bored. Make a Coffee!</td>
<td>2, 13</td>
</tr>
<tr>
<td></td>
<td>Coffee police is watching you!</td>
<td>2</td>
<td>Milk is sour again!! :-(</td>
<td>3, 6, 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>I’m down to my last capsule! Where is the dealer Ronster?</td>
<td>2, 8, 11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>Ahh coffee the great social lubricant.</td>
<td>1, 13</td>
</tr>
<tr>
<td>Window Bay</td>
<td>What are you working on @The Edge</td>
<td>1</td>
<td>Meeting of UQVieSA</td>
<td>2, 5, 13</td>
</tr>
</tbody>
</table>

*Table 5.2:* Example comments and their coding with the coding numbers from Table 5.1
The comments classified in the negative notion or experience category (11\%) mostly commented on the place (46\%) or the activities (46\%) within the place.

The following subsections investigate the results of the content analysis incorporating data from the semi-structured interviews under the people, place, and technology paradigm of Urban Informatics (Foth et al., 2011). Additionally we discuss the findings in light of having PlaceTagz deployed and studied in actual urban public places rather than in a lab environment.

5.8.1 People

A small percentage of PlaceTagz comments referenced people who were either collocated at the same time, have been at the place prior to the commentator, or addressed their comment towards future occupants of the space. With PlaceTagz we wanted to investigate if such an approach can create digital narratives or conversations over time. Only 3\% of the received comments have been categorised as replies to previous PlaceTagz comments. The first example in Table 5.2 shows such a dialogue between people who have used the same space over time. While these dialogues are only a minority of the received comments, we argue that it is possible to create digital narratives or conversations over time. However, the content on the website and the previous comments are the crucial factors influencing the creation of conversations. While the first example shown in Table 5.2 exemplifies a digital conversation, PlaceTagz deployed at The Edge asking: “What are you working on@The Edge? - Work, play, or just enjoying the view... what’s on your agenda?” simply stimulated exact responses to the stated question leaving not much impetus for additional conversations. P2, who left a comment on the above mentioned PlaceTag however describes his interaction as contributing to a conversation. While we did not categorise these comments as conversations in terms of replying to other people’s comments, the study participants perceived them as such or rated the comments as valuable. P1 explained that he liked to be able to see what other people have done in the same space in the past resulting in a positive experience through using PlaceTagz “because you always want to hear what other people have to say about it”.

Sharing lightweight text comments in urban public places can raise the awareness towards people who used the same space in the past. Research in urban sociology showed that people
and their activities are seen as most rewarding while spending time in urban public places (Gehl, 1987, Whyte, 1980). PlaceTagz enable urban dwellers to access, read, and contribute to a digital layer of social information relating to a space.

This research project was also interested in the question whether people are curious enough to scan QR codes when they are attached in urban public places without contextual information hinting at their purpose. Curiosity was one of the main factors why the three interviewed participants scanned the QR codes. P2 explained that he was curious about the QR codes. “They are usually embedded in print ads or something else whereas this was kind of intriguing. Having it kind of by itself. Like it didn’t give its context really out”. P1 and P3 also stated that they were curious “to see where it led” (P3). Additionally, Figure 5.5 shows a large PlaceTag, which has been physically augmented by an unknown person with a sticker stating, “This inspires curiosity”.

### 5.8.2 Place

The location-awareness of the PlaceTagz through the icon next to the QR code and the displayed content on the website stimulated comments taking the location of the sticker into account. P3 states that the interaction with PlaceTagz “felt like it was location specific because of the image. Like in the men’s toilet there was a little men’s toilet symbol so I thought this isn’t the same barcode just splattered around everywhere”.

Out of the 121 analysed comments, 13% of the PlaceTagz comments generally referenced the place and commented on its characteristics and 16% of the PlaceTagz comments referenced the activity within the place. One PlaceTag attached at The Edge asked on the respective website “I like The Edge because...” which generally provoked positive place related answers such as “It has a nice view :))”, “great seats, great games, great vibe”, and “it’s a place where chance meetings can lead to new ideas”. On the other hand, place related comments on stickers placed at toilets mostly contained negative notions towards the place in regards of hygiene conditions. It appears that the geographic context in combination with the digital information of the PlaceTag essentially influences what sort of comments are received. P3 states that the digital content would influence what kind of comment he might leave: “If they all had something like ‘What
would you like the person following you to know about exactly this location’ then I might go: ‘I like them to know this or did you notice that’ and then it would encourage me to be specific about this location and my comments and to not comment about life in general”. The initial content on the digital representation of each PlaceTag was established at first to provide a conversation starter. P2 explains that he was waiting at an event to start at The Edge so he was “carrying on the conversation what was someone doing at this place”. P1, who left a comment at the coffee machine at The Edge states: “I thought it is an easy way to provide feedback. I didn’t have to talk to anyone. I didn’t have to do anything too labour intensive. It gave me something to do while I waited.” Stickers, which were placed at locations where people usually have to wait, receive more comments than PlaceTagz deployed in locations where people pass through (for example water fountains).

While waiting in a public urban space, the physical hyperlinks in form of QR codes symbolise the availability of digital information. “Adding a digital layer to the existing physical and social layers could facilitate new forms of interaction that reshape urban life” (Kjeldskov and Paay, 2006, p. 60). Usually, the digital layers of the urban environment are not physically visible to urban dwellers. People might have checked in at a specific place on Foursquare or Facebook resulting in shared recommendations, photos, or other digital information. These digital augmentations however are not physically represented at the urban space. The employed QR codes utilised for PlaceTagz act as physical markers in the urban space for an openly accessible digital layer containing digital augmentations and interactions.

5.8.3 Technology

All study participants had prior experience with scanning QR codes and explained that most of them are used for advertisement. P1 states, “if it is very obvious I ignore it because I think it might be advertisement. Whereas the quirky little ones in the corner, I want to see what’s it about”. The unusual location where PlaceTagz have been deployed motivated users to scan them, or as P2 explains: “I haven’t really seen them like as guerrilla stickers”. P3 states that he usually scans QR codes wherever he finds them but PlaceTagz were the first QR codes which let him interact and accept social interactions.
A small percentage of comments have been categorised as referencing the PlaceTagz system. Due to the novel and unknown concept we received comments asking, “Where does my comment go by the way?” or in a more humorous way if PlaceTagz is some sort of “Intimate Details Viral Marketing?” Others commented that “QR codes in random places is cool” or that it is an “awesome idea :-D”. One user stated his expectations towards the PlaceTagz system and was disappointed to find an empty PlaceTag without comments. This particular user left three comments on three different PlaceTagz, all deployed at The Edge stating: “What’s going on here? There should be thousands of posts here! :p”, “I’m a lonely place tag in a sea of toilets”, and “Tumbleweeds”. These comments are a good example of the co-experience (Battarbee and Koskinen, 2005) created through PlaceTagz. A user who scans a PlaceTag without previously submitted comments will have a significantly different experience than a user who scans a QR code containing various comments. This experience is further influenced by the content of the previous comments and has an impact on future comments in terms of sharing, empathising, rejecting, or ignoring the previously shared experience.

Additionally, Table 5.1 shows that 33% of all received PlaceTagz comments have been categorised as a reply to the content presented to the user after scanning the QR code. During the data collection time frame, we noticed this trend towards answering stated questions or referencing the PlaceTagz content. The initial driving force behind this project, however, was to find out how physical artefacts linked to digital message boards can generate interactions and narratives about a particular space. To find out what sort of comments we would receive, we deployed 13 stickers out of the 150 deployed PlaceTagz which did not contain any textual information on the respective digital resource. These PlaceTagz without any textual content only received one comment total. It appears that the openness of an empty canvas alienates prospective users not knowing what to do with the digital system and what is appropriate to submit.

5.8.4 PlaceTagz in the Field

Mobile applications and services are ideally evaluated in an environment which is as realistic as possible to the final application context (Kangas and Kinnunen, 2005). This implies that field
experiments or real world deployments are the preferred method instead of lab studies. However, lab experiments are the commonly used method in mobile human-computer interaction research, because they are easier and more manageable than field experiments (Kjeldskov and Graham, 2003). “An essential aspect of mobile and ubiquitous computing research is evaluation within the expected usage context, including environment. When that environment is an urban center, it can be dynamic, expansive, and unpredictable” (Kellar et al., 2005, p. 1533).

PlaceTagz have been deployed and studied in its designated application context: public urban places. Through having PlaceTagz deployed in the field and made available to urban dwellers, we found that the life cycle of PlaceTagz can vary dramatically. For example, two stickers have been deployed in two outdoor elevators at the university campus in the morning. Both PlaceTagz had been already removed in the afternoon either through university staff and students or the cleaning employees. While most of the deployed PlaceTagz are still at their designated place at the time of writing this paper, others were removed within days, weeks, or month.
Additionally, the physical characteristics of PlaceTagz can change when deployed in urban environments. Some PlaceTagz, which have been placed outdoors, got washed out and made unusable from natural forces such as rain and sunshine. On two occasions we could observe that PlaceTagz have been physically augmented in urban public spaces. Figure 5.4 shows a PlaceTag deployed in a public toilet with a personal comment using a waterproof marker: “Toilet door Man Do you take strange box as your lawfully wedded bride?” Figure 5.5 shows a large PlaceTag, which has been physically augmented by an unknown person with another sticker stating, “This inspires Curiosity”.

These kinds of physical augmentations (in the case of Figure 5.4 some might call it vandalism), the fact that some PlaceTagz were removed or made inaccessible through the act of nature beyond our control, and that some PlaceTagz still receive comments after being deployed over one year ago show that sticker based QR codes are a suitable low-cost technology for design interventions deployed in urban environments.

On the other hand, QR codes are not commonly used in Australia. According to the Telstra Smartphone Index, a market research study conducted by Nielsen for the Australian telecommunications provider, only 17% of the respondents ever scanned a QR code with their phone in 2011 (Nielsen, 2011). A comScore study for the US revealed that one out of five smart phone users scanned a QR code in December 2011 (comScore, 2012). The majority of the scans took place at participants’ homes while scanning QR codes on products to receive additional information. The participants interviewed for this study also mentioned that their prior experiences with QR codes was usually in an advertisement context.

The low rates of people using QR codes and the fact that many people associate them with advertisement resulted in an extend period of time needed to collect data through PlaceTagz. Figure 5.6 shows a diagram illustrating the amount of comments received, unique visitors who scanned PlaceTagz, and the amount of PlaceTagz deployed. As mentioned earlier, there is a discrepancy between the amount of PlaceTagz deployed and the amount of PlaceTagz still in place. Therefore, while the graph showing deployed PlaceTagz increases over time, there is no increase in received comments. The peak in May 2011 can be explained through a major event held at The Edge. Figure 5.6 also shows a discrepancy between people who scanned a PlaceTag and the actual amount of comments received. Research on online communities found that a large
Figure 5.5: PlaceTagz comments in the physical space
amount of members do not actively participate in discussions, the so-called lurkers (Nonnecke and Preece, 2000). One reason why lurkers do not post is because simply reading is enough for them and they do not feel the need to post (Preece et al., 2004). While online communities are mostly thematically focused around a specific topic of interest, the heterogeneity of people in places where PlaceTagz have been deployed might have contributed to the discrepancy between people who scanned a QR code and read the content and people who actually submitted a comment and contributed to the digital layer. Through having a design intervention deployed in the field and exposed to a variety of urban dwellers, the people, place, and technology factors of the studied artefact are as mentioned by Kellar et al. (2005) dynamic, expansive, and unpredictable. On the other hand, a methodological approach based on a simulated environment would not have generated the findings and experiences as presented in this paper.

The data from the interview participants and the collected comments presented in this paper shows that highly unique QR codes (in the case of PlaceTagz each QR code was redirecting to an individual website) in combination with interactive and location aware content are perceived
as novel, interesting, and intriguing and can stimulate digital augmentations of urban spaces.

5.9 Limitations and Future Work

Due to the real world deployment, this study has some limitations. As discussed earlier and visualised in Figure 5.6, there is a discrepancy between how many people scanned a PlaceTag and the amount of comments received. To gain a more general picture about PlaceTagz, it would be beneficial to investigate why urban dwellers did not leave a comment after they scanned the QR code. Additionally we would be interested if and how this user group perceived PlaceTagz. Researchers studying users lurking in online communities have access to their virtual presence. In the case of PlaceTagz, lurkers are only physically present at a specific time and place. Furthermore, the majority of PlaceTagz have been deployed in public toilets, making it impractical to get access to this user group. The second limitation of this study is that we could only find three interview participants. These three participants provided valuable insight into their motivation and experience interacting with PlaceTagz. However, more data especially from people interacting with PlaceTagz in the university location would generate more diverse insights into the variety of motivations and experiences PlaceTagz might create. On the other hand, the three interview participants were users who interacted with our system in its real world context without having any enforced incentives.

This exploratory study paved the ground for future work in the area of physical artefacts deployed in urban public spaces linking to location-aware interactive digital content. In the future, we want to redesign the workflow of creating PlaceTagz stickers, enabling urban dwellers to create and deploy them in their desired locations. In this study, the locations of PlaceTagz and the content creation were based on the authors’ ideas. The empowerment of urban dwellers to create and deploy their own DIY PlaceTagz might create a variety of new, interactive digital content ideas and installations beyond the authors’ ideas and the usage context described in this paper.
5.10 Conclusion

This paper presented our study on PlaceTagz, QR codes printed on stickers linking to digital message boards enabling collocated users to interact with the place and each other over time resulting in a place-based digital memory. PlaceTagz have been deployed in various urban public places and collected comments and interactions from urban dwellers. This paper presented the findings of a content analysis of the received interactions and interview data of people who interacted with PlaceTagz. We also discussed the implications and shared our experiences of deploying a QR code based design intervention in the field.

We found that PlaceTagz and the employed QR codes, which do not contain any contextual information about their purpose, piqued users’ curiosity about the linked web location. PlaceTagz deployed in locations where people wait for an event received the most interactions. The location awareness of PlaceTagz and the interactive content was perceived as novel, interesting, and intriguing by urban dwellers. While only the minority of the collected comments were directed at previous interactions, the collected data showed that people shared information about people, place, and technology and that the initial content plays a major role in what sort of comments might be received. All these factors can positively influence the experience of people while interacting with PlaceTagz in space or as the poet Dorothy Parker stated: “The cure for boredom is curiosity. There is no cure for curiosity”.

Overall, this paper provided insight into how people can be inspired to engage with their physical surroundings using mobile phones. This engagement adds a digital layer to the existing environment, resulting in people interacting with their surroundings and possibly developing a new perspective of their city and other urban dwellers.

5.11 Acknowledgements

This research was carried out as part of the activities of, and funded by, the Smart Services Cooperative Research Centre (CRC) through the Australian Government’s CRC Programme (Department of Innovation, Industry, Science and Research). I thank all study participants, The Edge, Brisbane for allowing us to place stickers on their premises, as well as Marcus Foth and
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the anonymous reviewers who helped to improve this paper.

5.12 Epilogue

The second case study, PlaceTagz, provided further evidence that mobile mediated interaction can positively influence the experience of people in public urban places. Location-based content on interactive websites encoded in QR codes attached to unusual locations can create mobile mediated interactions and pique users curiosity as well as raising awareness towards people and place. The synthesis of the three case studies presented in Chapter 7 further discusses the curiosity and awareness aspects of PlaceTagz in relation to the urban experience.

The idea, concept, and design behind PlaceTagz has been brainstormed while attending the Internet of Things conference in Tokyo, Japan in 2010 where QR codes where prominently featured in workshop and conference presentations. The initial targeted application context for PlaceTagz was public transport. The top part of Figure 5.7 visualises the first thoughts on the PlaceTagz project. The idea of the PhD candidate was, that each seat in a bus or train has a unique QR code attached, so that a passenger can read previous comments from people who sat in the exact same bus or train seat. The decision has been made to not place stickers into the government owned busses in Brisbane because of the likelihood that all stickers will be removed through cleaning staff or even the possibility to be held accountable for the cleaning costs. Additionally, the introduction in Chapter 1 and the methodology described in Chapter 3 state, that different design interventions will be deployed in different public urban place to get broader insights into anonymous mobile mediated interaction in public urban places. Therefore, instead of bus seats, public toilets have been selected as the primary site for this case study.

The initial design of PlaceTagz is visualised in the top part of Figure 5.7. As described in this chapter and as visualised in the middle part of Figure 5.7, the PlaceTagz design moved away from labelling, describing, or giving hints towards the purpose of the QR codes. Instead, images or icons have been used, whereas the PhD candidate was inspired by street art and urban sticker culture. This inspiration has been reflected in creating stencil like icons which refer back to the location where the PlaceTagz stickers have been placed. The middle part of Figure 5.7 shows these stencils.
Figure 5.7: Iterations of PlaceTagz designs
The stickers visualised in the middle of Figure 5.7 have been presented to the team members of the Urban Informatics Research Lab to get feedback. Additionally, some of the stickers have been placed within the office space of the Urban Informatics Research Lab for initial testing. The overall feedback was, that some of the stencils as shown in the middle of Figure 5.7 were not directly recognisable. Therefore, most of the deployed PlaceTagz, which collected data for this chapter, had more simplified icons which made them more recognisable (see Figure 5.3).

The PlaceTagz website containing all received comments is available at http://placetagz.net. Some of the entries stored on the website are from further deployments where the PlaceTagz system has been repurposed or used for different scenarios. The bottom part of Figure 5.7 visualises QR codes as part of an artistic installation for the Changing Lanes\(^4\) festival, a festival to celebrate the laneways of Brisbane in combination with a student design competition. The PlaceTagz design for the Changing Lanes festival has been created by Leonardo Parra, QUT Urban Informatics Lab, Brisbane, Australia. Additionally, Peter Lyle from the Urban Informatics Research Lab in Brisbane, Australia is considering to utilise the PlaceTagz system in his PhD research on urban agriculture. PlaceTagz will be used to provide digital and interactive content in relation to native plants and fruit grown at an inner-city non-profit community farm.

The data collection and analysis reported in this chapter has been finalised in February 2012. As reported, 121 comments have been collected and analysed within the PlaceTagz case study. PlaceTagz still collect data and an additional 30 comments have been received through the remaining stickers placed in the urban environment.

\(^4\)http://www.changinglanes.net.au/
Chapter 6

Case Study 3: Urban Public Screen Interactions

This chapter presents the third and last case study of this PhD thesis. After investigating music sharing between collocated people in real-time utilising mobile devices (Chapter 4) and sharing comments through QR code and mobile phone interactions over time (Chapter 5), this case study presents research on public urban screens and mobile phone interactions.

The introduction in Chapter 1 and the user experience framework in Section 3.2 discuss Sapporo World Window as the sole design intervention within this case study. However, while progressing with the candidature of this PhD research, the need for further iterations of Sapporo World Window seemed necessary. This chapter describes how the concept of Sapporo World Window and therefore aggregating social media for location sharing has been further developed and informed through user studies towards video sharing on public urban screens. The observational study conducted with Brisbane Hot Spots, a redesigned version of Sapporo World Window for an Australian Context, helped to create design principles for YourScreen. YourScreen enables urban dwellers to send YouTube videos to a public urban screen utilising existing social media services such as Facebook and Twitter for video submission.

The investigative questions that guide each case study have been answered as follows. Investigative research question 3 is interested in what kind of non-privacy sensitive data can be utilised at a particular urban setting. YourScreen is deployed at a public urban screen located at a university campus shuttle bus stop in Brisbane, Australia. People who spend time at this location are usually waiting for the bus to travel to a second university campus in Brisbane. The widespread
use of Internet-enabled smart phones enables urban dwellers to watch videos while waiting for the bus. This provides an opportunity to enable urban dwellers to share such content on the public urban screen utilising their private devices.

Investigative research question 4 is concerned with how the available data can be utilised to deliver content and services to users collocated in the same urban setting in order to facilitate meaningful digitally mediated social user interaction. The urban setting of YourScreen is a bus stop at a university campus in Brisbane, Australia. YourScreen enables urban dwellers to anonymously send a YouTube video to the public urban screen utilising their mobile phones for immediate playback while waiting for the bus.

Investigative research question 5 is related to what criteria need to be met in order to establish and maintain digitally mediated interaction between collocated users. As the following chapter shows, the spatial and social context is important when designing applications for public urban screens. In general, private, lightweight, and in-situ means for interactions have to be met in order to engage urban dwellers with public urban screen applications.

And finally, investigative research question 6 asks how the success of ICT mediated social interactions can be evaluated and measured and how that can change the social experience of a particular public urban place for different users. The research described within this case study went through three phases. First, the exploratory phase involving concept development and an initial user study. Second, an observational phase analysing interactions in the urban space and third, an interpretative phase involving an online survey to gather insights into the created experience. This approach revealed that sharing content on public urban screens can pique the curiosity of users towards collocated people and the application itself resulting in raising the awareness of application users towards collocated people.

An early concept of Sapporo World Window has also been published at the 2011 IEEE International Conference on Pervasive Computing and Communications (PERCOM) as part of the Second International Workshop on Pervasive Collaboration and Social Networking (PerCol 2011). As the concept of Sapporo World Window shifted, this paper is not included in this PhD thesis but can be found here:

Choi, J. and Seeburger, J. (2011). Sapporo world window: urban interaction through public
6.1 Statement of Contribution

This paper is co-authored with my principal supervisor Assoc. Prof. Marcus Foth. I’m responsible for the entire draft of this publication. The principal supervisor provided editorial guidance, feedback, and advice. Therefore, the intellectual contribution of the principle supervisor is acknowledged and reflected through the co-authorship of this paper.

6.2 Preamble

The purpose of this paper is to describe the last case study within this PhD thesis utilising mobile mediated interactions to influence the experience of people in public urban places. This paper describes the research conducted with public urban screens and content sharing utilising mobile phones. While the design interventions within the previous case studies in Chapter 4 and Chapter 5 enabled mobile mediated interaction between collocated people, this case study investigates how mobile mediated interaction between a user and a public urban screen can influence the experience for this particular user. Therefore, three studies have been conducted collecting qualitative and quantitative data to inform the design of public urban screen applications and gather insights into the impact on the experience such public urban screen applications might create.
6.3 Abstract

This paper describes the design and study of public urban screen applications aiming to facilitate urban dwellers to control content shown on public urban screens. Two types of content sharing are presented: aggregating existing social media content about particular locations for sharing, and sharing online videos with collocated people at a public urban screen. The paper describes an exploratory study, an observational study, as well as an interpretational study in regards to application usage and user experience. Sharing content on public urban screens can pique the curiosity of users towards collocated people and the application itself resulting in raised awareness of collocated people.

**Keywords:** Urban Screens, Mobile Phones, Urban Informatics.

6.4 Introduction

In recent years, public urban screens have been installed and deployed in public urban places to inform and entertain urban dwellers with a wide variety of content such as public transport timetables, art installations, live transmissions of large sports events, or local advertisement. Such uses of public urban screens usually involve uni-directional communication that pushes information to the public. The widespread adoption and use of mobile devices, which enable a constant connection to the World Wide Web, provides new opportunities to interact with the urban space (Foth et al., 2011). One opportunity to interact with the urban space utilising mobile devices could be, to open up the mostly closed environments of public urban screen installations and allow urban dwellers to share content that they choose on such screens. These types of digital augmentations could reshape urban life through new interaction possibilities (Kjeldskov and Paay, 2006). The research field of Urban Informatics is interested in “the study, design, and practice of urban experiences across different urban contexts that are created by new opportunities of real-time, ubiquitous technology and the augmentation that mediates the physical and digital layers of people networks and urban infrastructures” (Foth et al., 2011, p. 4). One opportunity to design and study the urban experience created through real-time, ubiquitous technology is to employ screens in public urban places to influence the experience of people
through digital content and services.

This paper presents our research on public urban screen applications and how they can be utilised to enable an open dialog allowing users to create and share digital augmentations. “Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody” (Jacobs, 1992, p. 238). While this citation arises out of an urban planning context, we believe that being able to share content on public urban screens provides opportunities to create and customise the experience of spending time in a public urban place.

The prospect of opening closed public urban screen environments to the general public and creating participatory systems similar to the Web 2.0 paradigm, is starting to be recognised in the research community (Davies et al., 2012).

This paper sets out to explore how public urban screens can be utilised to enable content sharing utilising urban dwellers’ mobile phones. We are interested in the question how sharing content on public urban screens can influence the experience of spending time in a particular urban space. We present findings from three iterations of a public urban screen application deployed in two urban settings focusing on sharing data between collocated people mediated through such screens.

The remainder of this paper is structured as follows. We first review the relevant literature followed by a description of our research approach. Three design interventions are presented whereby each iteration focuses on a particular phase of this research: exploration, observation, and interpretation. The paper concludes with a discussion of the findings and presents future work in this area of research.

### 6.5 Literature Review

Public urban screens have become a common feature in public urban places. We often see - at least in developed countries - information displays on public transport systems, commercial advertisements on the digital façade of buildings, and increasingly on interactive touch-screens around central business districts. Public urban screens are increasingly present and influencing our everyday interactions with information, place, and people.
There have been numerous technical endeavours to enable interactions amongst collocated people via urban screens and networked technologies. *Discussion in Space* (Schroeter, 2012) utilises urban screens and mobile phones to involve citizens in urban planning and design decisions through situated digital augmentations. *PhotoSwapper* (Eriksson et al., 2007) enables urban dwellers to share pictures from their personal mobile devices with collocated people through visualising the images on a public screen to stimulate social user interaction. *Opinionizer* (Rogers and Brignull, 2002) visualises humorous and provoking statements on a public screen encouraging bystanders to share their thoughts by commenting using a laptop computer, resulting in real world social interactions. *CHIplace* and *CSCWplace* are public screen applications showing digital content from an online community in combination with content generated in the physical space enabling unplanned encounters with the content as well as raising awareness of the digital activities in the physical space (Churchill et al., 2004). *TiltRacer* (Vajk et al., 2008) is a gaming application utilising mobile phones as an input controller to play a car racing game visualised on a large public display.

Social media services have been used in public urban screen applications for various purposes such as viewing and uploading images from the online photo sharing service *Flickr*, browsing videos from a dedicated *YouTube* account, or using the account information from the social networking service *Facebook* for authentication to browse personalised content (Hosio et al., 2010). Munson et al. (2011) compared two public screen applications: the *Thank You Board* and the *SI Display*. The *Thank You Board* enables users to send structured thank you messages to a public display utilising a website containing a form for messages generation. The *SI Display* visualises *Twitter* messages on a public display directed at a specific Twitter user with the @username syntax. The study revealed that people preferred the *SI Display* due to the flexibility and openness of the system. In contrast, the study also showed that users were uncertain about the purpose of the system and what messages were appropriate to send to the screen. *Instant Places* (Jose et al., 2008) utilises a public urban screen and a Bluetooth device scanner, which periodically scans the surroundings for discoverable device names. The gathered device names are visualised on a public display whereas the system allows two modes for advanced screen interaction. First, users can specify tags in their Bluetooth device name. Second, users can specify a *Flickr* username in their Bluetooth device name, which triggers the
system to visualise the photo stream of the particular username. The study showed that such a system could facilitate situated messages regarding place and collocated people within.

*FunSquare* (Memarovic et al., 2011a) is a public urban screen application deployed in the urban computing testbed of the city of Oulu, Finland (Ojala et al., 2012). *FunSquare* aggregates environmental context data such as temperature or wind speed with facts from various categories such as sport or history and composes fun facts visualised on the urban public urban screen infrastructure of Oulu. Additionally, a trivia quiz has been deployed presenting multiple-choice options of matching environmental context data with facts. An initial user experience study showed that people appreciated the connections between the local context and global facts while others were confused by the sometimes odd correlations. It was also reported that “Oulu’s UBI-displays where often ignored by passers-by, making it difficult to observe many interactions with [the FunSquare] content” (Memarovic et al., 2011b, p. 8). While focusing mainly on non-interactive content, research on display blindness has shown that public urban screens are often ignored by urban dwellers (Huang et al., 2008, Müller et al., 2009). Research in Oulu further states that urban dwellers do not interact with public urban screens simply because they do not know that the installed public urban screens are interactive and suggest further research into how people can be motivated to interact with such systems (Ojala et al., 2012).

This paper presents real world deployments of public display applications enabling content sharing from existing social media sites utilising urban dwellers’ mobile devices. In contrast to previous studies, our approach focuses on social media and the possibilities to share such information with collocated people using mobile devices. This research combines the efforts of using existing social media services to control content on a screen (Munson et al., 2011), and combine and aggregate this information with additional social media resources (Jose et al., 2008), to enable digital in-place augmentations (Schroeter, 2012) through sharing data (Eriks-son et al., 2007, Rogers and Brignull, 2002).

### 6.6 Approach

Our approach in relation to the research problem and research question can be subdivided into three separate phases: exploration, observation, and interpretation.
The exploration phase begins with the concept building (Choi and Seeburger, 2011), then development, and finally an initial evaluation of a public urban screen application that enables urban dwellers to share content with their mobile devices. This first research cycle called Sapporo World Window (SWW) was initiated as part of a commercial research project winning a tender to get access to ten public urban screens and deploy an application in downtown Sapporo, Japan. The public urban screen application was deployed for an initial user study in the beginning of March 2011. However, conducting research in urban centres can be unpredictable (Kellar et al., 2005). Due to events beyond the control of the researchers, the research site in Sapporo was made unavailable after the earthquake on 11 March 2011 and its major implications. A new site was selected and a scaled down version of the application was then introduced into Brisbane, Australia, in order to facilitate the observational phase. Observations were conducted to investigate if and how urban dwellers interact with such a system.

The third phase, interpretation, involved a redesign of several parts of the system informed by the results of the observational phase. The newly designed and deployed system has been utilised to collect data about how people make use of the system and also utilising an online survey to collect data of people’s motivation and perception of the application.

The three steps of this research project - exploration, observation, and interpretation - helped to form an understating of how to engage urban dwellers with public urban screen applications. While the change of the research site was beyond our control, it opened up new insights into the role that the situated context of a public urban screen plays. This further corroborates previous research calling for multi-location evaluations due to the importance of the location of a public urban screen (Ojala et al., 2012). The following three sections describe each phase in more detail.

### 6.7 Exploration

The exploration phase was conducted to gather first insights into content sharing on public urban screens in Sapporo, Japan. Sapporo is the capital city of Hokkaido, the northernmost island of Japan. The city has recently completed the 4-year development of a public underground passage that links two major train stations. The passage is designed to promote Sapporo as a
“Creative City” especially in the domain of media arts. As such, the passage integrates a hybrid physical/virtual space named North 2, which contains ten large urban screens with webcams and audio speakers (Choi and Seeburger, 2011). Sapporo City Council invited application proposals to transform North 2 into a “public media space for communicating messages based on citizen’s creative activities about creative industry, tourism, art and culture, local government publicity and so on.” We proposed an open social media mash-up for knowledge exchange about creative hot spots and other interesting locations in Sapporo. It was accepted.

6.7.1 Sapporo World Window

We created SWW, an interactive screen-based application that focuses on enabling and encouraging people to share their creativity and knowledge about places in and around Sapporo. Six screens attached to the west-side wall of North 2, display a QR code and a collection of people’s creative outputs including videos, images, and comments about places in Sapporo from various social media services such as YouTube, Flickr, Foursquare, and Twitter. Use of QR codes is prevalent in Japan today, with most mobile phones natively equipped with QR code readers. As such, QR codes are featured prominently on the visual interface of SWW. By using QR Codes linking to mobile websites, pedestrians can easily find out more about the places shown on the screens, including what it is, how to get there, and what others have said about the places, as well as expressing their own thoughts. In turn, SWW helps people to turn the passageway into a social place, a “point of connection” that thrives on and inspires people’s sharing of creativity and knowledge with the locals and visitors alike.

Figure 6.1 visualises the overall system enabling SWW. The system consists of three main components: (1) website for content creation, (2) screen applications, and (3) a mobile website for each screen. Content created through the website is stored in a database for generating the screen applications and the respective mobile website when requested. Figure 6.2 shows the North 2 space screening SWW.

The initial concept of SWW contained an application feature to interact with collocated application users through the mobile user interface (Choi and Seeburger, 2011). Due to the fact

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1Official statement from the Sapporo City Council website when calling for application proposals in 2010. The call for application proposals has been removed from the website.
Figure 6.1: SWW system overview
that the application proposal was written without the opportunity to visit the space beforehand, we decided to remove this feature from the application proposal after being able to inspect the underground passage due to spatial and social constraints: the underground walkway is mostly used for travelling through the city. Therefore the application has been designed for passive interaction allowing passing urban dwellers to engage with the content without the need to directly interact. Additionally, mechanisms to interact with, contribute to, and create SWW content are provided.

6.7.2 Exploratory User Study

For the exploratory user study, we invited 10 participants to the underground space to interact with the application in the real environment. At the time of conducting the study, the construction of North 2 had already been completed but the site was not open to the general public. Participants consisted of 8 male and 2 female university students and staff, aged between 21 and 37. We first asked the participants to fill out a one-sheet paper based survey to gather demographic information and general questions about how they use the current underground passages in Sapporo. Following this, we asked them to explore the North 2 space and interact with the SWW screens as shown on the bottom part of Figure 6.2 followed by an open-ended semi structured focus group. The whole study was conducted in Japanese assisted by a Japanese interpreter. It lasted for approximately 90 minutes, was video recorded and transcribed. The same interpreter who was present at the study verified the English transcription.

The study participants mainly use the existing underground passages for travelling through downtown Sapporo or meeting someone in the downtown area especially during cold days, as the passages provide a warmer environment. Participants expected that they would use the new underground walkway for the same purposes. However, after viewing and interacting with SWW as well as other content to be deployed in the space, the participants expressed that they would come to see and “play” with the provided technology and information.

One emerging theme from the study was that seeing user-generated content in public urban places was perceived as novel. Despite the growing amount of public displays in urban environments in Japan and around the world, interactive user-generated content and services in
6.7. EXPLORATION

Figure 6.2: North 2 space screening SWW
public places still remain uncommon. Participants found it difficult to differentiate between purposefully prepared promotional content and user generated Web 2.0 content.

Participants highlighted three likely scenarios in which they would use SWW. First, participants expressed that North 2 would be a great meeting place, and that they would probably interact with the screens while waiting for someone in the space. Second, users pointed out that they would more likely use the application when they are in a group rather than on their own. The third scenario is directly related with the physical characteristics and constrains of the underground space. Because there are no shops or cafés in the vicinity of North 2, the space is constantly in flux. Participants said they would likely stop and interact with the screens if they see content that deals with subjects of their interest. This highlights the need for locally produced content about various niche and locally-specific points of interest rather than well-known and touristic locations. One participant stated: “If I [could] get some non-mainstream local, ‘underground’ information about smaller clusters to which some of my friends may belong, then it’s going to be a lot of fun for me [to use SWW].”

Study participants described SWW as a fun tool for local knowledge exchange within the city, which can transform the public space into a place of social collaboration and thus animating and promoting Sapporo as a whole. The exploratory study provided promising insights into how SWW and the concept of content sharing on public urban screens could be used and perceived by the citizens of Sapporo. After conducting this exploratory user study, the aim was to conduct further observational studies on how real users interact with the system during their daily lives. Previous research identified the discrepancy between laboratory and real-world studies (Ojala et al., 2012). An observational study could provide further knowledge into how different levels of engagement with SWW - from spectator to participant, then to content creator - can change people’s experiences of the public urban place.

6.8 Observation

Following the exploratory study, usage data of how urban dwellers interact with public urban screen applications and share data was required to provide more insights into the concept of content sharing on public urban screens. An observational study has been conducted at an urban
public screen installation at a shuttle bus stop at a university campus in Brisbane, Australia.

6.8.1 Brisbane Hot Spots

Due to the change of location for the observational study, SWW had to be redesigned and adapted towards its new application context. The concept of SWW has been repurposed for the public urban screen in Brisbane. Several distinctions had to be considered for Brisbane Hot Spots (BHS):

- instead of having access to 10 HD screens, BHS had to be recreated to operate on one screen;
- instead of showing BHS in portrait mode like SWW, BHS has to be recreated to operate in landscape mode;
- the user interface which had been designed for a Japanese audience had to be redesigned;
- no audio is available at the bus stop location.
6.8.2 Observational User Study

To get insights into how urban dwellers interact with BHS, a covert observational study has been conducted. Over a time span of five days, the researchers went to the bus stop 7 times for one-hour intervals to observe if and how people react and interact with BHS. The covert observations found three categories of potential users:

- **Walk by:** People pass the bus stop screen and are able to watch the content while walking by.
- **Sit:** People sit on the benches of the bus stop.
- **Stand:** People stand in the vicinity of the bus stop and are able to watch the content while walking by.

In addition to this categorisation, all people in the above categories have further been grouped into groups according to their level of involvement with BHS.

- **Short glance:** People notice the content on the screen and have a short glance of around 1 to 2 seconds but then move their focus of attention to something else.
- **Long glance:** People notice the screen and look at its content for a longer period of time. People in this category passively engage with the screen’s content.
- **User:** People who stop, look at the screen’s content and scan the QR code to get more information about the content on the screen.

Figure 6.4 shows the results of this observational study. During the 7 observations distributed over 5 days, 802 people could be observed as potential users. Out of these, 63 people could be categorised into the group of people who shortly glanced at the BHS application, and only 11 people looked at the screen’s content for a longer period of time. Out of the 802 observed potential users, not a single person tried to scan the QR code shown prominently on the screen.
6.8. OBSERVATION

During the observation, several factors influencing the interaction with the urban screen have been revealed and are discussed in the next subsection.

6.8.3 Findings

While the reported numbers of the observational study presented above are quite low in terms of people noticing and interacting with BHS, the observations revealed several indicators how the design of the space and the setup of the screen influenced these results.

Screen orientation. The main activity for people who sit at the benches or stand near the bus stop is waiting for the next bus to travel to a second campus location. Therefore, people mostly observe the streets to see if the bus is driving down the street. The public urban display on the other hand is attached to the lower end of the bus stop roof as shown in Figure 6.5. As most people are facing the street, the content shown on the public display is not in a position where it is noticeable for people waiting at the bus stop.

Screen location and bus stop location. Figure 6.5 shows the bus stop with benches and the urban public screen attached to the lower end of the roof. However, the actual location where the bus stops, is about 15 meter further down the road. During peak hours, students immediately start queuing at the actual location where the bus will stop instead of waiting at the bus stop booth. On one occasion it could be observed that even if the queue of people waiting for the bus...
is going all the way down to the bus stop booth, people still face the streets and therefore ignore the screen.

**Flow of people.** Through observing the bus stop, several patterns of how people traverse through the space could be identified. Due to the buildings surrounding the bus stop, the main stream of people is not directly passing the urban screen at the bus stop. The black lines in Figure 6.5 indicate the flow of people. As visualised in Figure 6.5, the main flow of people is going from a university building located opposite the bus stop towards a mixed use building on the left side of the bus stop using the pedestrian crossing and vice versa. Additionally, as visualised in Figure 6.5, a significant amount of people who pass the bus stop walks on an angle towards the garbage bin to dispose their rubbish and walk away from the bin on an angle resulting in not noticing the public screen.

**Looking down, not up.** People who actually sit or stand at the bus stop mostly look down and focus on their mobile device rather than looking up towards the public screen.

**Public interaction.** Due to the way the screen is attached to the bus stop roof and the orientation
and angle of the screen, people who want to experience the screen’s content mostly stand right underneath the bus stop roof between the two benches. Interacting with BHS through scanning the QR code visualised on the screen results in a public interaction visible for collocated people. As reported in previous research (Brignull and Rogers, 2003), social embarrassment through this sort of public interaction can be a key factor why people do not interact with public urban screens in this way.

**Environmental conditions.** The bus stop roof is made out of transparent glass resulting in low visibility during sunny days in Australia.

### 6.8.4 Summary

The observational user study confirmed how rarely people notice and look at public urban screens (Huang et al., 2008, Müller et al., 2009). Not a single interaction in terms of scanning a QR code could be observed. On the other hand, the observational user study revealed how the design of the public urban place and the display within can influence and hinder interactions. An artful integration of screen and space is required.

The initial design concept behind BHS is based on SWW. SWW on the other hand was particularly designed for the characteristics of the North 2 underground space. SWW would have been exposed to over 100,000 people a day in a more open public urban place with urban dwellers having different backgrounds than those at the bus stop in Brisbane. Potential users who spend time at the bus stop where BHS was shown were mainly university staff and students travelling to the second campus location in Brisbane. Given the fact that people who spend time at the bus stop mostly have to attend classes or meetings at the second campus and are generally familiar with Brisbane and its surroundings, the whole concept of aggregating social media about interesting locations seems not as suitable as it would have been within the Sapporo context.

The results of the observational user study provide implications into how to design an application for the bus stop screen context. The next section describes the third iteration of studying the concept of content sharing on public urban screens incorporating the lessons learnt from the exploratory and observational study.
6.9 Interpretation

The results of the observational study described in the previous section resulted in a reiteration of the current interactional and conceptual process of information sharing on public urban screens. The observational study showed that the spatial and social context of a public urban screen application has to be carefully considered to create engaging public urban screen content sharing applications. To gather deeper insight into the concept of data sharing on public urban screens, we redesigned the current implementation deployed in Brisbane incorporating the findings and experiences from previous iterations and conducted further user studies. The following design principles derived from the observational study were embedded in this iteration.

**Private interaction.** Instead of having to scan the QR codes as the only means to interact with the public urban screen application, such applications should utilise mechanisms which enable users to control and interact with the content shown on the screen in a private way.

**Lightweight content.** SWW and BHS are based on aggregated content from various social media services showing media for a particular location. Users are able to create new content through an online form, which is then shown on the urban screen upon approval. However, the content creation process involves some thought in form of researching content from existing social media sources. This complexity of process hinders in-situ content creation while in front of the urban public screen. Additionally, the SWW user study described earlier showed that study participants would more likely interact with the urban screens if the content would show subjects of their particular interests. Therefore, the third iteration should employ a simple and in-situ approach for content creation, sharing, as well as consumption while being in front of the urban public screen.

**Auditive experience.** To draw more attention to the urban public screen, speakers are utilised for audio output in addition to the visual information shown on the screen. This should help to get the attention of people when environmental conditions such as bright sunshine hinders visibility of the content shown on the public screen. However, audio should only be played if a user interacts with the system possibly resulting in what Brignull and Rogers (2003) call the “honey-pot effect”.
6.9. INTERPRETATION

6.9.1 YourScreen

The concept behind SWW and BHS is to share favourite locations through aggregating various sources from existing social media sites. To incorporate the previously mentioned design principles, this concept had to be significantly changed. Instead of sharing locations on public urban screens, the new iteration named YourScreen, enables urban dwellers to share online videos. YourScreen aligns to the concept of a music Jukebox, enabling urban dwellers to consecutively play videos on the public urban screen visible for all collocated people. YourScreen provides private means to play online videos hosted by the video storage service YouTube on the public urban screen while waiting at the bus stop. To enable urban dwellers to watch YouTube videos on the public urban screen, existing social media services have been repurposed to submit videos to the YourScreen application.

Similar to the SI Display application (Munson et al., 2011), our public urban screen has been equipped with a user account from the micro-blogging service Twitter. Additionally, a fan page on the social networking service Facebook has been created. Through utilising these services, private means for interacting with the public urban screen are provided to urban dwellers as they are able to send a link of a YouTube video to the YourScreen Twitter account using the
‘@TwitterName’ syntax or share the link on the fan page on Facebook. While the observational study described in the previous section showed that not a single observant scanned the QR code, we decided to additionally add a QR code linking to a mobile website enabling video submission for urban dwellers without accounts in the utilised social media services. However, in this iteration we also visualised the URL encoded in the QR code at the public urban screen application. Figure 6.6 shows the waiting screen of the YourScreen application explicitly stating the purpose and functionality of the application.

Once the YourScreen system receives a video submission via Twitter, Facebook, or the mobile website, the waiting screen shown in Figure 6.6 fades out and the video screen as shown in Figure 6.7 fades in and starts playing the video. If multiple videos are submitted at the same time or while already screening a video, the received videos are added to a playlist visualised underneath the currently played video in Figure 6.7. After all videos in the playback queue have been screened, the video screen fades out and the waiting screen re-appears. The waiting screen in Figure 6.6 and the video screen both state explicitly what functionality the urban screen application offers and how to interact with the screen. As stated in the literature review, previous research emphasised the importance of stating what an urban screen application is designed for and what it has to offer to stimulate interaction with an interactive public display.

Figure 6.7: Yourscreen application screening a video
Through utilising Twitter, Facebook, and a mobile website for video submission, YourScreen can be used by a variety of smartphone models, touch devices, as well as portable computers without the need to develop various mobile device applications for multiple operation systems. Additionally, the utilised services enable ad-hoc and in-situ interaction with the YourScreen system without the need to download and install software.

6.9.2 Data Collection

YourScreen has been deployed at the same public urban screen (Figure 6.3) that has been studied during the observational phase. While the interaction with the screen itself is private in a way that collocated people cannot know who submitted a video, we have access to the usernames of people who submitted videos through the utilised social media services and email addresses from people who used the mobile website. Given that urban dwellers spend approximately 5 to 10 minutes at the public urban screen before the bus arrives, we decided to employ an online survey stating open-ended questions to gather more insights into the motivation, experience and perception towards the YourScreen application. Additionally, all video submissions have been stored in log files to collect insights into how urban dwellers make use of such an application and what type of content is shown on the public urban screen. Therefore, we replied to Twitter messages containing a YouTube URL with an invitation to fill out a survey and commented on Facebook entries shared on the YourScreen fan page. The survey URL has also been shown to users who used the mobile webpage after submitting a video. The possibility to win an MP3 player has been offered as an incentive for users to fill out the survey.

6.9.3 Results

The data presented in this section is based on a 10-week real-world deployment of the YourScreen application. During this time period, 183 video submissions have been received from 79 distinctive users. The average user submitted 2.4 videos (standard deviation (SD): 3.2, maximum (max): 19, minimum (min): 1) to the screen. More than half of all video submission were received through the micro-blogging service Twitter (52%), followed by the mobile website
with 44%. Only 4% of the received videos were shared on the fan page of the social networking service Facebook. Altogether 16 responses from application users could be collected through the online survey. The next subsection presents the quantitative data about application usage recorded through the YourScreen system followed by a presentation of the qualitative data collected through the online survey.

6.9.3.1 User Interactions

All video submissions have been logged in regards to their YouTube categories. The majority of over 65% of all submissions are in the categories music, comedy, and entertainment containing for example music video clips, funny excerpts from comedy TV shows, or celebrities. The remaining categories mostly focus on specific interests such as car tuning (auto and vehicles), screen cast from massively multiplayer online role-playing games (games), excerpts from sports events (sports), political speeches (people and blogs), new technological developments (science and technology), or charity movements (nonprofits and activism). The analysis of the logged categories in combination with the survey results shows a trend towards two screen usages. First, urban dwellers who submit a video such as popular music videos and ‘funny’ videos, which might also be liked by the majority of collocated people. Second, urban dwellers who selected more specific videos such as political speeches or excerpts from sports events, which might be of particular interest for the user or to share this particular interest with collocated people. As reported in previous research, some users try to ‘troll’ or ‘game’ public urban screen applications (Schroeter, 2012). In the case of YourScreen, some users tried to ‘game’ the system by submitting up to 10 hour-long videos containing audio/video loops of the same video sequence. Another user ‘trolled’ YourScreen through submitting a slightly sexist video 10 times in a row. Besides these two cases no other instances occurred.

Through logging timestamps of video submissions, two peaks of interactions could be recorded. One peak of interactions is situated around lunchtime in the early afternoon and the second peak in the early evenings. Due to the location of the urban public screen, the first peak of interactions can be explained through the vicinity of restaurants and people passing the screen on their way to lunch. The second peak results in the heightened visibility of the public urban screens content due to the early sunsets in autumn in Brisbane. Additionally due to the visibility of the screen’s
content, more interactions have been received in cloudy and rainy days rather than sunny days. During the real world study of YourScreen, we noticed that the application attracted some urban dwellers who extensively used the application over the period of deployment whereas most of them always played the same video. Overall, comparing the recorded interactions with the previous iteration of BHS, incorporating the proposed design principles could encourage interactions with YourScreen.

6.9.3.2 User Experience

After interacting with YourScreen, 16 users filled out the online survey, 9 male, 7 female, aged between 15 and 35 (mean: 23.1). Out of the 16 participants, 13 responses were collected from students studying on various levels (high school, undergraduate, postgraduate) and the remaining three responses were collected from university staff and nearby service employees. The qualitative data from the online survey has been organised around reoccurring themes followed by searching patterns and connecting threads (Seidman, 2006). The data presented highlights the subjective user experiences (Hassenzahl and Tractinsky, 2006) aggregated around these themes.

We asked in the online survey what participants’ first impression of the public urban screen application was. Generally, the idea of being able to control the content of public urban screen has been perceived as “awesome”, “cool”, and “an interesting concept.” One response in particular mentions that “the idea of employing a choice of entertainment that people can relate to (TV) as well as request for their favourite video is a good and well thought idea.” Showing TV program in public and semi-public urban places is a common utilisation of public urban screens, but empowering urban dwellers to have a say in what is shown is a novel concept.

We were interested in what motivated urban dwellers to submit a video to the public urban screen. Three themes could be identified: idle time, curiosity, and reactions from collocated people. Due to the context of the YourScreen application, urban dwellers spend time close to the public urban screen waiting for the next bus. One participant explains that he “was waiting for a bus one day and decided to try it” and a different response reported that the participant “had some free time and was interested.” Having nothing to do while spending time in public
can result in YourScreen interactions. The responses showed that the concept of sending content to the public urban screen has been perceived as novel and piqued urban dwellers’ curiosity. People wanted to test the functionality of YourScreen “to see what happens” and were surprised that the submitted videos were played immediately. One response states that “first [it was] curiosity I would say. [I] Wanted to see, what will happen in the screen and around me, if I send the request.” This and other statements show that YourScreen piques urban dwellers’ curiosity towards the application itself and the reactions of collocated people.

YourScreen raises the awareness towards collocated people. We asked participants why they choose the video they submitted. Some participants based their video submission on what they thought other collocated people might like. One participant states, “I thought [my video submission] was pretty broad, and would cater to other people’s tastes as well.” Another participant explains his considerations for his submission: “I think the action in the video would have been an entertainment to everyone present at the stop,” whereas another participant states that with his submission he “wanted to rock out the street a bit.” Another group of participants selected videos based on their own tastes and preferences. For example, participants mentioned that they had submitted videos of songs that were stuck in their head, submitted their favourite song, or music videos by their favourite bands.

We wanted to know what reactions by collocated people urban dwellers observed after they submitted their video choice to the public urban screen. Due to the nature of the application’s context, half of the participants reported that the bus arrived shortly after they submitted their video and one person tried the application while being alone at the bus stop. However, other participants reported how collocated people reacted to their submissions. For example one participant who submitted a ‘funny cat’ video explains how she noticed that other people “were weirded out” whereas another participant states that his video submission “changed the mood of the surrounding area, and really caught people’s attention.” Other reactions reported include that people were confused and even scared after the YourScreen application suddenly started to play a video, collocated people were laughing at a funny video submission, and one participant stated that the collocated people “seemed new to this and few of them interested in watching the song.” Another participant gives a detailed description of the surroundings: “There were three people standing fairly close to the screen, because it was raining. One person was scared coz
the screen suddenly plays the video, and mainly because it was a loud first beat. The other 2 people were on their headphones, doesn’t seem like they care.” It seems that through having the ability to send content to a public urban screen, people are not only aware of what content they might submit and for what kind of audience, but also observe their surroundings or as one participant states that he “might try different type of videos to see different reaction of people. E.g. news/comedy/viral videos.”

After interacting with the YourScreen application, we wanted to know what urban dwellers think about the ability to send content to a public urban screen at a bus stop location and how they felt when their video submission was played on the screen. YourScreen gives urban dwellers something to do while waiting for the bus and has been perceived as “a really cool idea and a great way to pass time.” Another participant states that from now on, he does not have to worry about missing the bus because there is something to do while waiting. In general the adjectives used to describe YourScreen are: awesome, fun, pretty cool, amazing, brilliant, and ingenious. Participants reported that they felt excited and thrilled when their video was played. “The first time I did it, I was quite excited. It came up straight away on the screen and I thought that was brilliant. I would say, the volume needs to be turned up.” Another participant reports his experience of seeing a video he submitted to a public urban screen: “This was the first time I encountered such an application [...] I felt thrilled.” Other participants described the feeling of seeing their submission played through the YourScreen application as impressed, interested, slightly amused, super cool, and enjoyable. It has also to be noted that one participant felt dissatisfied and embarrassed because only the audio without video was played due to an outdated version of a browser plugin. Another participant who played her own music video to observe reactions from collocated people reported that she felt apprehensive due to the public exposure. The previous example where the YourScreen application has not screened the video and only played the audio shows how bugs of a public urban screen application can negatively influence people’s experience.

Overall urban dwellers enjoyed interacting with YourScreen and many people used the application more than once. The interaction possibilities of YourScreen created a community around the bus stop. One participant explains: “I’ve tweeted at the screen whilst at the bus stop. On this particular occasion, I was listening to a song at the [...] library and decided to tweet it to the bus
stop, just in case there were people there. I like the song that much.” The statement shows how the participant was aware of the YourScreen application and people possibly spending time at the bus stop and wanted to remotely share her experience of listening to a music video. Another participant explains her emotional connection to the people spending time at the bus stop: “I was at home and I felt bad for the poor people who were at [university] that day. Thought I’d give them something to watch while waiting for the bus.” These statements show how YourScreen can create a sense of community in public urban places.

6.10 Discussion

We set out to explore how public urban screens and mobile phones can be utilised to share data in the urban space and how this might be perceived and experienced by urban dwellers. A comparison and synthesis of research results and findings in the area of public urban screen applications and their impact seems challenging due to the varying contexts of public urban screens: city centres (Memarovic et al., 2011a, Ojala et al., 2012), social events such as a book launch or welcome party (Brignull and Rogers, 2003, Rogers and Brignull, 2002), a university setting (Munson et al., 2011), a lab environment (Eriksson et al., 2007), a campus bar (Jose et al., 2008), and professional events (Churchill et al., 2004, Vajk et al., 2008). Our data shows that while location sharing did not entice interactions on the public urban screen at the bus stop location, sharing videos could create user interactions and a positive user experience while waiting for the bus.

Previous research found that both, the spatial and the social contexts of a public urban screen influence the occurring interactions (Ojala et al., 2012, Taylor and Cheverst, 2012). While, for example, a public urban screen in a swimming hall building resulted in collaborative interactions between collocated people (Ojala et al., 2012), our observations showed that a more isolated social context exists at the bus stop. The research presented in this paper is based around two different spatial and social contexts, the underground walkway in Sapporo, Japan and the bus stop location in Brisbane, Australia, where the concept of location sharing has been adapted to a different context as initially designed for. While both public urban screen applications enable content sharing, various differences in the interaction design and presentation have been made
to suit the respective spatial context. The underground walkway in Sapporo is a transitional space, which is used by urban dwellers to comfortably traverse through the city and does not provide any street furniture such as benches to allow urban dwellers to rest and spend time in the particular space. The bus stop on the other hand is mostly a dead-end space where urban dwellers wait for public transport to arrive. While people are actively traversing through the transitional space, people are passively waiting at the dead-end space. We suggest that in public urban places, in which urban dwellers passively spend time such as at a bus stop, public urban screen applications should actively encourage interactions through stating explicitly what they have to offer resulting in an immediate response from the application after interaction. On the other hand, in locations in which urban dwellers actively engage in activities such as walking from one place to another, public urban screens should passively broadcast for example previous interactions and provide additional means such as QR codes for interactions for interested urban dwellers. The public urban screens deployed in Oulu, Finland, offer a hybrid approach of passive mode showing media presentations and the (inter-)active mode when sensors detect urban dwellers in the vicinity (Ojala et al., 2012). Further research is needed in the area of how to visualise interactivity in public urban screen applications when the screen is deployed in a transitional space showing passive interaction possibilities.

The study conducted with YourScreen showed how public urban screens can be utilised to create a connection between people at the bus stop as well as between remote, non-present people and people at the bus stop. Previous research found that public urban screen applications could raise the awareness towards the events held within a community through sharing such information on public urban screens (Taylor and Cheverst, 2012) and raise the awareness towards online communities in a physical gathering of such a community (Churchill et al., 2004). This study showed how public urban screen applications could raise the awareness towards collocated people in a public urban space. This awareness is created through enabling urban dwellers to control the content on public urban screens. For example, being able to select and show an online video on a public urban screen makes application users carefully consider their submissions towards how other people might like it and react. Our data shows that application users either selected videos suiting their own interests or selecting videos that other people might like.

Urban planners and designers create opportunities for people to for example stand, sit, and
move to activate public places (Whyte, 1980). This study showed that public urban screen applications could activate public urban places through sharing content on screens and mobile interactions. Applications such as presented in this paper enable urban dwellers to customise the urban experience by being able to control and push content to public urban screens. Being able to take an active role in public urban spaces through sharing content on public urban screens results in novel experiences raising awareness towards collocated people.

Utilising existing and well-known social media services and promoting them on a public urban screen resulted in interactions between urban dwellers and the urban environment. The advertised Twitter account for the public urban screen at the bus stop received 27 messages from urban dwellers not containing a URL to an online video. Instead, messages contained feedback about the application: “[I’m] back at Kelvin grove and I just watched an @amazingphil video in public! :D it was funny too :) use @QUTBusStop and a link :)”, messages directed at the bus stop itself: “Need a shaded shelter at @QUTBusStop”, the bus service: “where is ma bus!!!!”, or messages describing activities and moods of urban dwellers: “Ditching lectures to go shopping in the city with @[username] :).” It seems that creating and attaching social media to public urban places can itself create open and uncontrolled messages in reference to people, place, and technology. While previous research which utilised Twitter for communication between a mobile device and a public urban screen reported that the openness of a system through not restricting the Twitter usage made people unsure about the displays’ usage and hindered some people from interacting (Munson et al., 2011), our research shows that stating strict rules of how to use the social media technology can encourage urban dwellers to break these rules and reappropriate the technology towards their desire.

6.11 Conclusion

This paper presented research towards enabling urban dwellers to share content on public urban screens with collocated people using their mobile phones. The study presented in this paper described three research phases: exploration, observation, and interpretation. The three phases were spread across two different social and spatial contexts resulting in a conceptual and interactional shift within the studied concept of content sharing on public urban screens. This
paper set out to explore how public urban screens in combination with mobile phones could be utilised to create a more social and enjoyable feeling while spending time in public urban places. We conclude that utilising existing multimedia content in combination with being able to anonymously share and showcase such content can result in a positive experience piquing users’ curiosity towards the public urban screen, collocated people, and how they might react. In this way, the research showed that observational studies of public urban screen environments are an essential part in designing engaging applications.

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6.13 Epilogue

The third case study on public urban screens and mobile phone interactions provided further insights into the question of how ICT can be applied in public urban places to influence user experiences. The YourScreen study showed how ICT can be applied in a way to relieve boredom and pique the curiosity of urban dwellers resulting in a raise awareness towards collocated people. Chapter 7 further discusses boredom, curiosity, and awareness in relation to YourScreen as well as the PlaceTagz (Chapter 5) and Capital Music (Chapter 4) case studies.

As mentioned in this chapter, this case study went through three phases of research: an exploratory phase, an observational phase, and an interpretational phase. Each of these phases within this case study involved different user interfaces for mobile mediated interactions with the public urban screen application. Figure 6.8 shows the initial user interface for the concept of Sapporo World Window as submitted to the Sapporo City Council in the tender application. After visiting Sapporo and learning about the culture as well as inspecting the underground walkway where Sapporo World Window should be deployed, the interface design changed
significantly as shown in Figure 6.9. Each screen within the Sapporo World Window application has a dynamic layout to enable urban dwellers to comfortably scan the QR codes. As visualised in Figure 6.2 the height of the QR code varies from screen to screen of the Sapporo World Window application. The height of the QR code is always within reach as shown in the bottom right image of Figure 6.2 Additionally, the embedded URL is also visualised on the respective screen.

All design interventions within the public urban screen and mobile phone interactions case study have been developed with the Ruby on Rails web application framework. Therefore, these design interventions can be shown on public urban screens using a common Internet browser in fullscreen mode calling the URL of the respective application. The PhD student decided to learn and use the Ruby on Rails web application framework due to its “plug and play” approach to software development. This “plug and play” approach was beneficial to technically implement the very first working prototype as shown in Figure 6.8 and gradually iterate towards the SWW interface as shown in Figure 6.9 and the modified BHS system. In retrospect, a dedicated desktop application using for example Adobe Flash as authoring tool would have been a more suitable choice due to the following reasons:
The wireless network at the bus stop is provided by Queensland University of Technology. The wireless network requires users to type in login credentials to access webpages outside the university network to create a user session. This user session expires after an unspecified amount of time. This resulted in occasionally losing the internet connection and displaying the login webpage after a video was submitted due to the expired user session. A dedicated desktop application can circumvent this problem.

While the benefit of having the design interventions hosted on a web server is that they can be easily accessed through a web browser, using a web browser for public urban screen applications can also have drawbacks. Usually web browsers are designed to surf through the World Wide Web. The public urban screen applications however are opened once in the browser and are then screened for days. The PhD candidate experienced that web browsers are not designed to just present information for a long period of time and occasionally updating content though asynchronous javascript calls. Sometimes, a javascript stopped working and needed a restart or a style sheet was not loaded properly.

The public urban screen applications had to be closely monitored and occasionally restarted to
ensure full functionality. On the other hand, some users utilised Twitter to report the malfunction of the YourScreen application. Overall, designing and developing these design interventions utilising the Ruby on Rails web application framework helped to create these applications to a stage where the general public could easily interact with them for data collection and analysis.

The YourScreen application is still deployed at the bus stop and urban dwellers submit videos while waiting for the bus. Over 500 videos have been played at the public urban screen showing the YourScreen application since conducting the study described in this chapter. In the future, PhD student Jimmy Ti, who specifically investigates user experiences created through mobile mediated interactions in public transport, is using the YourScreen application for his research. Jimmy Ti deployed the 391 PaX² iPhone application, which enables users to leave doodles at specific seats and also enables them to participate in a real-time passenger chat. Both applications will be coupled so that 391 PaX users can send YouTube videos to the screen utilising the iPhone application. Additionally, features such as automatically sending YouTube videos to the YourScreen application utilising the iPhone’s GPS signal are possible.

Chapter 7

Discussion


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7.1 Preamble

The purpose of this paper is to provide an overall analysis and discussion of the conducted case studies. So far, three case studies have been presented. Chapter 4 discussed the user experience of Capital Music, a mobile application allowing users to discover what songs are currently played in vicinity and also enabling private means for exchanging messages. Chapter 5 presented the study on PlaceTagz, QR codes printed on stickers placed in unusual locations linking to digital message boards. Chapter 6 discussed the research conducted with public urban screens and content sharing utilising mobile phones.

The studies presented in Chapter 4, Chapter 5, and Chapter 6 evaluated the respective design intervention in regards to the user experience of interacting with the application. This chapter provides an analysis on the impact on the urban experience of having design interventions as
described in each case study used in public urban places. The impact of the design interventions is discussed in terms of activities and social interaction in place, boredom, curiosity and awareness, as well as anonymity and lightweight data.

This chapter is a response to the second research question stated in Chapter 1: How does the establishment of ICT-mediated social interactions between collocated users influence the experience of those users in particular urban spaces?

7.2 Abstract

During everyday urban life, people spend time in public urban places waiting for specific events to occur. During these times people sometimes tend to engage with their Information and Communication Technology (ICT) devices in a way that shuts off interactions with collocated people. These devices could also be used to better connect with the urban space and collocated people within. This paper presents and discusses the impact of three design interventions on the urban user experience enabling collocated people to share lightweight, non-privacy sensitive data in the urban space. We investigate and discuss the impact on the urban experience under the notions of people, place and technology with an emphasis on how the sharing of non-privacy sensitive data can positively transform anonymous public urban places in various ways through anonymous digital augmentations.

**Keywords:** Urban Informatics, Mobile Phones, Public Displays, User Experience, Urban Experience

7.3 Introduction

As the majority of the world’s population now lives in urban environments (UnitedNations, 2008), much attention has recently been paid to the research field of urban computing which promises to solve some of the resulting problems that modern cities face through the densification of the urban space such as providing more effective transportation or improving the sustainability of cities. Urban Computing is defined as “the integration of computing, sensing, and actuation technologies into everyday urban settings and lifestyles” (Kindberg et al., 2007, p.
18). While urban computing research is mostly focusing on the technology itself, the emerging research field of urban informatics is investigating the impact of technology on people in urban environments (Foth, 2011). Urban Informatics is defined as “the study, design, and practice of urban experiences across different urban contexts that are created by new opportunities of real-time, ubiquitous technology and the augmentation that mediates the physical and digital layers of people networks and urban infrastructures” (Foth et al., 2011, p. 4). One opportunity to utilise real-time ubiquitous technology in urban environments could be to augment the public urban space with a digital layer containing information about colocated urban dwellers (see Chapter 4, 5, and 6).

The major uptake of social media in combination with the widespread use of mobile devices equipped with a constant connection to the World Wide Web and GPS functionality gave rise to new kinds of mobile applications enabling people to connect to their social circle while on the move. During everyday urban life, people spend time in public urban places waiting for specific events to occur. While waiting, people sometimes tend to use their ICT devices to create a cocoon while in public shutting off interactions with colocated people (Bassoli et al., 2007, Crawford, 2008, Mainwaring et al., 2005). On the other hand, location-based services, which deliver content according to the location of the user (Junglas and Watson, 2008), enable urban dwellers to retrieve information about nearby places. Gordon and de Souza e Silva introduce the term NetLocalities, stating that “location-aware mobile technologies can change the way we experience both, physical and digital spaces by configuring a new hybrid space, which is composed by a mix of digital information and physical localities” (Gordon and de Souza e Silva, 2011, p. 56).

This paper reports on our research efforts studying the impact of utilising location-aware mobile technologies on the experience of physical spaces through. During a three-year study, several digital artefacts have been deployed and evaluated in the urban space enabling anonymous colocated people to collaboratively augment the urban space (see Chapter 1). Each digital artefact has been evaluated against the user experience it helped create and the results have been reported elsewhere (see Chapter 4, 5, and 6). Due to the lack of a common definition of the term user experience (Bargas-Avila and Hornbæk, 2011, Law et al., 2009), a framework for designing and evaluating user experiences has been established and applied for the purpose
of this study (see Section 3.2). This paper presents an analysis that goes beyond the subjective user experiences (Hassenzahl and Tractinsky, 2006) of interacting with the digital artefacts and focusses on discussing the wider impact on the urban experience.

In this paper we try to answer the question how the establishment of mobile mediated interactions and digital augmentations can influence the experience of people in public urban places. Our discussion draws on research informed by urban sociology, psychology, and urban design to provide insights into how mobile human-computer interaction and urban informatics (Foth et al., 2011) design interventions can create urban user experiences that go beyond interacting with a product and digitally augment and amplify the collective sociality in public urban spaces (Paay and Kjeldskov, 2008).

The remainder of this paper is structured as follows: The next section presents and discusses the three design interventions and the interactions and augmentations they create. Afterwards, a detailed discussion on how such applications can have an impact on the user experiences in public urban places with regards to people, place, and technology is presented, followed by concluding remarks and future research directions.

### 7.4 Urban Digital Design Interventions

The subject of this study are three mobile and screen-based applications, which have been designed to enable collocated people to anonymously exchange lightweight data in the urban space. Figure 7.1 visualises the user interfaces of the designed applications. The iOS application Capital Music is depicted on the left, PlaceTagz and the respective interactive mobile website in the middle, and YourScreen on the right side of the image, whereas the top image shows the screen waiting for submissions, and the bottom image shows the user interface while playing a video submission. The following subsections introduce each design intervention and summarise the findings. A detailed study of each design intervention can be found in the respective referenced chapter.
7.4. URBAN DIGITAL DESIGN INTERVENTIONS

Figure 7.1: Three design interventions aiming to positively influence the experience in urban public places: Capital Music (left), PlaceTagz (middle), and YourScreen (right)

7.4.1 Capital Music

Capital Music is a mobile application designed for iOS devices, enabling application users to listen to their music as usual but also visualising album artworks of songs currently played in vicinity. Users are able to anonymously send and receive ‘like’ and text messages based on currently played song only utilising nicknames. The user interface visualised on the left side of Figure 7.1 shows a mosaic of album artworks where each artwork represents a collocated user. Tapping one of the artworks reveals more information about the song choice such as album, artist, title, and genre.

A paper-based study utilising post-it notes evaluated the concept of anonymous music sharing and guided the design and the development of Capital Music (see Section 4.1). A user experience study utilising the Wizard of Oz method to simulate a real world environment has been conducted and described in detail (see Section 4.2). In summary, Capital Music raised awareness toward collocated people and piqued users curiosity in terms of who is listening to what in the physical space. Capital Music has been described as a voyeuristic tool to peak into people’s music listening habits and aids in reconsidering perceptions towards collocated people. Sharing, recommending, and discovering music in combination with anonymous social user interaction has been perceived as a fun and entertaining activity while using public transport.

The peer-to-peer approach employed by Capital Music enables users to exchange lightweight data in form of meta data about currently played songs with other users who are in the same place at the same time. A radius slider in the user interface allows users to control the reach of
the song updates they receive. A user can be in multiple location-based peer-to-peer networks and thus exchange song information as visualised in Figure 7.2.

Capital Music interactions and augmentations are only visible to application users in a “right here and right now” approach, whereas the album artworks being exchanged are not persistent and therefore not visible for later users.

7.4.2 PlaceTagz

PlaceTagz are QR codes printed on stickers that are linked to an online message board enabling collocated users to interact with each other over time resulting in a place-based digital memory. As visualised in the middle of Figure 7.1, a PlaceTag sticker only contains the QR code and an icon without explicitly revealing purpose or destination. After scanning a PlaceTag with a mobile phone, users are redirected to a website containing location-based information and questions - enabling users to leave a comment for later users. The stickers have been mostly deployed in places where people spend time on their own, the place is mostly used for only a short period of time, or people are resting and are waiting for a specific event to occur. Examples are public toilets, park benches, public workstations in a library space, or coffee shop counters.
A content analysis of 121 received comments and semi-structured interviews with people who submitted comments has been conducted (see Chapter 5). Summarised, decontextualised QR codes with means for social user interaction and location-based digital representations were perceived as novel, intriguing, and interesting, and stimulated user responses relating to collocated people, place, and the PlaceTagz technology itself.

Figure 7.3 visualises a conceptualised view of how one PlaceTag enables interactions and augmentations in the urban space. PlaceTagz enable interactions for collocated people over time resulting in persistent augmentations and interactions visible for future users who scan the QR code.

7.4.3 YourScreen

YourScreen is a public urban screen application deployed at a bus stop allowing users to collectively watch online videos while waiting for the bus. As part of this design intervention, the bus stop screen has been equipped with a user account from the micro-blogging system Twitter and
a fan page on the social networking service Facebook. Urban dwellers can use these services to submit videos from the online video service YouTube utilising their mobile devices.

A study based on a ten-week deployment at a bus stop location has been reported in detail elsewhere (see Chapter 6). Summarised, received video submissions and the conducted user study showed that urban dwellers submitted videos out of curiosity, to overcome boredom, and observe reactions of collocated people. YourScreen has been perceived as a fun application and urban dwellers submitted videos they thought other collocated people might like. Additionally, urban dwellers not present at the screen location submitted videos for people located at the screen to share their favourite videos.

Figure 7.4 shows a conceptualised view of the interactions and augmentations enabled through YourScreen. YourScreen enables urban dwellers to share digital augmentations in form of videos with people who are at the same place at the same time. While the interaction with the public urban screen privately takes place on the mobile phone, the resulting interaction is visible for collocated people who spend time at the bus stop. Like Capital Music, the augmentations are not persistent and only visible at the time of interaction.
7.5 Impacting the Urban Experience

The following subsections discuss the impact of anonymous mobile mediated interactions on the urban experience utilising urban informatics’ (Foth et al., 2011) guiding triad of people, place, and technology as analytical pillars. However, the division between people, place, and technology is often overlapping and cannot always be clearly distinguished. People collocated in public urban places and the social interactions which occur, are experienced as the “filling” of space (Lechner, 1991). Therefore we discuss the impact on the urban experience as perceived by the individual urban dwellers in the people subsection. The place section analyses the urban experience of collocated people in place informed by Goffman’s theory of *The Presentation of Self in Everyday Life* (Goffman, 1959) as well as the activities that occur in a place. While the place section discusses collocated people in space, the people section elaborates the concepts of boredom and curiosity as well as the resulting awareness of an urban dweller in relation to the design interventions discussed in this paper.

Public urban spaces are experienced through technologies such as streets, cars, or buildings and location aware technologies contribute to an additional digital layer of a technologically mediated urban experience (Gordon and de Souza e Silva, 2011). The technology section discusses how design interventions enabling mobile mediated interaction should consider and align towards the concept of anonymity in public urban places.

Each design intervention has been studied with regards to the user experience in terms of how people feel about interacting with such services. A summary of the user experience that our study revealed has been provided in the previous section also containing references to the more detailed studies published elsewhere. The following discussion goes beyond the user experience of the design interventions and instead investigates from a meta perspective the impact of anonymous mobile mediated interactions on the experience of everyday life as experienced in public urban places.
7.5.1 Place

The three design interventions are explicitly location-based and focus on the collocated people within. As shown in Figure 7.2 Capital Music has been explicitly designed for interactions between collocated people whereas YourScreen interactions (Figure 7.4) are between a user and the artefact. The result of the YourScreen interaction however is visible to other collocated people. On the other hand, PlaceTagz interactions (Figure 7.3) are asynchronous, i.e., designed for people who use the same space but at a different time. The following subsections discuss the impact of deploying such applications in urban public places in terms of activities and social interaction in place.

7.5.1.1 Activities and Place

According to architect and urban designer Jan Gehl (Gehl, 1987), activities in public urban places can be simply categorised as necessary activities, optional activities, and social activities. Necessary activities such as commuting to work or buying groceries do not depend on the physical characteristics of the urban environment and take place all year long. Optional activities highly depend on the physical characteristics of the urban environment and include activities such as going for a walk or relaxing in a park. Social activities depend on collocated people and include activities such as greeting other people, conversations, or even just passive contacts. Gehl (1987) states that optional activities will occur to a greater extent if the physical characteristics of a public urban space are inviting. Social activities are resultant activities because they evolve from necessary and optional activities. The amount of necessary and optional activities influences the amount of social activities. If a public place is perceived as inviting, people will allow more time for necessary activities and more people will use a public urban place for a variety of optional activities. Gehl states that social activities often occur spontaneously out of the variety of activities that occur within a public urban place.

Gehl originally published his book in 1971 and focused on the urban planning and architecture aspects of public urban places. Nowadays, the widespread use of location-aware and Internet enabled devices can impact on the way that urban dwellers experience the physical environment (Gordon and de Souza e Silva, 2011). The possibility to digitally interact with collocated
people in an anonymous way can change the relationship between the above-described chain of necessary, optional, and social activities in urban public places.

The designed digital artefacts presented in this paper provide means for digitally mediated social activities while a necessary activity occurs. While Gehl states that social activities can occur from necessary activities, he argues that optional activities are increasing the likelihood of social activities. Having ICT devices used in public urban places, however, can impact on the relationship between necessary, optional, and social activities. For example, collocated urban dwellers can digitally interact with each other in form of exchanging meta-data of currently played songs using the Capital Music application while taking part in the necessary activity of commuting. Exchanging such presence data can be considered as a digital alternative to what Gehl terms the social activity of passive contact (Gehl, 1987). Thereby, using ICT devices to interact with collocated people creates a virtual optional activity that may not depend on the physical characteristics of the space, yet it can result in social activities. Additionally, physical artefacts, which enable digital interactions and augmentations such as urban screens or QR codes, are changing the physical characteristics of a public urban place. While such changes to the physical environment do not necessarily make public urban places more inviting, they do provide - as discussed above - new opportunities for optional activities that can facilitate social activities. Overall, the digital layer created by the design interventions deployed in our study can create new optional activities resulting in digitally mediated social activities. Notwithstanding physical characteristics such as the climate at a public urban place that are some of the influencing factors of how inviting a public urban place can be (Gehl, 2010), the digital layer also has the ability to make a particular place more inviting.

7.5.1.2 Social Interaction in Place

Our study brings Goffman’s theory on The Presentation of Self in Everyday Life (Goffman, 1959) to bear as a theoretical framework for discussing the design interventions with regards to social interactions in public urban places. Goffman uses the metaphor of theatrical performances to describe the process of social interaction in public urban places. He describes how the actions of actors are based on social performances to give (explicit information such as the words spoken) and give off (implicit information such as body language and fashion) the
right impressions to the audience, which in turn is also performing for the actor. It has to be noted that digitally mediated interactions lack the richness of face-to-face communication and have different kinds of implicit, given off information one consciously or unconsciously shares (Miller, 1995). Rather than giving off information such as body language or tone of voice, digitally mediated interactions usually only contain a limited amount of implicit information such style of writing (Miller, 1995) or in the case of the design interventions discussed in this paper, the intention behind the content that a user shares.

Figure 7.2 shows a conceptualised view of the mobile mediated interactions created by Capital Music. As these interactions are similar to a face-to-face setting, we found Goffman’s theory partly applicable to analyse the behaviour of application users utilising his key concepts. The Capital Music user interface provides the stage where the performances take place. Props used in the setting are the songs a user selects to share with others and constructs the front, which defines the situation for other users, the observers. In Goffman’s terms, a Capital Music user might listen to a specific song to give a recommendation to others but also give off the impression that his or her music taste is for example non-mainstream, demonstrating a certain kind of identity and belonging what furthermore contributes to the manifestation of the front.

Introducing design interventions as discussed in this paper results in a digital presentation of self added on top of the physical presentation of self in everyday life. Research has been conducted on the presentation of self with electronic communication such as emails and personal websites (Miller, 1995), mobile phone calls (Fortunati, 2005), Facebook (Birnbaum, 2008), and the presentation of place through location-based services (Sutko and de Souza e Silva, 2011). The design interventions discussed in this paper are presenting a unique case of the digital presentation of self, because they are designed to anonymously exchange non-privacy sensitive data between collocated people. Interacting with Capital Music while on a bus results in additionally maintaining and managing the digital presentation of self on top of the physical presentation of self. However, due to the anonymity of the design interventions, the digital presentation is decoupled from the physical representation resulting in the need to manage two fronts simultaneously. The physical front while using Capital Music would be commuting with public transport and waiting for the bus while interacting with YourScreen. Our observations (see Section 4.1) show that these activities mostly involve managing the information that is
implicitly *given off* rather than explicitly *give* information in form of social user interaction, since people do not directly interact with each other while waiting for a specific event to occur (waiting for the bus at the bus stop, sitting in the bus and waiting that the bus arrives). People are now given tools to create and perform in their desired *front* using the data they share to *give off* information. Additionally, Capital Music allows users to directly *give* information through the built-in messaging functionality. From this analytical point of view Capital Music and YourScreen provide attractive means to experience well known urban scenarios such as waiting for or commuting with public transport by being able to create *fronts* and observe the theatrical performances and reactions from collocated people - with the onus of direct face-to-face interaction being completely optional.

As shown in Figure 7.3, PlaceTagz are in contrast to Capital Music and YourScreen mostly used in isolation, enabling an urban dweller to read previous interactions and explicitly *give* information for successive collocated people. PlaceTagz content can also contain implicitly *given off* information (Miller, 1995). Due to the nature of PlaceTagz interactions, the digital representation of a QR code can be seen as the digital stage where the theatrical performance occurs. While interacting with PlaceTagz, a user is in the *back* where no other performers are present and can prepare their performance. After submitting the text comment, the performance in form of a text comment is then added to the digital stage demonstrating the user’s *front* comprising *given* and *given off* information.

It has been argued that talking on a mobile phone while spending time in a public urban place results in the revelation of the backstage and the exposure of various roles which might differ to the presented front (Fortunati, 2005). The widespread adoption and use of location-based services such as *Foursquare* result in a presentation of place, “a multiplicity of agents giving and giving off impressions - impressions that collectively become impression of a place” (Sutko and de Souza e Silva, 2011, p. 811). While PlaceTagz might also contribute to the presentation of place, we showed that the interactions generated through the discussed design interventions enable new means to create and be playful with digital fronts to anonymously interact with collocated people resulting in a digital presentation of self in place.
7.5.2 People

While conducting user studies with the described digital artefacts, two themes could be identified of how such design interventions integrate with and impact on urban life. First, the described design interventions help to relieve boredom while waiting, and second, they pique users’ curiosity. Boredom and curiosity can be interrelated where boredom can be the fertile ground for curiosity (Loewenstein, 1994). The research presented in this paper shows that curiosity can cause raised awareness towards collocated people.

7.5.2.1 Boredom and Waiting

Boredom has been defined as “an unpleasant, transient affective state in which the individual feels a pervasive lack of interest in and difficulty concentrating on the current activity” (Fisher, 1993, p. 369). The term boredom has emerged in the 18th century following the “development of the notion of leisure and the increase in what has been called leisure time” and the “increasing emphasis on the individual, particularly the greater concentration on the self” (Conrad, 1997, p. 466). The mobile phone, which contains personal contacts and multimedia data, has been described as a personal device that can be seen as an extension of the human body (Townsend, 2000). With the uptake of social networking services such as Facebook, an urban dweller’s extended social circle is always available in their pocket. Research has also shown that mobile phones are used as a social utility to relieve boredom through socialising (Wei and Lo, 2006). On the other hand it has been argued that there is a positive value in being bored and people should disconnect from technology and actively embrace in boredom to allow the brain to reset itself and enable new ideas to flow (Bell, 2011). Humans experience boredom when being disconnected from what is going on or when they are understimulated and there is nothing to do (Conrad, 1997). The design interventions described in this study all aim at being used while idle, waiting, and being bored.

The research conducted with the YourScreen application showed that urban dwellers mostly engage with their mobile devices or observe the streets while waiting for the bus. The opportunity to watch an online video while waiting for the bus gives people something novel to do in their idle time. PlaceTagz have been specifically deployed at locations where people have
to wait. For example, an interview participant told us that he was bored waiting for an event to start. He then discovered the PlaceTag, scanned the QR code, and left a comment for future visitors in order to keep the digital conversation going. An observation conducted for the Capital Music study revealed that people mostly either read, listen to music, interact with their mobile device, or stare out of the window if they travel alone. Participants for the user experience study explained that travelling with public transport can be a boring activity and that the social interaction mechanisms integrated into the application can help to transform commuting into a fun experience (Foth and Schroeter, 2010). Additionally, discovering the music played by collocated people has been described as a fun and entertaining activity while spending time in public transport.

All three design interventions give people the possibility to escape the boredom of mundane activities by providing the possibility to interact with a digital artefact. As explained at the beginning of this subsection, boredom is tackled from both sides in terms of understimulation and disconnection: first, the digital artefact gives people something to do, and second, it provides information to connect to the place and the people within.

### 7.5.2.2 Curiosity

According to research in psychology, curiosity is an “intense pleasant experience” that has been defined as “a positive emotional-motivational system associated with the recognition, pursuit, and self regulation of novel and challenging opportunities” (Kashdan et al., 2004, p. 291). Curiosity can result from the deprivation in cognition through a gap in a person’s knowledge (Loewenstein, 1994). Russian psychologist Ivan Pavlov already discovered during his experiments on conditioned responses that dogs would naturally investigate any unusual external object or light (Pavlov, 1927). Human beings are curious in a way that they try to possess information about collocated people before they initiate social interaction (Goffman, 1966).

Curiosity has been categorised by Berlyne (1954) along two dimensions: perceptual and epistemic curiosity as well as diverse and specific curiosity. Perceptual curiosity is brought about by novel stimuli and reduced by continued exposure; epistemic curiosity is based on the desire of
gaining knowledge. Diverse curiosity is grounded in seeking stimulation while being bored and specific curiosity describes the desire for a particular piece of information. Figure 7.5 visualises the dimensions of curiosity as categorised by Berlyne but also mapping the design interventions onto the two dimensional chart. The data from the conducted studies show that when used for the first time, all three applications are mostly situated within the perceptual/diverse corner of the curiosity chart. As described in the previous section, the digital artefacts give people the possibility to escape the boredom of mundane everyday activities. Before using one of the systems, the curiosity is based on the desire to escape boredomness (diverse curiosity) in combination with the novel digital artefacts (perceptual curiosity) in the urban space. For example, a user is bored while waiting at a coffee shop for his order when she discovers a PlaceTag whereas the QR code symbolises the availability of digital information but does not physically reveal its destination. In the case of the YourScreen application a user might be bored while waiting for the bus but discovers the urban screen application and the novel possibility to send and watch a YouTube video.

While interacting with one of the systems, the curiosity categorisation shifts from the diverse
to the specific curiosity. For example after scanning the QR code of the PlaceTag, the user is puzzled and surprised about its purpose and background of the digital information. Our data showed that in case of the YourScreen application, users where mostly curious if it actually works and how long it takes until the video is shown on the screen as well as how and to what extent collocated people might react to the video submission. While using Capital Music, people are curious about who in the physical space is listening to what song as visualised in the user interface.

As described by Berlyne (1954) it must be noted that the perceptual curiosity towards the novelty of the application is decreasing with continued exposure. Figure 7.5 shows the curiosity before and during initial use. Established users however may lose perceptual curiosity, and switch back and forth between diverse and specific curiosity.

Curiosity has been discussed under the umbrella of interaction design suggesting to create a “zone of curiosity” through hiding small parts rather than large parts of information (Anderson, 2011). PlaceTagz hide their content and purpose in the physical space but scanning them will reveal the information withheld. On the other hand, the Capital Music application never reveals who in the physical space is listening to what song visualised in the user interface. Users are not able to break through the “zone of curiosity” and only digitally mediated social interaction with collocated users will reveal the hidden information.

With the above discussion in mind, it seems that urban informatics design interventions vary on the duration and level of curiosity they might pique. The curiosity of YourScreen is mainly based on its technical functionality. The curiosity of PlaceTagz is based on their contextless appearance and their hidden content. The curiosity of Capital Music is based on the people collocated in the same place. Our studies show that curiosity towards technology is easy to satisfy and decreases upon use whereas curiosity towards people is a long lasting experience that in the case of Capital Music can never be fully exhausted. As shown within this study, curiosity can be a major component of the user experience that urban informatics design interventions might create. Being curious is thus related to a positive experience in relation to the self, the world, and the future (Kashdan et al., 2004).
7.5.2.3 Awareness

The research conducted with Capital Music, YourScreen, and PlaceTagz showed that the technologies created as experiments for our study raise the awareness towards people who are in the same place at the same time or have been in the same place previously. The Oxford dictionary defines awareness as “knowledge or perception of a situation or fact.” The experiences created by Capital Music, YourScreen, and PlaceTagz can influence the perception of users towards people collocated in place. Goffman’s concept of civil inattention describes how strangers acknowledge and are aware of one another in a public urban space such as an elevator, but do not require or expect to directly interact with each other (Goffman, 1966). While people are generally aware of each other when spending time in a public urban place, the exchanged information through interacting with one of the design interventions increases this awareness through combining digital information with physically present people or place. Previous research has shown that location-based social networks such as Foursquare can raise the awareness towards friends nearby (Sutko and de Souza e Silva, 2011). However, location-based social networks have also been criticised that they mostly connect people who already know each other (Crawford, 2008). Our study tried to broaden the scope of appeal to also include the civil inattention sphere (Goffman, 1966) between anonymous people. We found that providing design interventions tailored for idle situations in public urban spaces, and also piquing a user’s curiosity, can result in new forms of expression of self as well as raise awareness towards collocated people in place through these new forms of digital self expression.

7.5.3 Technology

The three design interventions have been design to be used without utilising user profiles or subscriptions, and enable urban dwellers to anonymously share lightweight data. This subsection discusses the concepts of anonymity and lightweight content sharing in urban public places.

7.5.3.1 Anonymity

Anonymity is a social construct brought about by the presence of other people and the desire to not being identifiable to them (Marx, 1999). Urban life is mostly anonymous, and the vast
amount of people inhabiting urban centres that a single urban dweller could potentially interact with creates an overload of potential stimulation (Milgram, 1970). Simmel describes the blasé attitude, “an incapacity [...] to react to new sensations with the appropriate energy” during everyday urban life through “the rapidly changing and closely compressed contrasting stimulations of the nerves” (Simmel, 1950, p. 413). On the other hand, anonymity in urban centres also has positive aspects such as increased tolerance for individuality and eccentricity of urban dwellers belonging to marginal groups (Milgram, 1970). All software applications discussed in this paper have been designed in a way that the shared content is the central focus of the interaction rather than the person behind the content. This aligns with the above-mentioned concept of implicitly giving off information (Goffman, 1959) while spending time in public urban places. For example, people demonstrate parts of their identity and belonging through the fashion they choose to wear, or body language and facial impressions might provide insights into the mood of a person. We argue that urban digital design interventions should align to and consider the concept of overstimulation and anonymous urban life in a way that the digital information exchanged represents an additional, given off clue towards collocated people and place. Instead of utilising user profiles or subscriptions and overload potential users with digital information about collocated people, we argue that design interventions should be designed in an anonymous way focussing on content rather than people. Considering the fact that users would be overstimulated with having access to the demographic information of all collocated people around them, it seems obvious that urban design interventions for anonymous collocated people should employ mechanisms to filter out and present information in a way that is most attractive and stimulating for the user. Also considering that in an anonymous public urban place a person only has access to the given off information from collocated people, the question arises why digital design interventions should change that and provide users with a wealth of information possibly resulting in a digital blasé attitude. Instead we argue that the information provided in design interventions for anonymous collocated people should provide a digital lens into the variety of lightweight data describing collocated people and place, ultimately stimulating an intéressé attitude towards the variety of lightweight data that collocated people share.


7.5.3.2 Lightweight Content

Throughout this paper, the term lightweight data has been used. Lightweight data is information that does not breach a user’s privacy if they volunteer to share such information. In this study, lightweight data in form of currently played music, videos, and text comments have been utilised. However, these kinds of lightweight data are only non-privacy sensitive and lightweight, because the data is anonymised and decoupled from identity. As an example, the web service ijustmadelove.com enables users to share the geographical location of where they just made love. The location in turn is visualised and aggregated on a map without identifying a user. The information shared by ijustmadelove.com could be considered as highly privacy sensitive information but the web site does not include any identifiable information other than location. As the service received over 240,000 submissions while writing this paper, it seems that its users do not have strong concerns towards sharing such personal data - albeit in an anonymous way.

Capital Music shares the currently played song choice with collocated people. While music does not seem to be private data, some people might not feel comfortable with granting access for other people to browse their playlist. The concept of playlistism describes how people might judge other people on the basis of their personal music taste (Valcheva, 2009). Most of the PlaceTagz stickers have been deployed in public toilets enabling urban dwellers to leave a comment on a digital message board. Utilising user profiles and therefore connecting content to an online identity could have resulted in some people feeling uncomfortable due to the context of the interaction: being in a public toilet. YourScreen on the other hand provides private means for video submissions utilising the mobile phone of a user while also avoiding to display any identifying information about the user who submitted the video currently played on the screen.

The proliferation of participatory Web 2.0 services requiring registrations and user profiles has created a trend of collecting data about users for future business model opportunities. We emphasise that software applications designed for anonymous collocated people should avoid this trend and enable interactions without the need to provide personal data. Furthermore, as the applications discussed in this paper are designed to be used in-situ while spending time in an urban public place, requiring a user to fill out a registration form while for example waiting
for the bus to submit a video to the YourScreen application, would negatively influence the user experience and probably lessen their motivation to use the service.

A potential threat of abusing people and exchange inappropriate content through anonymising data for lightweight information sharing between unknown collocated people exists. Mechanisms to block and prevent such behaviour should be integrated into design interventions to reduce the probability of abuse. While PlaceTagz did not receive any abusing messages during its real-world deployment, the spam filter employed by the app prevents the use of offensive language in text comments. During the real world deployment of YourScreen, a small group of users tried to ‘game’ the system by submitting 10 hour-long videos, which led us to add a timer function switching to the next video after 5 minutes of playback. During the simulated real-world evaluation of Capital Music, two user groups could be identified: one group of users who would enjoy arguing about personal music tastes, and one user group who would be afraid to receive offensive messages. A simple way to assist the latter group could be to integrate functionality to block and hide users. We believe such mechanisms should provide sufficient protection.

### 7.6 Conclusion

In this paper we presented three software applications designed to enable collocated people to anonymously augment the urban space with mobile mediated interactions. Drawing on research from urban sociology, psychology, and urban design, and the findings from our own user studies, we discussed how such interactions can have an impact on the urban experience. Previous research suggests that urban technologies should connect urban dwellers more to physical places and people within (Lentini and Decortis, 2010). This paper demonstrated that mobile technologies and public urban displays in combination with anonymous mobile mediated interactions and digital augmentations can create new digital optional and social activities in space. Additionally, design interventions as discussed in this paper enable urban dwellers to play with their anonymous digital presentation of self in place. The paper discussed how - on the individual level - design interventions can help to relieve boredom, and pique and stimulate people’s curiosity towards collocated people, place, and the design interventions themselves.
This in turn can result in raised awareness towards the environment. Finally, on the technological level, we recommend to design anonymous interactions for collocated people aligning with the anonymity which urban dwellers usually experience in everyday urban life. Furthermore, design interventions should focus on the content of the digital augmentations rather than on people’s identity. Our goal was to create a new digital layer of personal information volunteered by users rather than privacy sensitive information revealing a user’s identity.

This paper provided insights into how anonymous mobile mediated interactions influence the experience of people in urban public places. While this analysis and discussion provided insights into how the urban experience might be influenced, we hope that these findings can also be used to inform the design of future urban informatics applications enabling interactions between collocated people. For example, designers can consider the questions: how can design interventions enable users to be playful with the digital presentation of self in place, decoupled from the physical presentation of self? How can design interventions pique curiosity towards collocated people and place? How can data be anonymously shared in a meaningful way? The findings presented in this paper have been discovered through a bottom-up approach: three different applications have been designed with an emphasis on what data can be shared in particular public urban places followed by user experience evaluations. Insights from these three studies led to this synthesis paper.

7.7 Acknowledgements

This research was carried out as part of the activities of, and funded by, the Smart Services Cooperative Research Centre (CRC) through the Australian Government’s CRC Programme (Department of Innovation, Industry, Science and Research). We would also like to thank all study participants.
Chapter 8

Conclusion

Inspired by the fact that ICT devices are sometimes used as cocooning items (Bassoli et al., 2007, Crawford, 2008, Mainwaring et al., 2005) to create your own personal space while in public to avoid contact with collocated people, this PhD study departed with the exploration of new opportunities to utilise ICT devices used and available in public urban places to connect urban dwellers with a particular place and the people within. Rather than trying to enable collocated people to talk to each other and transform strangers into friends, this PhD thesis was interested in how design interventions enabling anonymous sharing of non-privacy sensitive data in public urban places can create new user experiences while interacting with a mobile device. Additionally, this thesis investigated how such design interventions deployed and used in public urban places can have a wider impact on the urban experience during everyday life, which goes beyond the experience of interacting with a design intervention.

As visualised in Figure 8.1, the study provides innovative outcomes and contributions to knowledge. These outcomes and contributions include the creation and evaluation of innovative design interventions utilising ICT devices, a methodological framework for evaluating user experiences such design interventions might create, and a theoretical discussion on the impact of anonymous lightweight data sharing and mobile mediated interactions between unknown collocated people.

This chapter summarises the outcomes of this PhD study followed by a discussion on the limitations and constrains. An outlook towards future work in this area of research is concluding this thesis.
### Main Research Questions

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<tr>
<th>RQ1: How can ICT in public urban places be applied to influence user experiences and in what ways?</th>
<th>RQ2: How does the establishment of ICT-mediated social interactions between collocated users influence the experience of those users in particular urban spaces?</th>
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### Chapters

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<tr>
<th>Design Artefacts: Capital Music, PlaceTagz, Sapporo World Window, Brisbane Hot Spots, YourScreen</th>
<th>Theoretically and empirically informed implications for the urban experience</th>
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### Investigative Questions

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<th>RQ3: What kind of non-privacy sensitive data can be utilised at a particular urban setting?</th>
<th>RQ4: How can the available data be utilised to deliver content and services to users collocated in the same urban setting in order to facilitate meaningful digitally mediated social user interaction?</th>
<th>RQ5: What are the criteria (such as comfort, sensitivity, cautious, private, tact, etc.) that need to be met in order to establish and maintain digitally mediated interaction between collocated users?</th>
<th>RQ6: How can the success of ICT mediated social interactions be evaluated and measured and how does this change the social experience of a particular public urban place for different users?</th>
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### Outcomes

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<tr>
<th>Design Artefacts: Capital Music, PlaceTagz, Sapporo World Window, Brisbane Hot Spots, YourScreen</th>
<th>User Experience methodology for mobile mediated interactions and digital augmentations</th>
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**Figure 8.1:** Summary of research outcomes
8.1 Outcomes and Contributions

8.1.1 Design Artefacts

This study produced 3 major design artefacts within the three case studies, which extend the current understanding in their respective areas within HCI research. The PhD candidate has created all three design interventions. The design artefacts titled Capital Music, PlaceTagz, and YourScreen are a response to research question 1: How can ICT in public urban places be applied to influence user experiences and in what ways? The design of each artefact has been informed through answering the investigative questions within each case study. The design interventions utilise available ICT devices carried and used by urban dwellers, ICT devices available in public urban places, or a combination of both. The nexus between the activities that take place in a public urban setting, the available technologies, and the anonymous mediation of lightweight data informed the design of each case study application.

8.1.1.1 Capital Music

The Capital Music study extends the current understanding of mobile music sharing applications and the user experiences created through exchanging lightweight data in real-time between collocated people in an anonymous way. This PhD study revealed that Capital Music has been perceived as a tool to share, recommend, and discover songs. The conducted user study showed that song selections were either influenced by collocated song choices, were made to recommend music to others, or were popular songs based on the participant’s opinion. Even considering that Capital Music does not enable users to listen to other peoples song choices, Capital Music was perceived as a tool to discover new songs or artists. In terms of social interaction, music was perceived as an ideal icebreaker for mobile mediated interactions and the ‘like’ message functionality provided easy means for initiating interactions. Capital Music stimulated the curiosity of urban dwellers towards colocated people in terms of whose album artwork is from whom in physical space, resulting in a raised awareness towards colocated people. Interacting with Capital Music results in visualising the invisible data of the urban environment. Therefore, Capital Music has been perceived as a voyeuristic tool to peek into
the habits of other people also resulting in reconsidering the perceptions towards collocated people in terms of “not judging a book by its cover”. Summarised, the Capital Music case study showed that sharing, discovering, and getting music recommendation as well as anonymous social user interaction with collocated people based on their music selection was perceived as an entertaining and fun activity resulting in piquing users curiosity and a raised awareness towards collocated people.

8.1.1.2 PlaceTagz

The PlaceTagz study extends the current body of literature on findings of how QR codes can be utilised to create mobile mediated interactions between collocated people over time in public urban places. The real world deployment of PlaceTagz revealed that QR codes have the general notion to be just being used for advertisement. On the other hand, having a QR code without any contextual information attached to unusual locations can pique the curiosity of users resulting in scanning the QR code. The uniqueness of each single PlaceTag, the location-awareness, and the interactivity to leave a comment was perceived as novel, interesting, and intriguing by urban dwellers. PlaceTagz raised the awareness of people towards other people who used the same place in the past through sharing lightweight text comments in public urban places. PlaceTagz mostly received comments referencing people, place, or the technology itself containing lightweight information exchange whereas most of the received comments directly commented on the content of the sticker, what, however, was perceived by users as contributing to an existing digital conversation. The user experience of PlaceTagz is constructed together with other users through the amount and notions of previous comments, the so-called co-experience (Battarbee and Koskinen, 2005). PlaceTagz deployed in locations where people have to wait by themselves and are bored received the most comments. Study participants mentioned that they interacted with PlaceTagz because they were waiting or bored. The PlaceTagz study demonstrates that QR codes can be utilised as a cheap and lo-tech solution to integrate design interventions enabling asynchronous mobile mediated interactions into the urban space resulting in lightweight interactions with people in the space or the place itself.
8.1. OUTCOMES AND CONTRIBUTIONS

8.1.1.3 YourScreen

The YourScreen study extends the current understanding of research on public urban screen applications and content sharing utilising the mobile phones of urban dwellers. The YourScreen study showed that the social and spatial context of a public urban screen has to be considered and designed for to create engaging applications enabling mobile mediated interactions between a user and the application. YourScreen has been used by urban dwellers to escape boredom during idle times, while waiting for the bus, out of curiosity towards the technology itself, and in response to the reactions from collocated people. People submitted videos to entertain the crowd at the bus stop or submitted videos to show content of their particular interest. Interactions with YourScreen resulted in the phenomenon that urban dwellers submitted videos to observe the reactions of collocated people. Therefore, interactions with YourScreen raised the awareness of users towards collocated people. YourScreen has been experienced as a novel and exciting opportunity to customise the urban space through mobile mediated interactions and digital augmentations. Being able to customise the urban space by playing videos of one’s choice created a community and connected people at the YourScreen application and people at remote locations who also submitted videos to entertain the crowd currently at the bus stop.

8.1.2 User Experience Framework

The study proposed a framework guiding the design and evaluation of user experiences mobile mediated interactions might create. The framework was created as response to the lack of a common definition, scope, or methods to design and evaluate user experiences (Bargas-Avila and Hornbæk, 2011, Battarbee and Koskinen, 2005, Law et al., 2009). The user experience framework described in Section 3.2 extends the current understanding of research on HCI in user experience evaluation approaches for urban informatics design interventions. The framework aggregates existing elements of user experiences and recategorises them under the urban informatics notions of people, place, and technology (Foth et al., 2011). Guiding questions within each category are provided which aim to influence the design of an application. Methods and tools to evaluate certain elements of the recategorised elements are presented. The user experience framework helped this PhD research to systematically design and evaluate the case
study applications and has been created as a response to the investigative research question 6: How can the success of ICT mediated social interactions be evaluated and measured and how does this change the social experience of a particular public urban place for different users?

8.1.3 Theoretically and Empirically Informed Implications

This PhD study provides an interdisciplinary contribution in the intersection of HCI research and urban sociology. While the design contributions within each case study discussed in Section 8.1.1 will help the HCI research community to design future mobile mediated interactions and digital augmentations for collocated people, the discussion presented in Chapter 7 extends the current understanding of how such interactions can have an influence on the urban experience. Anonymous mobile mediated interactions between unknown collocated people in public urban spaces are a new phenomenon. The author of this PhD thesis created, deployed, and studied applications that enable such anonymous mobile mediated interactions in the urban space. Through collecting data and conducting user studies with these applications and drawing on research from urban sociology, psychology, and urban design this PhD thesis showed how such interactions help to relieve boredom, pique the curiosity of users, and as a result raise the awareness towards collocated people while spending time in public urban places. Goffman’s theory on *The Presentation of Self in Everyday Life* (Goffman, 1959) has been applied to analyse and discuss the design interventions with regards to social interactions in public urban places. The interactions generated through the discussed case studies enable new means to create and be playful with digital *fronts* to anonymously interact with collocated people resulting in a digital presentation of self in place. From an urban planners perspective, the PhD thesis revealed how anonymous mobile mediated interaction can influence the chain of activities, which occur through utilising the categorisation of activities in public urban places by Gehl (1987). Physical artefacts such as urban screens or QR codes, which enable digital interactions and augmentations, are changing the physical characteristics of a public urban place. While such changes to the physical environment do not necessarily make public urban places more inviting, they do provide new opportunities for *optional activities* that can facilitate *social activities*. Additionally, anonymous mobile mediated interactions between collocated people create a virtual *optional activity* that may not depend on the physical characteristics of the
space, but can result in social activities.

Urban life is mostly anonymous, and the vast amount of people spending time in urban centres that a single urban dweller could potentially interact with creates an overload of potential stimulation what Simmel (1950, p. 413) describes as the blasé, attitude “an incapacity [...] to react to new sensations with the appropriate energy.” The case study applications have been designed in a way that the shared content is the central focus of the interaction rather than the person behind the content. This aligns with the concept of implicitly giving off information (Goffman, 1959) while spending time in public urban places. For example, people demonstrate parts of their identity and belonging through the fashion they choose to wear, or body language and facial impressions might provide insights into the mood of a person. This PhD thesis revealed that mobile mediated interaction between unknown collocated people should consider and align to the concept of overstimulation and anonymous urban life in a way that the digital information exchanged represents an additional, given off clue towards collocated people and place. Therefore this thesis recommends that exchanged content should be anonymised and decoupled from identity, to create lightweight data exchange.

8.2 Limitations

This study has some limitations that will be discussed in this section in terms of public urban place and the generalisability of the results, people who participated in the presented studies, as well as the user experience of interacting with the technology.

8.2.1 Place - Generalising the Findings

Within this PhD thesis, three case studies have been conducted. The case studies enable mobile mediated interactions, whereas public urban place and design interventions varied within each case study. The findings presented in this thesis are based on these three case studies. As described in Section 3.1.1, each public urban place has unique characteristics. These characteristics influence the technological intervention and the available data which can be shared between collocated people. Data for this PhD thesis has been collected at a bus stop, public
transport, public toilets, a digital culture centre, and an underground walkway utilising the
described design interventions.

However, due to the fact that each public urban place offers unique opportunities for mobile
mediated interactions between collocated people, generalising the results from this study is
crucial. While the synthesis of the three case studies revealed common themes, it is uncertain
if for example there might be an urban setting in which people want to be identified by others
rather than interacting anonymously (e.g. due to safety reasons at night).

To heighten the generalisability of the findings on the urban experience, more design inter-
ventions should be designed, deployed, and evaluated following the methodological approach
utilised in this PhD thesis. Given the limited timeframe as well as human and financial resources
within a PhD study, the three case studies seem to present a satisfactory trade-off between
feasibility and generalisability.

8.2.2 People - Real World versus Recruitment

The findings presented in this PhD thesis are based on the interactions of urban dwellers with the
developed design interventions. However, the groups of people who interacted with the design
interventions or participated in the reported user studies also contribute to some limitations for
this study. Participants of the Capital Music study and many urban dwellers who interacted with
YourScreen or PlaceTagz were university staff and students. However, this is based on the fact
that PlaceTagz and YourScreen have been deployed in a university context and Capital Music
required a study with recruited participants.

Capital Music is the only design intervention which has not been directly deployed and made
available for the general public and instead has been studied in a simulated real world environ-
ment. While the study participants for the Capital Music study consisted of a balanced mix of
university staff and students with a broad age range, these application users were recruited
through mailing lists utilised at Queensland University of Technology, Brisbane, Australia.
Therefore, the results for this study are based on a group of people who otherwise might not
necessarily interact with an application such as Capital Music if made available to the general
public.
PlaceTagz on the other hand has been made available to the general public and deployed in the urban environment. The findings presented in Chapter 5 are based on interactions with real users who interacted with PlaceTagz without recruitment or any incentives. However, due to the real world deployment, this PhD thesis cannot report on experiences of urban dwellers that might have seen PlaceTagz and were curious about them, but did not scan them with their mobile phone. Additionally, no data could be collected from people who scanned a PlaceTag, but decided to not leave a comment.

YourScreen has also been deployed in a real world setting to collect interactions from urban dwellers. The findings presented in Chapter 6 are based on the responses of users who submitted a video to the screen without any incentives. Therefore, these findings are also limited and constrained because no data could be collected from people who were aware of the YourScreen application but did not have the required mobile phone technologies at hand or decided to not submit a video due to other unknown reasons.

The above-mentioned issues present a general trade-off between studying a design intervention through a real world deployment and recruiting users providing incentives to participate in a user study. A real world deployment provides very rich insights into the user experience of such design interventions for actual users. Recruiting study participants and providing incentives can help to attract people who otherwise might not interact with the studied system in a real world setting and therefore report on issues why they would not interact. Having the information available from non-users could help to improve a system through incorporating such information and also get insights if the design interventions have an impact on the urban experience of non-users.

A possible next step to address these limitations could be to release Capital Music to the general public to gather real world data from real users and conduct studies with YourScreen and PlaceTagz in simulated real world environments. This would help to gather very rich insights into the user experience through the real world deployment and uncover issues through conducting studies in simulated real world environments with recruited users.
8.2.3 Technology - User Experience over Time

While PlaceTagz and YourScreen were deployed for data collection over a long period of time, the Capital Music study participants only used the application once. Evaluating location-based social networking applications such as Capital Music is crucial due to the amount of resources needed to conduct studies that involve the amount of users required to create a realistic experience for study participants. The simulated real-world study of Capital Music provided a possibility to circumvent this problem and provided an approach to explore the user experience. However, the user experiences reported in Section 4.2 only present a snapshot after initially using Capital Music for 15 minutes. This experience might change over time for different people in various ways. For example, users might stop using the application after they received a message from a collocated person who disliked the song choice. Other users might start to engage more with the application as they made positive experiences through more enjoyable bus rides. Capital Music might be used by work colleagues or groups of friends to anonymously share song choices while spending time in the same place. These unanswered questions could be addressed through a real-world deployment of Capital Music as described in the previous section.

8.3 Future Work

This thesis presented innovative design interventions to share data between unknown collocated people in public urban places and discussed how this might influence the urban experience. The excitingness and relevance of this area of research is undermined by recent product feature upgrades of the popular social networking service Facebook. In end of June 2012, Facebook released the “find friends nearby” feature\(^1\), which enables Facebook users to browse profiles of collocated urban dwellers through visiting a specific mobile website which utilises a users location information. The “find friends nearby” feature was removed within a day as Facebook just tested its functionality. However, concerns have been raised by popular web blogs and their

\(^1\)http://techcrunch.com/2012/06/24/friendshake-facebooks-new-mobile-feature-for-finding-people-nearby-and-a-highlight-killer/
readers about the chosen approach\(^2\) of seeing Facebook profiles of collocated people stating it as “creepy” and the need to carefully design such interactions.

The previous section on the limitations and constrains of this PhD thesis and the example of Facebook’s “find friends nearby” feature described in the previous paragraph show that more research is needed to fully understand the dynamics and implications on the urban experience of mobile mediated interactions between unknown collocated people in public urban places. This thesis provides a methodology and exemplifies and demonstrates its instantiation in the form of the presented case studies. This provides a blueprint for researchers and practitioners to create future design interventions in the application space of mobile mediated interactions between unknown collocated people.

Personally, in the future I’m aiming to conduct further research utilising outcomes and insights from this PhD thesis applied to different scenarios. The first scenario is based around Capital Music and the question of how the concept of sharing song choices could be applied for emotional well-being. The aim is to create a design intervention which helps troubled teenagers to regulate their mood and emotions through sharing and interacting with music in novel ways. The second scenario is based around blood donations collected by the Australian Red Cross Blood Service. The aim is to research a concept for a mobile application that creates engagement around available blood stocks, raises encouragement to donate blood, and increase loyalty of existing blood donors. The concept of sharing data in an anonymous way and making the invisible data of the urban environment visible could be employed to pique the curiosity of urban dwellers and create awareness towards blood donations in the city.

\(^2\)http://www.wired.com/gadgetlab/2012/06/facebook-quietly-releases-find-friends-nearby-then-quietly-pulls-it/
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