Interacting Places - Networked Public Displays That Stimulate Community Interaction

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I certify that except where due acknowledgement has been given, the work presented in this thesis is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; and the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program.

Nemanja Memarović
Zurich, 12 November 2014

To my wife.

Ti si moja hrabrost, moja smelost, moja muzika koju slušam...

Abstract

Networked public displays are envisioned as a new communications medium for the
21st century, potentially having the same impact on society as radio, TV, or Internet.
This thesis examines the impact of networked public displays medium on society by
focusing on understanding its use for stimulating community interaction – interaction
between community members residing within and across public spaces. In other words,
the thesis focuses on "Interacting Places" – networked public displays that stimulate
community interaction in public spaces. By building on top of diverse literature – from
Marshall McLuhan's media theory and literature on interactions and processes in public
spaces – I have first conceptualized the design space. Next I have designed, developed,
deployed, and evaluated three networked public display applications "in the wild" and
have analyzed their effects, uptake, and use. The outcome of the thesis are lessons
learned in the process and conceptual tools for design and analysis of networked public
displays that stimulate community interaction within place-based communities.

Acknowledgements

Contents

Figures

Tables

Chapter 1

Introduction

Public spaces such as streets, squares, and parks play an important role in our lives as they foster the process of building local communities: they provide the space for people with common interests and values to bond and interact. Public spaces allow people to create shared emotional connections and ultimately develop a sense of belonging to a community [8].

One of the proliferating resources in public spaces – public displays – can enrich these environments and stimulate community building processes. Due to significant price drops of LCD screens public displays are becoming a ubiquitous resource in urban settings: we can find them at metro stations showing latest news and schedule, in shopping malls advertising upcoming sales, or entire building facade advertising new brand products. Most of these displays are singular installations that run locally stored slide shows and videos. However, this type of content has seen dwindling 'eyeballs' and led to the fact that viewers ignore much, if not most, of such animated advertising [33, 73].

Instead these closed and isolated installations could be networked and running a diverse range of interactive applications, allowing users to fully participate in the medium and contribute to it [12, 13, 78]. These could range from services showing place specific information to more open applications that allow users to upload/post content of their choice, e.g., photos through display attached camera. In addition, content preferences could be expressed through simple on-display 'likes' as in Facebook[1] (e.g., through a 'thumbs up' button displayed next to the image) in order to ensure that displayed content is fresh and relevant for the viewers.

These are some of the properties that would constitute the pillars for a novel communication medium that would come in the form of networked public displays [13]. The vision of creating a communication medium is the main driver behind the 'PD-NET' project: Towards Future Pervasive Display Networks'[2], funded by the

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[1]http://www.facebook.com/help/like
[2]pd-net.org/about/

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EU's Future and Emerging Technologies Open Scheme (FET-Open) in the Seventh
Framework Programme (FP7). As a member of the PD-NET team, in my PhD thesis I
explored the role such a medium may play in public spaces and how it can be used to
stimulate interaction between community members [55].

1.1   Motivation

By analyzing media theory [50], community psychology [11],
architecture/environmental behavior [7, 8, 24, 25, 28, 30, 94], and social networking
[5, 79] literature I identified four opportunities for networked public displays as a
communication medium:

1. *Connecting Local Communities* – Carr et al. [8] explain how public spaces are the
   building blocks of local communities as they provide the ground where local
   neighbors bump into each other to socialize and share the latest news, help
   with a heavy grocery bag, or just 'hang out'. These activities, in turn, help in
   creating the common identity: "When public spaces are successful [...] they
   will increase opportunities to participate in communal activity. [...] In the
   parks, plazas, markets, waterfronts, and natural areas of our cities, people from
   different cultural groups can come together in a supportive context of mutual
   enjoyment. As these experiences are repeated, public spaces become vessels to
   carry positive communal meanings". Today's highly mobile lifestyles make this
   harder and harder. As explained by Carmona et al. [7], the communities of
   place are still an important part of our lives, but they are more and more being
   replaced by distributed communities of interests that can be one-click-away and
   may well be detached from any geographical location. To put it in his own
   words: "In a highly mobile age, it is argued that people no longer want or need
   the previous sense of community and neighbourliness: they can now choose from
   the entire city (and beyond) for jobs, recreation, friends, shops, entertainment,
   etc. - and in the process form communities of choice. The issue, though, is
   not one of an either/or choice between mobility with spatially diffuse contact
   networks or spatially proximate contact networks. Instead, it is one of providing
   opportunities for both, and allowing people to find their own balance." In other
   words, local communities and neighborhoods are equally important as spatially
   distributed communities of interest that are conveniently one-click away, but are
   unable to help out sometimes with simple problems, e.g., a tablespoon of sugar
   when in need [5].

2. *Promoting Community Diversity* – As public spaces are occupied with more than
   a single community Holland [30] argue that public spaces should promote the
   'provision of difference', i.e., they should be able to cater to the needs of different
   groups successfully and in a concurrent way, and should not be promoting

just social homogeneity. They furthermore state that "being able to be seen in public and to be able to see different types of social groups may go some way to enabling everyone, and children and young people in particular, to observe difference, and thereby perhaps, promote tolerance for social diversity." However, sometimes certain groups do not mix well together, e.g., elderly and teenagers [7, 30], which may even result in some of the groups moving out from public spaces to "gray" or "slack" areas such as remote hallways or walkways [25]. Carmona et al. point out the benefits of mixed communities in neighborhoods in creating "balanced communities" and state that community diversity provides better opportunities for "lifetime" communities where families and individuals live better within a neighborhood. The need for connecting locally different and diverse communities is best captured by Thompson [94] "Although information technology does allow for a greater flexibility in terms of location, particularly for some office functions, it is also resulting in new urban concentrations for face-to-face activity. People need human contact and the city is the place for that, even if technology allows us to do otherwise if we choose. [...] We are thus looking to an urban society where, perhaps, more people are living in relative proximity than ever before, but where the regular daily social contact that comes from sharing homes or living in culturally homogenous districts no longer pertains. It is an intriguing prospect – a close-knit society of strangers."

3. *Stimulating Greater Connections Within Geographically Distributed Communities* – Public spaces have the power to connect people across time and distances and stimulate connections that exist in larger society [8]. Such connection "involves an understanding of the meaning of places beyond the superficial level" [8]. Some of these connections are developed due historical events that were carried out at a particular place. In their analysis of public spaces in the US Carr et al. point out several examples, amongst one of them is the example of the Boston Common that captured a tremendous amount of the US nation's history, ranging from being a British camp in the American Revolutionary War in the 18th century to protests in the 20th century against the war in Vietnam. Although not many people can recall all the events that occurred in that space, the space itself emits a beacon of greater historical connections within the people of Boston and the American nation. However, as we reallocate more often than we use to our connections with local roots tend to get weaker [30]. Although media such as online social networks offer benefits in terms of long distance connections and increased social capital, recent research pointed out some of the drawbacks in its use as its nature of use is shifting towards self-promotion [79].

4. *Enriching Local Life* – Public spaces offer glimpses of connections of our locality with other distant places, e.g., seeing Chinese restaurant can spark and intrigue imagination/day dreaming about a faraway location (unless you are in China);

or even broader to faraway galaxies, e.g., looking at Stonehenge can portray our connection with the universe [8]. When it comes to communities these connections could be stimulated by connecting otherwise distant places and areas. These places do not have to be so far away, but rather diverse from the local. In some cases this could bring up similarities within culturally different communities [71]. In other, e.g., in distant or rural villages, distance from the rest of the world can have negative effects [24, 28], and amongst others, on social interactions in them as public spaces and public life can become too homogenous/concentrated only on the local [8]. Sometimes this sense of isolation is due low diversity in social life of a place and as a result more and more teenagers leave these places once they obtain the legal age (other reasons also influence this decision, e.g., finding a better job or moving to a university).

By using space as a dimension the above stated opportunities can be grouped. *Communities that occupy the same public space* could benefit from connections within local community members and promotion of community diversity. At the other end of the spectrum, members of *geographically distributed community* could benefit from the sense of connection that goes beyond a single/local space. Also, these distant places comprise of communities that can be diverse from the local and that could enrich local life.

I define communication between members of the similar or distinct community that reside both within and across public spaces as *community interaction*. Community interaction can go beyond direct communication where, for example, members interact directly, and can also be in the form of "awareness" where members of the same or distinct community are aware of each other and their interests/values/ethos.

We can group the four opportunities into what I call the *community – space cluster*. The community - space cluster is summarized in Table 1.1 and describes an agenda for facilitating community interaction in public space: 1) connecting local community members, 2) promoting community diversity and connecting communities that occupy the same public space, 3) stimulating greater connections within geographically distributed communities, and 4) enriching local life by connecting diverse public spaces.

1.2   Thesis Goals

In my research I focused on creating *Interacting Places*, i.e., networked public displays that stimulate community interaction in public spaces [55, 62, 63]. The application of Interacting Places within the community–space cluster is illustrated in Figure 1.1. As a first step towards understanding how networked public displays operate and stimulate community interaction I focused on designing, developing, deploying, and evaluating Interacting Places that support community connections between local

Community		
	Intra−/Within	*Inter/In Between*
Place Intra	Support community connections between local members	Support awareness of social diversity between local communities
Inter	Connect spatially distributed communities with similar interests	Enrich local community through exchange w/ remote communities

Table 1.1. Community – space cluster and community interaction through networked public displays [63, 64]
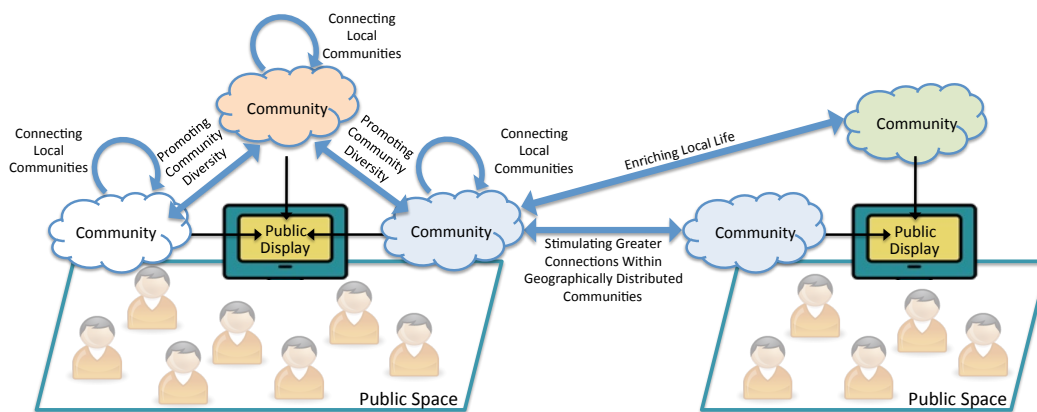
Figure 1.1. Interacting Places and the community – space cluster.

members. Overall, the work documented in this thesis is trying to answer the following question:

Research Question: *How can networked public displays affect community interaction and connections within local community members?*

The outcome of my research are conceptual tools that can be used for design and analysis of networked public display systems that stimulate community interaction and lessons learned in the process of designing, developing, deploying, and evaluating three networked public display applications "in the wild", i.e., in the real-world settings, as well as documented effects they had on the surrounding communities. Also, the outcome of the thesis are high-level findings that inform future research on networked public displays in general, as they explain return patterns of returning users, the impact of the setting on this behavior, the constraint of posting inappropriate user-generated content when interaction with public displays is tethered, and the need to understand the use of networked public displays as part of user's media ecology.

The remainder of the thesis is organized as follows: I will start by presenting the background for the work carried out in this thesis in Chapter 2, i.e., McLuhan's media theory that explains the importance of understanding and building upon processes and interactions happening in the context of the medium (which is in this case networked public displays); the connection between communities and public spaces; and previous work on public displays for communities.

After that in Chapter 3 I will describe two studies that were carried out in order to understand how to build this novel medium on top of practices with current ones, i.e., a study on practices around traditional notice boards, and a study on a community's practices with today's information and communication technologies. Next I will describe three deployments of networked public display applications, i.e., FunSquare in Chapter 4, Moment Machine in Chapter 5, Moment Machine 2.0 and Moments Gallery in Chapter 6, and will present how each of the applications affected the community. For each of the five studies (two user requirement studies and three deployments) I will present a summary section that will describe the main findings coming out of a study, as well as how the study was connected with the rest of the studies.

After that I will present conceptual tools for the design and analysis of Interacting Places and lessons learned from deploying them "in the wild" in Chapter 7. The lessons learned and tools are summarized in the "Interacting Places Framework" that presents a conceptual space for developing applications that stimulate community interaction, described in Section 7.1; the P-LAYERS framework that describes the multi-faceted issues facing community-supporting public display deployments, described in Section 7.2; a model that generalizes how users behave and coordinate around public displays – the Elastic Space-Interaction model, described in Section 7.3; and commonalities in using situated snapshots for community interaction, described in Section 7.4. Finally I will present concluding remarks where I will describe how different studies were connected and influenced each other, and will also describe the high-level findings that are generalizable for networked public displays, and will also provide insights and directions for future work on Interacting Places.

Overview of different parts of the thesis that have undergone peer-review process and have been published are presented in the list below.

1. Memarovic, N., and Langheinrich, M. 2010. *Enhancing Community Interaction in Public Spaces Through Situated Public Displays*. Workshop on Social Interaction in Spatially Separated Environments. Parts of the paper are appearing in Chapter 1 and Chapter 2.

2. Memarovic, N., and Langheinrich, M. 2010. "*Your place or mine?*" – *Connecting communities and public places through networked public displays*. Workshop on the Urban Internet of Things. Parts of the paper are appearing in Chapter 1 and Chapter 2.

3. Memarovic, N., Elhart, I., and Langheinrich, M. 2011. *FunSquare: First*

Experiences with Autopoiesic Content. 10th International Conference on Mobile and Ubiquitous Multimedia. Parts of the paper are appearing in Chapter 4.

4. Memarovic, N., Langheinrich, M., and Alt, F. 2011. *Connecting People through Content – Promoting Community Identity Cognition through People and Places*. CIRN Community Informatics Conference. Parts of the paper are appearing in Chapter 1 and Chapter 2.

5. Alt, F., Memarovic, N., Elhart, I., Bial, D., Schmidt, A., Langheinrich, M., Harboe, G., Huang, E.M., and Scipioni, M.P. 2011. *Designing Shared Public Display Networks – Implications from Today's Paper-Based Notice Areas*. 9th International Conference on Pervasive Computing. Parts of the paper are appearing in Chapter 3, Section 3.1.

6. Memarovic, N., Langheinrich, M., and Alt, F. 2012. *Interacting Places Framework – Designing Applications that Promote Community Interaction and Place Awareness*. 1st International Symposium on Pervasive Displays. Parts of the paper are appearing in Chapter 7, Section 7.1.

7. Memarovic, N., Langheinrich, M., Alt, F., Elhart, I., Hosio, S., and Rubegni, E. 2012. *Using Public Displays to Stimulate Passive Engagement, Active Engagement, and Discovery in Public Spaces*. Media Architecture Biennale. Parts of the paper are appearing in Chapter 4, Section 4.4.

8. Memarovic, N., Langheinrich, M., Rubegni, E., David, A., and Elhart, I. 2012. *Designing "Interacting Places" for a Student Community using a Communicative Ecology Approach*. 11th International Conference on Mobile and Ubiquitous Multimedia. Parts of the paper are appearing in Chapter 3, Section 3.2.

9. Memarovic, N., Langheinrich, M., Cheverst, K., Taylor, N., and Alt, F. 2013. *P-LAYERS – A layered framework addressing the multi-faceted issues facing community-supporting public display deployments*. ACM Transactions of Computer-Human Interaction. Parts of the paper are appearing in Chapter 7, Section 7.2.

10. Memarovic, N., Fatah gen Schieck, A., Kostopoulou, E., Behrens, M., and Traunmueller, M. 2013. *Moment Machine: Opportunities and Challenges of Posting Situated Snapshots onto Networked Public Displays*. Human-Computer Interaction-INTERACT 2013. Parts of the paper are appearing in Chapter 5.

11. Memarovic, N., Elhart, I., Michelotti, A., Rubegni, E., and Langheinrich. M. 2013. *Social networked displays: integrating networked public displays with social media*. 2013 ACM conference on Pervasive and Ubiquitous Computing Adjunct Publication. Parts of the paper are appearing in Chapter 6.

12. Memarovic, N. 2014. *"Marshalling" Networked Public Displays: Connecting McLuhan's Media Theory With Networked Public Displays*. Interaction and Architectural Space: A CHI2014 Workshop. Parts of the paper are appearing in Chapter 2, Section 2.1.

13. Memarovic, N., Gehring, S. and Fischer, P.T. 2014 (To appear). *ELSI Model: Bridging user engagement around interactive public displays and media facades in urban spaces*. Journal of Urban Technology. Parts of the paper are appearing in Chapter 7, Section 7.3.

Chapter 2

Background

This chapter describes the background of the thesis and connects media theory, more precisely Marshall McLuhan's media theory, with the context of the medium and its audience, i.e., public space and communities. Also, I describe network and singular public display systems that are relevant for the thesis.

2.1 McLuhan's Media Theory

In order to understand what is it that this medium could be doing and how it could address its audience I turn to mass media theory, or more precisely to Marshall McLuhan's media theory [50]. His iconic work is best known for phrases like "the medium is the message", "the user is the content", or "the global village". According to him every medium is an "extension of ourselves" and has a message regardless of its content, and every medium builds upon existing ones. In his work he is covering a wide notion of media from, e.g., contentless light bulb that stimulates social interactions by creating spaces that otherwise would not exist in the dark, to radio, TV, and the Internet that stimulated connections within and across space and time creating the notion of "the global village" where people receive news from their locality and distant places equally. Overall, McLuhan's work allows examination of the wider effects of the medium on the society.

The key to understanding how a medium impacts society lies in understanding the interplay between the "figure", i.e., the medium, and the "ground", i.e., the context in which a medium is used. According to McLuhan [51], the figure amplifies the invisible and sometimes intangible effects of the ground : "The figure is what appears and the ground is always subliminal. Changes occur in the ground before they occur in the figure. We can project both figure and ground as images of the future using the ground as subplot of subliminal patterns and pressures and effects which actually come before the more or less final figures to which we normally direct our interest." [52][1] One of his

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[1]cited text found at [43]

examples of the interplay between the figure and the ground is how the car (as figure) impacted the ground (as ground) and led to creation of suburbs, and connections between the people in suburbs and cities - these are also the messages of the car as a medium. By examining the delicate impact of the ground – public space – on the audience – community – I infer effects that could be stimulated through the figure – networked public displays – thus putting McLuhan's theory into work [56]. These effects are summarized in the community – space cluster presented previously in Table 1.1 and Figure 1.1, and are 1) connecting local community members, 2) promoting community diversity and connecting communities that occupy the same public space, 3) stimulating greater connections within geographically distributed communities, and 4) enriching local life by connecting diverse public spaces.

Furthermore, in order to understand the underlying processes that lead to these effects we can use another tool that McLuhan left us, i.e., the rear-view mirror. The rear-view mirror metaphor states that a medium becomes fully visible only when a new medium has overtaken it. For example, the telephone overtook the telegraph and was first thought of as the "talking telegraph"; or the car that was first thought of as a "horseless carriage". Although the rear-view mirror has usually negative association and its use is seen as "march[ing] backwards into the future" this happens when the role of a new figure is understood through the previous figure - this is how public displays are seen and designed now as digital signage that shows similar content as analog signage or poster boards, just in the form of videos and slide shows – that have little or no connection with the ground/context. However, I look at the ground through the rear-view mirror in order to understand some of the causes of people's connections with public spaces and uncover some of the basic principles that we could build this medium upon.

This is in contrast to most of the current examination and understanding of the role of this new medium, which has been mainly focused on the figure, i.e., the screen [13, 77]. Other works also tried to connect McLuhan and media architecture, and discussed how a screen can be seen as material for artistic expression [15]. Similarly, McQuire [54] examined the connection between large urban screens – media façades – and the city, and how they connect a mediated space between the virtual and the real, and how they impact the actor and spectator role of people in public spaces.

2.2   Public Spaces and Communities

In order to stimulate engagement networked public displays can also here leverage on extending and building upon the ground of public space and the way people create connections to it and participate in it – in other words we can look at the ground through the rear-view mirror. As mentioned in Chapter 1, public spaces are building blocks of local communities as they provide the ground where local neighbors bump into each other to share the latest news, help with a heavy grocery bag, or just 'hang

out'. These activities, in turn, help in creating the common identity: "When public spaces are successful [...] they will increase opportunities to participate in communal activity. This fellowship in the open nurtures the growth of public life, which is stunted by the social isolation of ghettos and suburbs. In the parks, plazas, markets, waterfronts, and natural areas of our cities, people from different cultural groups can come together in a supportive context of mutual enjoyment. As these experiences are repeated, public spaces become vessels to carry positive communal meanings."

Carr et al. also talk about the processes that affect our notion of belonging to a community "Meaningful spaces are those that allow people to make strong connections between the place, their personal lives, and the larger world [...] By the build up of overlapping memories of individual and shared experiences, a place becomes sacred to a community [...] The freedom to leave a personal mark on a site, one that can rest within marks of history is one kind of valued modification. The photographs, notes, and flowers left at the Vietnam Memorial in Washington offer a moving image of this kind of transformation [...] The development of meaning is an interactive process between the space and person that evolves over time, a transactional process in which user and setting are both impacted. [...] Repeated direct experience is a requirement for connections to develop." In other words, good spaces are those that go beyond the local and convey connections to "the larger world", allow people to engage in them and create "overlapping memories of individual and shared experiences" or allow them to "leave their mark". This in turn supports the creation of a meaning through "an interactive process between the space and the person" impacting the surrounding, and sometimes greater, community and person's sense of belonging.

There are four important concepts from Carr et al.'s work that describe engagement in public spaces that can be extended through networked public displays. The first involves creating individual or shared experiences through engagement with a public space. One of the key processes in public spaces is 'social triangulation', a phenomenon where unusual features or events in a space trigger conversations with both friends and strangers and stimulates shared experiences: in turn this spontaneous interaction between people sparks sense of connectedness [8].

The second concept involves leaving a personal mark in the setting. Historically, people have been leaving their marks since the beginning of the time, e.g., cave paintings or pictograms or modern city graffiti. The third concept involves providing (greater) connections with the (larger) world. The fourth, and maybe the most important concept, involves "repeated direct experience" as a requirement for the connections to develop. In other words, in order to stimulate connections through networked public displays passers-by need to have the ability to engage repeatedly over a longer period of time: this is important as it shows the necessity of longer deployments.

Overall, all the effects summarized in the community – space cluster 1.1 and

the above-mentioned processes point out that the message of the networked public displays medium is the community. When it comes to defining a community there are many definitions: in 1955, Hillery pointed out no less than ninety-four different definitions [29] while, more recently, Clark noted the continuing change in the meaning of the term [11]. One reason for this diversity can be attributed to the different types of communities that exist. For example, communities of practice, as defined by Wenger [99], refers to groups of people tied through a common craft or profession. Alternatively, communities of interest, according to Fischer describes groups of people who have a common interest in a topic [20], while place-based communities, as defined by Ramsey and Beesley, relates to groups of people that reside and thrive within a geographical location [82]. In the context of my work, i.e., Interacting Places in general and the specific case carried out in this PhD that focuses on Interacting Places that stimulate interaction between local community members, I have focused on place-based communities.

It is generally acknowledged that one of the core ingredients of any community (and place-based community) is that it conveys a shared sense of belonging, a sense of community. According to McMillan and Chavis [53], this sense of community originates from four main factors : 1) membership, 2) influence, 3) integration, and 4) shared emotional connection. Membership reflects one's notion of belonging to a community. Influence refers to the ability of a member to make a change and impact upon the community and vice versa. Integration relates to one's willingness and need to belong to a community and leads to reinforcement of community ties. Shared emotional connection refers to having a shared notion of the community meaning and its values among the members. The interplay between the factors is described with this example from [53]: "Someone puts an announcement on the dormitory bulletin board about the formation of an intramural dormitory basketball team. People attend the organizational meeting as strangers out of their individual needs (integration and fulfillment of needs). The team is bound by place of residence (membership boundaries are set) and spends time together in practice (the contact hypothesis). They play a game and win (successful shared valent event). While playing, members exert energy on behalf of the team (personal investment in the group). As the team continues to win, team members become recognized and congratulated (gaining honor and status for being members). Someone suggests that they all buy matching shirts and shoes (common symbols) and they do so (influence)."

As pointed out by the example from [53], competitions are another way of stimulating community interaction between the members. In public spaces, these competitions can range from informal ones, e.g., competing in a street basketball game in a public games/basketball court, playing a game of chess in a public park, or street painting competitions – this is also aligned with Carr et al.'s notion of creating individual or shared experiences through engagement with a public space.

In my research I have built on the three properties described above, i.e., social

triangulation, leaving a mark in the setting, and stimulating community members to participate in a competition. FunSquare application in ambient mode (described later in Chapter 4) stimulates the notion of social triangulation by presenting intriguing place-specific information. Moment Machine, Moment Machine 2.0 and Moments Gallery (described in Chapter 5 and Chapter 6 respectively) allow passers-by to take a photo and leave it on a display network, thus leaving their mark in the setting. Similarly, FunSquare in the game mode allowed community members to take their photo and leave their nickname next to their score. Also, FunSquare application in the game mode stimulates community spirit by uniting people to compete for their neighborhoods; to a lesser extent this was also investigated in the Moment Machine 2.0 and Moments Gallery deployment where community members could end up in the "Hot4!" if their photo was "liked" the most.

2.3 Research on Networked and Situated Public Displays and Communities

There have been several studies that looked at current practices around public display's predecessors, i.e., publicly available notice boards and displays [10, 22, 33, 91]. Taylor et al. [91] looked at community notice boards in a rural village to inform the design of Wray Photo Display. Churchill et al. [10] looked at community notice boards in an urban area and in their own workspace to inform the design of their Plasma Poster Network, a system that displays information of different workgroups' activities. Huang et al. [33] conducted a field study to analyze various paper and digital displays and their actual placement as well as how much people actually look at them. Based on their findings they provided design recommendations for increasing display visibility and better matching between people's behavior and display content. Most recently Fortin et al. [22] have investigated the use of notice boards in a variety of settings that confirmed previous findings and showed that most of the content on public noticeboards is highly local in nature and reflects the community around it.

However, the below paragraphs summarize the *diversity of existing solutions* and show that there is no unique process, pattern, or framework that could be followed when creating Interacting Places that stimulate interaction between local community members. Previous research has explored the use of public displays in a variety of settings and communities, i.e., in urban areas, working environments, and rural places.

Some of the pioneering research on public displays in urban spaces has been conducted in the early 80s through the 'Hole in Space'[2] project that connected two urban public spaces in New York and Los Angeles through a video link. Similar and more recent projects are Connected Urban Spaces [17], Hole in the Earth[3],

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[2]http://bit.ly/de6vOG
[3]http://bit.ly/1exeai0

and Telectroscope[4]. Recently research on urban public displays has shifted from stimulating interaction through video links into creating more interactive multimedia applications. For example, José et al, [39] investigated how we can use familiar paradigms, i.e., pins and posters, to allow community members to express themselves on a urban screens. Peltonen et al. developed and deployed the CityWall [80], a large multi-touch display located in the city center of Helsinki, Finland. The installation displayed randomly chosen Flickr images tagged with 'Helsinki', which multiple users could browse in parallel. The CityWall installation was then extended to Worlds of Information [36] that displayed content in the form of a 'world' (globe) grouped into six different themes. Both CityWall and Worlds of Information deployments were more concentrated on information consumption. On the other hand Cityspeak [42], Digifieds [2], and DIS [86] are examples of applications that allow users to post their content on public displays in form of a short message [42, 86] or classifieds [2].

The work reported in this thesis on the Moment Machine application falls in the category of applications that allow people in a community setting to express themselves through photos, more precisely through situated snapshots taken through a display-attached camera. This ability to take the photos "in the moment" next to a display makes the nature of the photos different from posting the photos through other means, e.g., from a website/social network [49, 90, 86]. In the area of situated snapshots the work reported here is closest to UBI-Postcards [78] and Ubinion [31]. UBI-Postcards [78] allows passers-by to take photos using a camera attached to a display. Once the photos are taken users can send the photo to an email address. Similarly, Ubinion [31] used a public display as an input device: young adults/teenagers could use them to create posters with speech bubbles that would represent their concerns about the city of Oulu. Posters created on displays would be posted on dedicated Facebook and Twitter accounts. The studies reported in Chapter 5 and Chapter 6 complement the above mentioned ones by investigating longitudinal and open-ended/free use of situated snapshots in a community setting.

In a working environment Churchill et al. [10] and Munson et al. [74] allowed users to post classifieds as email attachments and twitter feeds respectively. Greenberg et al. [26] also used public displays as a digital version of a 'pin board' and allowed users to post a variety of media ranging from a simple 'sticky note' to more advanced 'live' desktop and live video feed. In contrast to Churchill et al.'s and Munson et al.'s deployments that aimed at creating awareness between colleagues belonging to different departments, Greenberg et al.'s work oriented more towards creating an awareness of different member's activities that collaborated closely. On the other hand, McCarthy et al . [48] went beyond the classifieds and post-its and displayed personal interests of colleagues on a large screen in a shared work space. While the above work focused on individuals in the community (posting and consuming content), Houde et al. [32] tried to foster connections between local community members by joining

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[4]http://www.telectroscope.net/

co-workers into creating a workplace newspaper collaboratively. The result, i.e., the newspaper, was projected on a big screen.

On the other hand, Wray Photo Display [90], Story Bank [37], and Nnub [83] are examples of public display applications that were deployed in more social settings, i.e., rural environments [37, 90] and urban neighborhood [83]. The Wray Photo Display application showed community relevant images, e.g., from festivals or important historical events (e.g., flood). Similarly, Story Bank displayed random local/historical images and audio files. In contrast to the two, Nnub allowed people to post classifieds in a similar fashion as Digifieds [1].

Although the above mentioned solutions are very diverse, they do offer some design implications:

- The importance of co–realizing the system with the community for whom the system is being built has been stressed throughout prior research [35, 37, 83, 90]. Without gaining insight and understanding a particular community's needs, the system is not likely going to be supported by the community.

- Having a number of strongly motivated initial users that would spark community interest in the system's use would be beneficial [35]. Taylor and Cheverst [90] note that promoting such a system with an event explicitly organized around it can help to jump–start its acceptance.

- Also, the system needs to be built on top of existing behavior and practice [3, 18, 75]. Getting community members to learn a new pattern to perform an existing habitual action will most likely not work [34]. This can also be connected to previous research that explains the value of some more analog tools used within communities such as public notice boards [10, 90, 22].

- At the outset, public displays will need to come already filled with content [90]. Storz et al. [89] stress that creating original content is a difficult thing. They also note that having a source of existing content greatly simplifies deployment, as people are typically more comfortable when they interact or manage already existing types of content.

- Equally important is to have the location of the display in mind, as this strongly influences how its function is perceived [88]: if the display is located near a workplace it is more likely to be associated with work, whereas if it is located near a cafeteria it is perceived to convey more leisure content.

- The distance between viewers and display also plays an important role, as larger, far–away displays typically do not invite people to interact directly with the display. This could be exploited as in O'Hara et al.'s 'visibility zones' [75], where,

e.g., only the most critical information is visible from afar and details are only revealed upon close inspection of the display.

The contribution of my thesis complements the current body of research on public displays for communities by providing a general coordination and engagement model that shows how users behave around public displays as well as two experience driven frameworks that summarize issues and challenges involved in developing and deploying networked public display systems for communities (P-LAYERS presented later in Section 7.2); and the conceptual design space for designing and developing networked public display applications that aim at stimulating community interaction and place awareness (described later in Section 7.1). Also I enumerate the effects of networked public displays on surrounding community that were examined through three "in the wild" deployments.

Chapter 3

Understanding the Use of Current Media

As every media builds upon and extends previous ones according to McLuhan, as a first step I conducted two very broad user requirements studies that looked into understanding how Interacting Places can be built on top of existing use-practices practices with today's widely used media. The first study revolved around understanding practices around traditional public notice areas (PNAs), commonly referred to as public notice boards [2]. The second study was on understanding practices with current information and communication technologies such as email, FaceBook, Skype, and/or Twitter, and how we can fit networked public displays medium within them [68].

3.1 Understanding Practices around Public Notice Areas

Previous work explains the value of traditional notice boards as a communication tool for communities [10, 90]. Following that lead, we investigated today's practices surrounding public notice areas (PNAs), i.e., places where customers and visitors can put up event posters and classifieds

This study was done in two steps. In the first step we performed a two-week photo-log study of twenty-nine diverse locations (e.g., retail stores, universities, and cafés) that deployed notice boards. Observations took place in four different cities in two countries (Switzerland and Germany). In particular, we looked at the content, different ways of posting (i.e., forms of content control), and the motivation for having a notice board. In the second step, i.e., after finishing our observational study, we conducted seven in-depth interviews with people in charge of managing the PNAs. The collected data, i.e., photos and interviews, was analyzed using a "data walkthrough" analysis: all the material was printed and distributed on walls and whiteboards in a single room, and all the photos were grouped by site in a chronological order. Also, interviews

and field notes for a particular site were placed on the appropriate wall/whiteboard. After placing the data material a team of five researchers walked around the room and annotated the data using individual sticky notes. This process supported discovering patterns and higher-level findings, whcih were written on a separate whiteboard. When the team was finished with the data walkthrough process we collected all the sticky notes with annotations and grouped them using an affinity diagram, i.e., sorting and grouping the notes according to their similarity and repeating the process until only a few groups were left. Overall, the goal of the process was to help in answering a set of predefined research questions: 1) who are the stakeholders, 2) what types of displays there are and what are their characteristics, 3) current practices with content distribution and layout on a PNA, 4) what is the purpose of posting content on a PNA, 5) what is the interplay between the space, stakeholders, and content, and 6) what are the needs of people who are putting PNAs up and people who are posting content on them.

I was involved in the design of the observational photo-log study. Data collection for the study was done with my colleague Ivan Elhart. Because interviews with PNA managers in Lugano required Italian language proficiency they were conducted by my colleague Marcello Paolo Scipioni, an Italian native speaker. My role in the interviews was to plan, record, and analyze the transcribed interviews (they were translated into English). After the interviews we conducted an extensive qualitative analysis of the collected photographs and interviews. The analysis was done with help from Elaine Huang and Gunnar Harboe from the Institute for Informatics, University of Zurich, and my colleague Ivan Elahrt. Based on our reflection and understanding of the data we suggested a set of design implications for networked display systems. In this section I report on the findings with a focus on current practices. I first describe the stakeholders around PNAs, then characteristics of displays and content, and uncover the motivation for having a PNA.

3.1.1   Stakeholders and Motivation

The data analysis of photos collected, interviews, and observations indicated clearly that there is a diverse range of stakeholders involved around managing, maintaining, and using public notice areas. We can differentiate between three different user groups involved in operation of PNAs, i.e., display providers and managers, content providers, and viewers.

Display Providers and Managers

Interview analysis revealed that the decision to install a PNA in store chains and public authority institutions is taken on a higher management level, making PNAs standard part of the stores or public building setting (L1, L2, L5, E3, E4, E5, E6, D1, M1, M2, M3, M4). Moreover, public and ecclesiastic institutions see information dissemination as a

ID	Name	Description	Obs.	Int.	Type	Cur.
E1	Turn Headshop (Rack)	Retail	x	x	ED	-
E2	Turn Headshop (Door)	Retail	x	x	ED	-
E3	Diocese (Office)	Church	x	x	ID	x
E4	Diocese (Entrance)	Church	x	x	ID	x
E5	Supermarket	Retail	x	x	SCD	-
E6	Supermarket	Retail	x	x	UCD	-
E7	University cafeteria	Public Bldg./Gov.	-	x	UCD	x
D1	City administration	Public Bldg./Gov.	x	x	ID	x
D2	Adult Education Center	Public Bldg./Gov.	x	x	UCD	-
D3	Public Library	Public Bldg./Gov.	x	x	ED	x
D4	Child Services	Public Bldg./Gov.	x	x	ED	-
M1	Supermarket	Retail	-	x	SCD	-
M2	Supermarket	Retail	-	x	SCD	-
M3	Supermarket	Retail	-	x	SCD	-
M4	Supermarket	Retail	-	x	SCD	-
L1	Supermarket	Retail	x	x	SCD	-
L2	University	Public Bldg./Gov.	x	x	UCD	-
L3	Bakery	Service	x	x	UCD	x
L4	Church	Church	x	-	ID	x
L5	Supermarket	Retail	x	x	SCD	-
L6	Café	Service	x	-	ED	-
L7	Hairdresser	Service	x	-	ED	-
L8	Bar	Service	x	x	ED	-
L9	Café	Service	x	x	ED	x
L10	Pharmacy	Retail	x	-	ED	-
L11	Bookstore	Retail	x	x	ED	-
L12	Red Cross	Public Bldg./Gov.	x	x	ID	x
L13	Laundry	Service	x	-	ED	-
L14	Church	Church	x	-	ID	x

Table 3.1. Overview of study locations. Abbreviations: Obs | Int: Observation | Interview Cur: Curated Display Display Types: SCD / UCD (Scaffolded / Unscaffolded Classifieds Display), ID (Information Display), ED (Event Display)

way of reaching out to their target audience and informing them about their (public institution's) activities. In contrast to store chains and public authority, in places where venue and shop owners are in charge of the location the decision to have a PNA is taken by the owner (L3, L8, L9, L11, E3, E4, E5, M1, M2, M3, M4).

We were able to distill three motivations for having a PNA installed. Retail stores and services have them in order to reach to their customers in an effort to increase customer satisfaction (interviews at M1, M3, M4, E6, D2). Public and ecclesiastic institutions use them to disseminate information about their ongoing activities (observations at L4, L14, interviews at E7, D1, D2, D3, D4). Also some of them use it as a way to attract third party content that fits with the place's scope (interviews at E3, E4, E7, D1, D2, D3, D4).

When it comes to content approval, public and ecclesiastic institutions usually have a dedicated manager that approves the content before putting it up. On the other hand, in shops and cafés the process is more relaxed and usually staff members make the decision whether the content can be put or not.

Content Providers

There are two very distinct groups of content providers, i.e., people who put classifieds and third party advertisers – both groups have the same goal to distribute their information to their target audience. Classifieds providers are usually people who live in the vicinity of a PNA or are frequent visitors of the place where the PNA is located. They usually seek some sort of matchmaking, e.g., from students selling, buying or exchanging textbooks to people offering and seeking housing opportunities. In many cases the longevity of the content depends on the type of information that is posted.

In contrast to classifieds providers, who are mainly individuals, third party advertisers are organizations such as businesses, government, churches, or other. Third party advertisers are seeking to reach out to their target audience located in the physical proximity of a PNA. For example, information about music events is typically posted in places such as music-oriented bars or universities. In some cases even the information abut events for a venue where a PNA is installed is blended with the rest of the content and is 'masked' as third party content (e.g., Li8).

The two stakeholders – display providers and managers one one side and content providers on the other – depend on each other : display owners need interesting content for their PNAs and content providers need a space where they can put the content. In order to avoid tensions between the two stakeholders it is best to create a shared understanding and clearly show what content is acceptable. Our interviews revealed that this is a common practice for PNAs as interviewees barely mentioned any problems or abuses (interviews at L1, L5, L8, L9, L11, E1, E2, D1, D2, D3, D4).

Viewers

Viewers are usually people that are somehow related with the location where a PNA is located, e.g., they live, study, or work in the area, and they can act as both viewers and providers (e.g., putting the content up on a PNA and at the same time reading it). Looking at PNA's content is usually either driven by finding a particular piece of information, such as information about housing or furniture, or it is accidental, e.g., 'killing time' while waiting for a friend next to a university's PNA. The second motivation is also somewhat driven by the PNA's location as many are located in high traffic areas where there is guaranteed waiting time, e.g., next to a printer or copy machine.

3.1.2   Displays and Content

Our analysis also revealed four different types of PNAs with respect to their content:

Scaffolded Classifieds Displays: This type of PNA is usually found in retail stores and supermarkets. Content on scaffolded classifieds displays is typically well organized into several rows of slots, where content providers can put their classified. In order to support this organization preprinted cards of typical size (that fits into the slots) can be found at the PNA. Also, in order to support high turnover and freshness of the content content providers are asked to put a date when their content should be removed. In some cases when a PNA was already filled or when the content does not fit into the prearranged row structure, content providers would attach their content next to the PNA. Typically content on scaffolded classifieds in hand written and created very fast (around a minute).

Unscaffolded Classifieds Display: These PNAs typically do not have an organized content structure (e.g., L2, L8, D2). In other words, the PNA owners provide self-service without any particular person being in charge of content approval. This allows content providers to post the content wherever there is space for it, which sometimes leads to content being overlaid and occluded by newer content (e.g., L2, L8). Content on unscaffolded classifieds displays is similar to the ones for scaffolded classifieds displays, with less structured layout, mixed sizes of posts, more colorful posts and more event-related content.

Information Display: As mentioned previously, this type of PNAs is usually found at public and ecclesiastic institutions that have information dissemination as part of their mission (e.g., observations at L4, L12, L14). These PNAs typically have a smaller number of postings than above-mentioned PNA types, and their content comprises from mainly professionally created ads. When it comes to putting the content on this type of PNA there is usually a formal process to be followed and implies going through existing organization network.

Event Display: This type of PNAs is typically found at bars and retailers (e.g., E1, L6, L8, L9) offering information on various events. Content is usually coming from

third parties, is professionally created, and sometimes thematically scoped for a certain type of events (e.g., focusing on events that have techno music as a theme). In certain cases it provides some form of urban aesthetic, due its colorful nature.

3.1.3 Managing Content and Supporting Memory

In our analysis we were able to differentiate between three distinct ways of supporting memory and helping viewers remember content they have seen. For example, some PNAs have essential information that is meant to stay on it and viewers are expected to somehow remember it or write it down. Other PNAs have content that can be completely taken away, e.g., flyers on racks; or parts of the content can be taken away, e.g., tear-offs with names, emails, or telephone numbers.

When it comes to cleaning the displays and making sure it has the mos appropriate content for the PNA we uncovered three practices. The most common practice of content removal was based on *expiration date*, i.e., content that passed beyond a certain date would be removed. On the other hand some PNAs had their content *completely removed* on a regular basis – this was usually the practice for PNAs had too much content. Also, there were cases of *curated content* on PNAs that required often formal submission and approval of the content. As mentioned several times, this was typical for places such as public institutions.

3.1.4 The Role of Shared Displays in a Space

Typically PNAs are used as community support tools and create a central location for community activity (observations at E1, E2, E7), whether this community is place-based, cultural, or religious. Their most common function is in supporting local item exchange, especially for items that outweigh shipping costs or some items that can be found fast as they are available in the locality (e.g, study material or text books). Also, PNAs typically have events of interests for the people that frequent the location, e.g., a music oriented bar would typically have content that advertises concerts, parties, and other live shows (observation at L8).

3.1.5 Interplay between Space, Stakeholders, and Content

Often times PNAs would be installed at locations that have high traffic, e.g., next to printers/copy machines or at the main entrance of a location – this directly impacts the turnover in content. Although there is a possibility for anyone from anywhere to post content on a PNA, most of the content was highly local and content that is not attached to a particular geographical area (where the PNA is located) appears rarely. For example, information about certain event(s) would be posted on PNAs that are close to the event venue; or babysitters that look for a job would typically be around the area where the PNA is located. Overall, PNAs would express the identity of the

venue and community that dwells in it, and content that does not fit with the venue's scope or mission would be removed (e.g., the public library D4 refuses to announce Mardi Gras events as it favors independent theatres).

3.1.6   Needs of Content Providers and Display Owners

Continuing from above, PNA owners often have an agenda for their PNA, which is often aligned with their motivation for having it in the first place (e.g., information dissemination). In some cases people acting as PNA managers would also become gatekeepers and would filter the type of content that can be put up on a PNA (as in the example mentioned at the end of the previous section where a person from a public library favored certain events and would not post others that do not align with the venue's scope and agenda).

In many places tools for content creation on the spot were provided, e.g., cards and pens. While in some cases, e.g., scaffolded PNAs, there was a typical size of the post and information it supports (e.g., expiration date, date when it was put up etc.) in order to maintain the 'order' of the PNA, most of them (PNAs) supported flexible types of content, e.g., homemade posts, specially colored posts to make it 'stick out from the crowd'. Interestingly, there were PNAs that contained multiple copies of the same content, e.g., on unscaffolded PNAs same content would be grouped next to each other making a larger area for the post; while on scaffolded PNAs same content would appear on different parts of the PNA. This flexibility goes also beyond just the content size and look and extends to the PNAs space, where most of the display owners were okay with posts being attached outside of PNAs surface and appearing next to it.

Although content providers and display owners typically do not have issues in creating a shared understanding of what content is and isn't allowed on a PNA, in certain cases there were problems as often this is not made explicit. In fact, only one PNA – at the adult education center – had an explicit notice that explained that teaching content is to be approved first. Content that is not approved or is removed from the PNA is mainly political content, offending or provocative content, competing content, and content which does not fit the agenda of the display owner.

3.1.7   Implications For Interacting Places from the PNA Study

The PNA study revealed three key parties involved: 1) display providers and managers, i.e., people who are providing the notice boards, 2) content providers, i.e., people who are supplying/posting the content, and 3) content viewers, i.e., people who are consuming/viewing the content. The work carried out in this thesis and the applications that were created focused on the content providers and viewers. Flexible content creation and content posting are one of the key requirements that allow a broad set of people using PNAs, where in some cases the means for creating content would be found next to a public display – cards of appropriate size, tables where they

could be filled in easily, and sometimes even pens. This on-the-spot content creation offers ease-of-use of a PNA. In order to increase the effectiveness of posted content on a PNA it is important that viewer have means to take the information with them – through physical tokens or digital technology.

3.2   Practices with Today's Information and Communication Technologies

In order to understand how Interacting Places would best complement information and communication technologies (ICTs) we investigated the communicative ecology [23] of the three student communities: USI's Faculty of Informatics, Faculty of Communications, and Faculty of Economics. A communicative ecology is a conceptual model used in media and communications research to represent the technical, social, and discursive contexts in which communication processes occur. We explored the ICT preferences through the three layers of the (communicative) ecology: 1) a technological layer that lists different ICTs (including *analog*, like face-to-face interaction, and *digital*, like instant messaging, social networking sites, and email) that enable communication and interaction, 2) a social layer that looks at how different ICTs are used to contact different social circles, and 3) a discursive layer that investigates the 'themes' that make the conversation. Each communicative ecology can be placed within the three dimensions, i.e., 1) online/offline, 2) global/local, and 3) collective networked thus further describing the properties of the ecology.

As conducting a full-fledged communicative ecology encompasses investigating the interconnection between different stakeholders (e.g., professors, students, and other University staff) as well as the use of non-digital and digital media, we conducted a more focused (and thus shorter) investigation. Instead of going wide we conducted an abbreviated and more focused study that only explored the use of the most widespread ICTs by our direct stakeholder – the students. In other words: we explored students' use of popular social networking services (SNS), email, and instant messaging (IM) for communicating with classmates, the University, friends, and family.

The study was designed in two phases. First, we performed interviews with seventeen students from the three faculties and investigated their communicative ecology, i.e., preferences with today's popular information and communication technologies such as email, social networking services, and instant messaging (full semi-structured interview scheme can be found in Appendix A). In addition to exploring their communicative ecology we also asked the students to envision potential content for Interacting Places. Students were recruited through the faculties' mailing lists. We selected a sample of individuals that represent the variety of the USI students. In total, we recruited 17 people: 7 from the Informatics Faculty, 5 from the Economics Faculty and 5 from the Communication Science Faculty. The interviews were taken at USI's premises and lasted about 30 minutes.

We then analyzed interviews and identified possible content items for Interacting Places. In the second phase we conducted an online survey that asked a wider student audience to rate various technologies with respect to their suitability for sharing and viewing identified content items. The two activities, i.e., sharing and viewing, emerged as the predominant activities from the interviews. The online survey asked students to select all tools that they would use (or like others to use) for sharing a particular content item: public displays, social networking sites, email, instant messaging, or "other". We also asked participants to explicitly identify content that they would find inappropriate for viewing and posting to public displays. A link to the survey was distributed through various university mailing lists. Overall we received 76 completed questionnaires. Full online survey can be found in Appendix B.

This study was designed with help from my advisor Marc Langheinrich, Elisa Rubegni (Postdoc at the Faculty of Informatics, USI), and Andreia David (at the time Master student at the Faculty of Informatics, USI). I was involved in the study logistics, interview design, and data analysis (for both phases).

We conducted a qualitative analysis of the interviews starting from the transcripts. Transcripts were anonymized by using an identifier comprising from the first letter of the participant's faculty of provenance (E – economics, I – informatics, and C – communications) and his/hers sequential number within that group, e.g., 2I would be the second interviewed student from the Faculty of Informatics while 3C would be the third student from the Faculty of Communications. Three researchers conducted open-ended coding to identify 1) the main themes pertaining the habits and attitudes of a student community in using ICTs with respect to how they see different sources and addresses in communication, and 2) the content and services they might like to have in an interactive public display. Affinity diagrams were used to group emerging key patterns, which in turn were used to create the follow-up online survey. The survey data was analyzed with the help of simple descriptive statistics to order the replies and identify trends. Considering the qualitative nature of both studies, as well as the modest size of the participant group, our results are not intended as statistical evidence for expected students behavior. Instead our results serve as an input to the design process by identifying prevalent tendencies in our student community.

Our findings are organized around two main areas: 1) students' communicative ecology, i.e., practices with current ICTs and 2) their publishing and viewing preferences for public display content. While the value of potential content is straightforward, the contribution of the communicative ecology analysis is more subtle: by analyzing the current communication portfolio of our target community, we try to improve our understanding of how Interacting Places can complement and/or enhance their current communication practices.
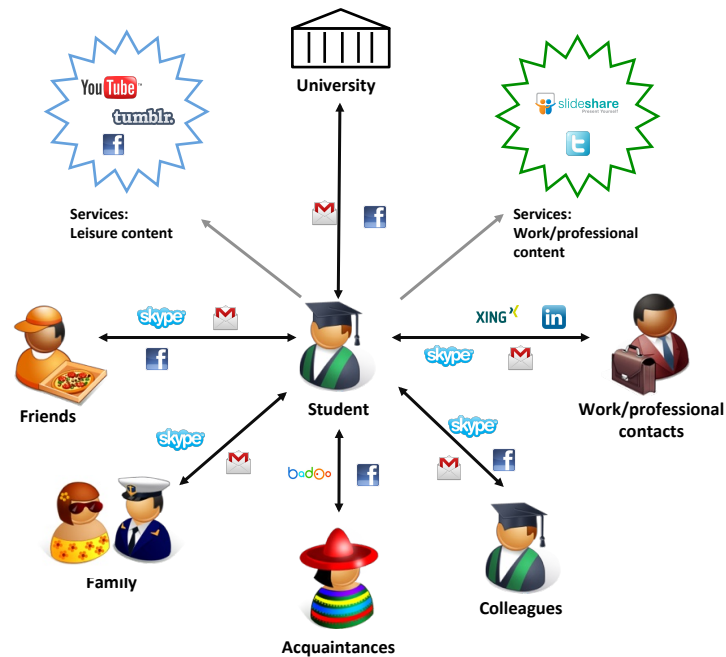
Figure 3.1. Illustrative representation of the students' communicative ecology

3.2.1 Students' Use of Current Information and Communication Technologies

Students' communicative ecology is illustrated in Figure 3.1. We organize our findings of the students' communicative ecology around the technological layer, by grouping students' use practices around the most prominent ICTs, i.e., social media (SNS), instant messaging (IM), and email. For each of these we show how they are used to connect with different social circles (social layer) as well as what themes make the discourse (discourse layer). We then present their ideas about the potential content for Interacting Places.

Social Media and SNS Technology

Not surprisingly, Facebook is seen as a leisure activity and a place for very casual communication, one where there is no place for 'serious stuff' (1I, 2I, 3C, 7I, 1E). Although Facebook offers several communication channels, e.g., private messaging, chat, and 'likes', one of the most common activities is 'lurking', i.e., looking at what other people are doing (1I, 2I, 3I, 4I, 5I, 6I, 1E, 2E, 4E). Private messaging is used for a closed group of people (1C, 2I, 3I, 1E, 5E, 2C, 3C), i.e., friends. This channel is usually used for people that are close friends, and in a similar fashion as email, e.g., to organize meetings or share pictures. Group activity is organized through the 'events' channel. Students use it to organize leisure activity within a smaller group (1C, 4C, 3I,

4I, 5I), while some use it actively to promote commercial events in the vicinity (3C). Lurkers use it to see social activities in the vicinity, e.g.:

2I: "[how does the student get informed about events] well, just by being on FB I have the LU, I also get disco events... That's usually, maybe yes, what usually comes to me perhaps a bit more by FB [events info]"

Another popular activity is 'liking' and commenting. 'Likes' are used as a quick feedback and to show content preferences for both close friends and acquaintances (3C, 2C, 1E, 6E). Comments were rated as 'the activity' Facebook is used for (4E, 5I).

4E: "[activity with photos] and of course I always make comments and things of this type."

5I: "[what do you use Facebook most for] ... to make comments to the status updates and events."

While YouTube also offers social media functionality, most of the students do not have an account. Instead, they use it strictly for consumption (2C, 2I, 3I, 1E, 2E, 3E, 5E, 4C). Most of the students use Facebook to share videos found on YouTube (4I, 7I, 5I, 3C, 4E). However, there are some that post content on it (2I).

2I: "Yes, i use YouTube a lot, mostly because playing the piano, I upload my videos from concerts..."

3C: "Every now and then I watch [YouTube] something funny so I put it on FB then people look at it and laugh."

Besides videos, students also share pictures from parties and other events (2C, 3C, 4C, 1I, 2I, 3I) via Facebook. Students also use other SNS and services, e.g., Badoo (3I), LinkedIn (1C), Xing (1C, 4C), Twitter (1I), SlideShare (1C), and Tumblr (3C), which for them serve a distinctively different purpose from Facebook. Badoo is seen as an SNS where one can meet new people who live in vicinity. This is different from Facebook, where face-to-face contact is preferred before adding someone as a friend. Twitter is used for a quick update on the topics of interest, unlike Facebook that serves for quick update on people (1B). SlideShare and Tumblr are used in a similar fashion as YouTube, i.e., for consumption. However, SlideShare is characterized as having professional content that provides a quick view on a topic of interest, similar to Twitter, while Tumblr is characterized as providing a very specific leisure content:

1C: "SlideShare is basically a YouTube for Powerpoint presentations... It's really helpful if you want to get a fast perspective on things other than reading articles"

3C: "Tumblr is a blog of pretty pictures ... I use it for photos I like, that inspire me, or things that make people laugh ... instead on Facebook where you put your pictures, you post here the pictures that you like."

Xing and LinkedIn are professional SNSs. Some students separate professional and leisure realms by having additional profiles on Xing or LinkedIn (1C, 4C) while some have two Facebook profiles for the same purpose (3C):

3C: "[...] I also have a page for my friends on FB, and a page of FB for the school, because I do not want those at school to see the life I lead with my friends."

Instant Messaging (IM) Technology

There are important differences in how students perceive SNS and IM. While Facebook was characterized as leisure realm used for very casual communication, Skype is used with a clear communication intention, 'not just for the fun of it' (2I, 5I, 1C, 2C, 5C, 4E).

4I: "[last time I used Skype] We discussed a test, oh no a presentation that [my colleague] did last night..."

2C: "Skype is always when I need to call someone... and when I directly need answers and replies."

Email

Students use email extensively on a regular basis in a similar way as they use IM, i.e., with a clear communication intention (1I, 2I, 6I, 2C, 4C, 5C, 1E, 2E, 4E). Some students use email for professional/work related communication (1I, 2I, 2C, 4E) while some use it to keep in touch with their family and close friends (1I, 2C, 4C, 1E, 5E). To avoid the confusion between the two, students have usually two email accounts to separate them (2C, 4C, 1E, 4E).

4E: "I use [my school email] exclusively for school only, most of the time I do not give the private email to my classmates because I prefer it like that..".

In particular, on their University email account students sometimes receive content that they are not sure if it is for them (1I, 2E):

1I: "University news, more than anything else I get in my mail [...] It seems like spam. Then there are the events, those conferences etc., where it is not clear whether it is for me, if I have to go. I think we would need a central place where the faculty, those who send the internships, job offers, conferences news... can go and publish them."

Potential Content for Interacting Places

Complementing the data on actual practices, we also asked students directly about possible content they could envision for Interacting Places. We group their responses in four categories: 1) Official University content, 2) cultural and social events in the vicinity, 3) student contributed content, and 4) non-local information that is topic oriented.

Official university content: Not surprisingly, students wanted to see faculty schedules, classroom locations, important administrative deadlines (e.g., enrollment and exam registration deadlines), grades, and invited lectures (1I, 2C, 3C, 2E, 3E, 4E). This type of content is very similar to what can be found at the University's public notice boards.
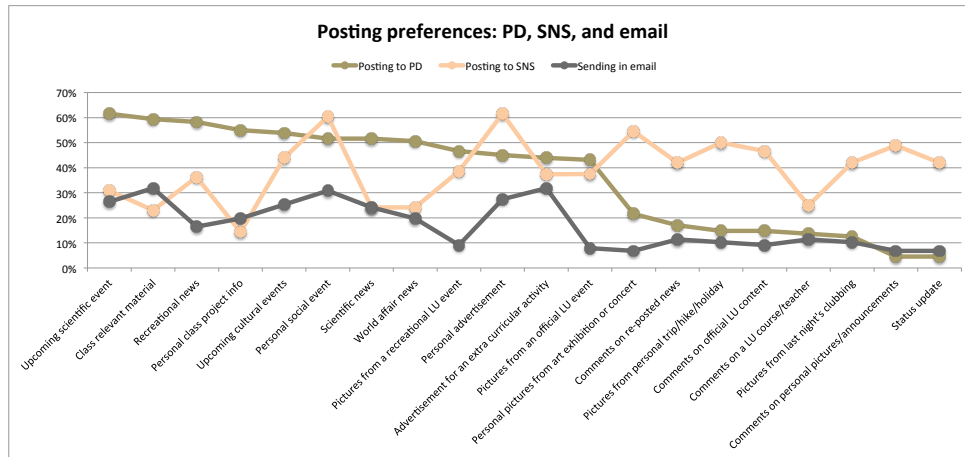
(a) Content posting preferences.
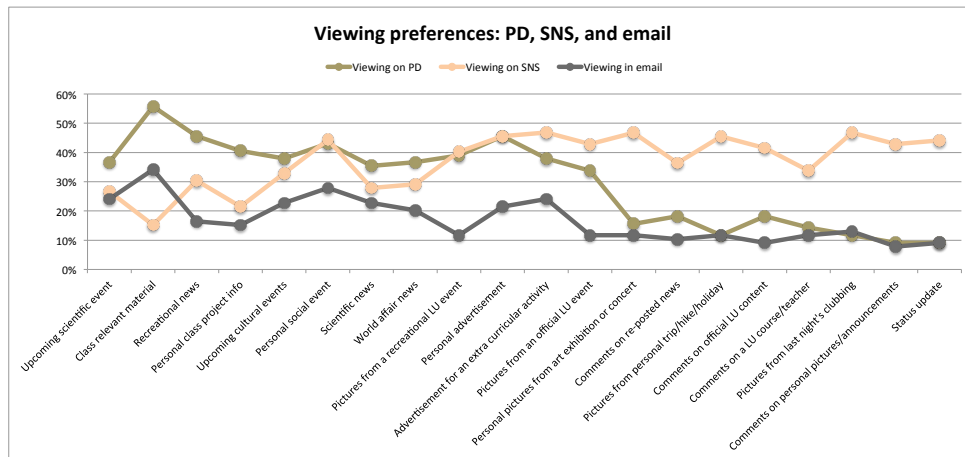
(b) Content viewing preferences.
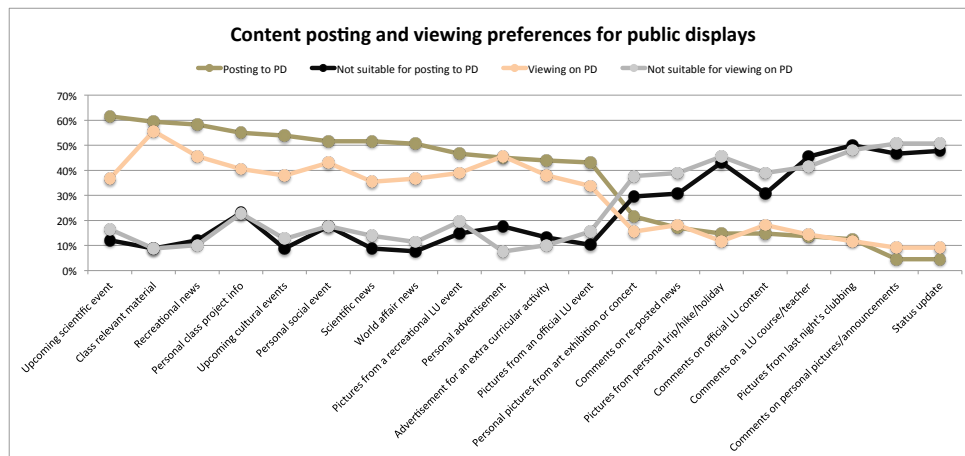
(c) Content preferences for public displays.

Figure 3.2. Content preferences from online survey. Using the most popular content items that emerged in the interviews, we asked students to rate the suitability of a particular medium for each content type – both for posting it themselves (a) and for reading others' posts (b). We also explicitly asked about content that would not be suitable to post or read on public displays (c).

3E: "[...] this is basically information what is going on at LU...okay for sure important deadlines...also like activities, what's going on at the university, invited lectures, if there is classroom change, things related to what is going on the campus actually."

Cultural and social events: Students wanted to be informed about cultural events in the vicinity, e.g., about concerts, festivals, and museum exhibitions (1E, 2E, 4E, 5E).

5E: "Information about the events that we have in Lugano, in Locarno... all these things here, what clubs are here...maybe, I don't know, festivals..."

Some of the students would also like to get information about student organized social events, e.g., parties or barbecues (1I, 3I, 1C, 2C, 1E, 3E, 4E) that would bring up the opportunity to meet students from different faculties outside the university premises (4E). For social events, some students would like the possibility to see who is attending them (similar to Facebook, 1I).

4E: "[...] the possibility of meeting between the faculties, maybe for a drink so you see the people as they are outside... it would be interesting to see maybe the last event, more than anything else something cultural..."

Content contributed by students: Students would also like to have the possibility to publish their content on the displays. This content would include classifieds (1I, 1C, 5C) but also the above-mentioned possibility to announce events organized by the students. What we have observed in the interviews is the students' desire to get in touch with other students and socialize, especially between the faculties, but also to get in touch with the professors (5E, 4E).

1I: "[...] something like a social event or a publication for those looking for a home, that too, not a bad thing. Topical content: Students wanted to get information relating to their field of study, but also something broader, e.g., news (7I, 1E, 2E, 3E, 4E, 4C). Students also associated the term 'discussion' with these topics, i.e., they felt like this would bring interaction in the actual physical space."

2E: "Current actual topics also ... like what is happening around the world... something on the economy, if something happens, that oil goes up or down or so, and certainly there would be people to discuss this."

3.2.2   Public Display Content Preferences

Survey results are illustrated in Figure 3.2, listing the responses for the 3 most popular media that emerged during the interviews: public displays, SNS, and email.

Overall, as seen in Figure 3.2c, content types that students would like (and would not like) to view and post are very similar. Figure 3.2c also shows a clear tendency: students would prefer to use public displays to share and view content that connects to the community and its interests, e.g., news about upcoming scientific events (62% would post it, 37% would view it – P for posting and V for viewing percentages from now on), class relevant material (P 59%, V 56%) and personal class project information (P 55%, V 41%), or upcoming cultural events (P 54%, V 38%). On the other hand more

personal content is not desirable for publishing and viewing on public displays, e.g., pictures from last night's clubbing (P 13%, V 12%), comments on personal photos (P 5%, V 9%), or personal status updates (P 5%, V 9%). Most of this type of content would stay at SNS, the predominant media for sharing and viewing personal content. This is reflected in the right part of Figure 3.2a and . However some personal posts that relate to community's interests, e.g., personal social events (P 52%, V 43%), personal advertisement/classifieds (P 45%, V 46%), personal advertisement of an extra curricular activity (P 44%, V 38%), personal pictures from recreational USI event (P 47%, V 39%), or personal pictures from official USI event (P 44%, V 34%) would be acceptable and desirable for viewing and sharing through public displays. This is illustrated in Figure 3.2.

3.2.3   Reflection on Students' Media Selection

Students make a difference between how they use SNS on the one hand and IM and email on the other. SNS are predominantly used for leisure communication (e.g., Facebook, YouTube), while IM and email are used for more work-oriented activities. Some students have two email accounts or two profiles on the same SNS in order to separate work and leisure. We can say that students make a clear selection of media depending on leisure or work use.

Students also choose ICTs according to the recipient of the message. In general, Facebook is used to address a larger audience. IM and SNS private messaging are instead used to address a rather closed group of people, e.g., family, friends, and colleagues. We can say that students choose ICTs depending on the addressee of the communication.

There is also a clear difference between the type of information students seek from different ICTs. For example, Facebook was characterized as providing 'people information', while Tumblr and YouTube were characterized as having leisure content and SlideShare as providing a quick update on topic of interest. Students thus choose their media also based on type of information they seek, i.e., they are looking for the appropriate source of information. This is also reflected on public display content. From our survey we can see that while SNS is selected as a media for more personal content public displays are selected as a media that addresses community and its interests.

3.2.4   Reflection on Students' Content Production and Consumption

Students produce a diverse set of digital content. They like to make photos on birthday parties, while going out, or while traveling. They also like to share the photos through Facebook and email. Students also like to discuss with their colleagues things they do as well as to express their preferences towards the content of others. Last but not least, they send out invitations for various social events.

On the consumption side, students seek updates on people (Facebook), professional topics (Twitter and Slideshare) and leisure topics (Tumblr and YouTube). Based on survey results for what type of content students would like to post on public displays we can see that some would come from their class related activities, e.g., personal class project information (55%) and class relevant material (59%), while some would come from various events around campus, e.g., personal social events (52%), upcoming scientific (62%), personal pictures from recreational (47%) and official LU events (44%). Similar trends for content consumption, i.e., viewing, can be seen in Figure 3.2c.

3.2.5 Implications for Interacting Places from Students Practices with Current Information and Communication Technologies

Based on the above reflections, we derived a set of guidelines for designing networked public display channels – an application that acts as a uni- or bidirectional carrier for transmitting multimedia content to its intended audience through networked public displays – and the corresponding content for creating Interacting Places. These guidelines offer three implications for the channel and four implications for the content and aim at 1) enhancing communication from the university to students, and 2) improving communication among the students.

Channel

In the following, we group our guidelines along three aspects: 1) guidelines for content sources, 2) guidelines for separating sources according to different realms they represent, and 3) guidelines for how to address the audience.

Source – With current ICTs, e.g., IM, email, and SNS, source and addressee are explicit. Students see sources as services that provide topic specific content, e.g., YouTube – leisure videos; Twitter and SlideShare – information of interest; Flickr and Tumblr – photos taken by professionals; and to certain extent Facebook – people information. Other ICTs, in contrast, provide individual content that clearly comes from conscious communication acts, e.g., messages that come through emails, Facebook's private messaging, or IM. Even though all of the content is "user generated", topic specific content is often characterized as if it was generated by a service.

In the context of Interacting Places, this implies that the source of the content for each channel has to be clear. Thus, when content is coming from university administration, a service-centric view should be communicated, while user recommendations or discussion items must retain their individual character. To maintain such distinctions on a shared, immobile display that has multiple channels running, a strong representation of the information source should be used, e.g. a dedicated logo (YouTube or SlideShare) vs. a person's avatar or user profile. This

is even more important for channel representation within a display network: while one could get used to the channel arrangements on a single display in his/her own setting (e.g., faculty one is attending) spotting the appropriate channel while moving through the real world (e.g., different buildings on campus) would be much easier if the channel source has a clear mark.

Separation of realms – Students make another clear separation based on the type of content they can find/get on a particular SNS, i.e., is it professional/work oriented or leisure content. For example, students see Facebook, YouTube, and Thumblr as providing leisure content whereas SlideShare and Twitter are seen as providing more professional/work-oriented content. They do not appreciate if different type of information comes from a content source than the one they are expected to receive. An example of such information crossover is USI's official communication done through Facebook: students found it quite intrusive since Facebook was seen as a source that provides casual/leisure information and not 'serious stuff'. In order to separate the two realms, i.e., work and leisure, some students opt for having two Facebook accounts.

Interacting Places should make a clear separation between channels that provide professional and those that focus more on leisure content. For example, one channel could be used to provide information about professional oriented events published by the university while another channel could be used to provide information about social events contributed by students. Different on-screen zones (ticker tapes, sidebars) and designs (professional vs. playful) can help with differentiating such channels. Realms might also differ according to the time of the day, e.g., leisure content would be displayed during lunch breaks, while in the morning professional information would be in focus. Also display location could influence the amount of professional or leisure content, e.g., more work oriented content could be displayed in libraries while displays located in the University canteen could have more of leisure content.

Addressee– While IM and private messaging recipients are explicitly addressed, SNS and topical services such as YouTube and Twitter do not explicitly specify recipients. Instead, users pick from a large set of public content. This illustrates two main modalities of choosing the addressee: either the message finds the audience (email, IM), or the audience finds the message (e.g., YouTube). Intersections are of course also possible (e.g., restricted wall posts on Facebook).

In the context of Interacting Places, addressing is usually implicit and serendipitous: even if we can guarantee that the intended audience is in the vicinity of a display when delivering the message, we can neither ensure that the (all of) the audience notices it, nor can we prevent others from potentially seeing it. This implies two strategies: we should support both serendipitous and implicit information discovery. Serendipity can be supported by context-aware channels that are able to

deliver information close to the intended audience, e.g., using client positioning or check-ins. Implicit information discovery supports information discovery by passers-by through explicit classification of information, e.g., through badges. For example, a message about an upcoming seminar could have a badge that specifies the faculty for whose students it might be of interest.

Potential Content for Interacting Places at University of Lugano

Based on the analysis of students' communicative ecology and follow-up survey, we see 4 possible groups of content: 1) content contributed by the students, 2) official university announcements, 3) content that promotes cultural and social events in the locality, and 4) content that comes from already existing sources and relates to students professional and personal interests. We can further group this content along three functional layers according to community-space cluster 1.1: 1) content that connects local community members, i.e., student contributed content and official university announcements, 2) content that connects different local communities and promotes provision of difference, i.e., content that promotes local events, and 3) content that connects physically separate communities, i.e., content that comes from non-locally sourced services.

Local Community Layer

Student generated content: Examination of students' communicative ecology revealed that students generate content from leisure activities (e.g., photos from events) as well as from more professionally oriented ones (e.g., piano playing). In our survey students expressed interest in posting and viewing similar types of content: they were interested in 1) class related material (P 60%, V 56%) and personal class project information (P 55%, V 41%), 2) pictures from recreational (P 47%, V 39%) and official USI events (P 44%, V 34%), and 3) personal advertisement (P 45%, V 46%). Networked public displays should provide the place where students post all three types of information. This could stimulate social interaction and could provide the opportunity for the community to express itself locally.

Student organized events: Another noticeable activity supported through ICTs is event organization. Students organize their social events through Facebook or email. The possibility to see and post student-organized events was highly rated in our survey (P 52%, V 42%). By promoting their own events (e.g., parties or hikes) through a display network, students could attract outside members in the locality and increase the connection with local communities and students from other faculties.

Official university announcements: When official university information arrives through email it is seen as spam and when it arrives through FB it is seen as intrusive/invasive of one's private space. This was also reflected in our survey: public displays came in front of SNS and email as the channel for viewing this type of

content (PD: 37%, SNS: 27%, email: 24%). Also scientific events at a university were the most desirable content for posting on public displays (62%). Interacting Places should represent a dedicated place where students would find official university announcements, and where it would be accessible according to one's availability.

Local Connectivity Layer

Our study revealed that most of the student meet outside of school and mainly during events organized in the vicinity. Such off-campus events also provide the main opportunities for cross-faculty student interactions. Upcoming cultural events in the locality were also marked as a desirable content for public displays in our survey (P 54%, V 38%). Including off-campus event information in Interacting Places would thus be quite relevant: pushing this type of content onto a University display network could improve connections between the various University communities, but also reach out to other communities within the city and the region, e.g., through advertising cultural events, e.g., art exhibitions or sport activities.

Remote Connectivity Layer

An often-expressed (but hardly novel) desire for future networked displays content was to show topic-based news (e.g., recreational, scientific, world affair). Students pointed out that 'certainly there would be people to discuss this' (2E), i.e., such information could stimulate community interaction through 'social triangulation' [8].

3.3   Chapter Summary

Both studies presented in this chapter showed the value of public displays for communities. The PNA study showed most of the content on PNAs is highly local, e.g., local events and items for exchange, and that content providers and viewers live in the PNA's vicinity. Similarly findings are coming form the study on students' communicative ecology that showed students' preferences towards local content such as information on events happening at university and events in the locality.

    The study on students' communicative ecology pointed out the complexity of creating networked public display applications for the students community as there was not a clear preferred application, but rather an information ecology that goes beyond a single application. (The study provided the input for the set of official university services developed by Ivan Elhart.) Overall the type of information students would like to see and post on a display network is similar to different types of content that can already be found on traditional PNAs, e.g., official information coming form the institution (the university in this case) as well as information on various events in the locality, both university related and other types of social events (e.g., concerts). The study on students communicative ecology also examined the possibility of posting

and viewing more personal type of content, e.g., pictures. While some more personal content would not be acceptable, e.g., pictures from last night's out, they would still be a desirable content if they are somehow connected to the community, e.g., pictures from events organized by the university. Posting images related to the community and the university was later on investigated through the Moment Machine 2.0 and Moments Gallery applications that were deployed at the University of Lugano; this is described later in Chapter 6.

Chapter 4

FunSquare Deployment

In this chapter I will describe the motivation behind designing and developing FunSuquare application as well as its evaluation in the two modes in which it operates – in ambient mode and game mode. I will also describe a coordination and engagement model derived from observing how people interact with FunSquare in ambient mode.

4.1 FunSquare Application

As previously mentioned at the beginning of Chapter 1, McLuhan's media theory points out the importance of context for a medium and the interplay between figure and ground, as the figure – the medium – amplifies existing processes happening in the ground – the context. In the case of networked public displays and Interacting Places, public spaces play a key role in fostering sense of community by providing a place where people bond and interact. For this reason it is important to uncover underlying processes that lead to the sense of community in public spaces. One of the processes pointed out by the desktop research [63, 62] is the 'social triangulation' phenomenon, a phenomenon where unusual features or events in a space trigger conversations with both friends and strangers. In turn this spontaneous interaction between people stimulates sense of connectedness [8]. Also, another way of building community spirit is by uniting community members into a competition and having them play for the same team/neighborhood [53]. In order to understand how networked public displays can trigger social triangulation and how they can unite community members within a competition, we have built FunSquare application [58].

FunSquare application builds on the notion of autopoiesis, a term that is used in biology to describe self sufficient systems that continuously regenerate themselves [46]. The same term is also used by sociologist Niklas Luhm [44] to describe social systems that continuously create themselves through communication within. In the context of the PD-NET project and networked public displays I refer to autopoiesic content as content that is self generated and automatically created by matching
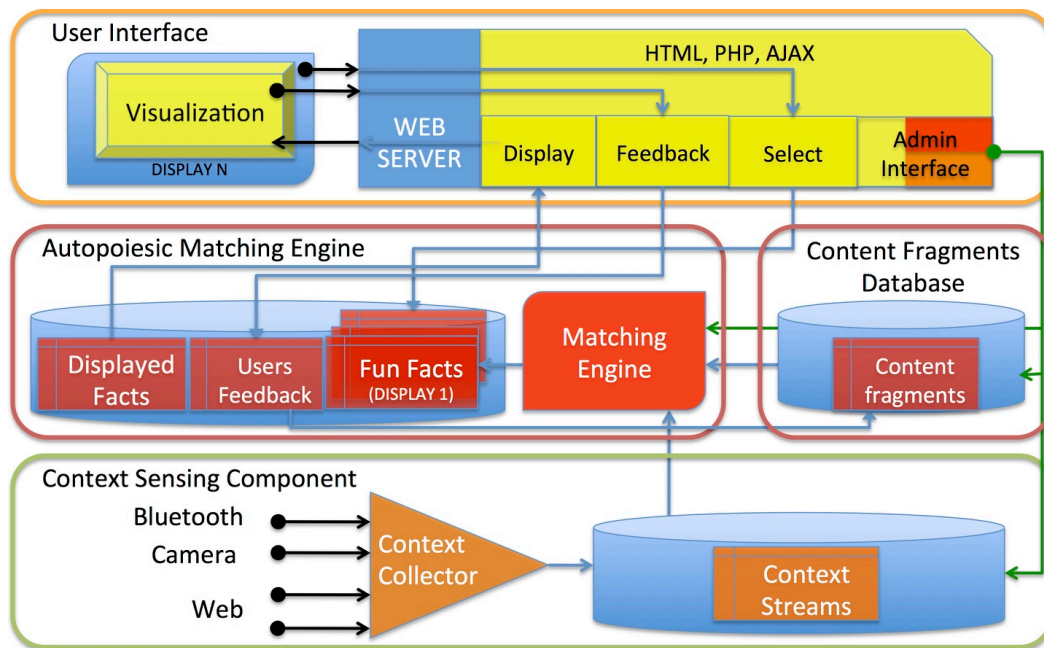
Figure 4.1. FunSquare system architecture.

local information about the display's context with similar information coming from somewhere else. For example, in the case of FunSquare application by matching information that comes from within display environment – e.g., current wind speed in a city (12m/s) – with information that comes from without – e.g., the speed of a honey bee (6 m/s) – a new fun fact would be created – "The current wind speed in the city (12 m/s) is twice the speed of a honey bee (6 m/s)". FunSquare operates in two modes, i.e., ambient mode and game mode. In ambient mode, a fun fact is simply presented, as shown in Figure 4.2. FunSquare's system architecture is show in Figure 4.1.

Each fun fact is displayed for thirty seconds. If a user wants to get a new a fun fact before the time limit runs out, s/he can do so by simply pressing the '+' button. Users can also vote for a fact with 'thumbs up' and 'thumbs down' buttons, or they can leave a comment for a fun fact. In the upper right corner there is a QR code which enables users to 'take' a fun fact with them on their smart phone (it gives them a permanent URI for a particular fact). In the lower right corner there is a timer visualizing how much time is left to view a fun fact. By pressing the timer it will reset and a particular fun fact will be displayed longer. In the lower center there is a 'switch language' button that allows switching between languages (only two were used: English and Finnish).

In game mode, fun facts are displayed in a form of a trivia question as seen in Figure 4.3c. The game starts with players choosing the neighborhood they want to play for (cf. Figure 4.3b). Players have to give as many correct answers as they

Figure 4.2. FunSquare user interface in ambient mode.

can. As seen in Figure 4.3c each question has three alternatives where only one is correct. For each correct answer players get a hundred points. They are rewarded for getting consecutive correct answers, where the next correct answer is multiplied with the number of consecutive correct answers given (e.g., if two consecutive answers are given, the third consecutive answer would be worth three hundred points). The number of points is displayed in the central blue circle. The game also has a time constraint of ninety seconds, i.e., if no right answer is given by then, the game comes to an end. For each right answer, players are rewarded with additional five seconds. Time left to play the game is shown in the left circle. Once the game is over players get a chance to leave their nickname for the various highscore boards (cf. figures 4.3d, 4.3f, 4.3g, and 4.3h). They also see their ranking overall, for that month, and for that particular display. After leaving their nickname players can "take" their score with them by scanning a QR code (cf. Figure 4.3e).

The requirements for the FunSquare application in the ambient mode came out of the desktop research on interactions in public spaces and the user requirements studies: while the former provided the process that should be stimulated the latter provided interactions that should be supported by the application, i.e., allowing take-away of information, liking, and commenting of the content, and leaving a mark in the setting by taking the photo and leaving the nickname on the scoreboard.

4.2   UBI-Challenge Competition

FunSquare was developed for the 1st International UBI-Challenge competition [76] that was oriented towards creating, distributing, (June 2011) and examining (July, August 2011) public display applications in a real world setting, i.e., on eleven public displays in the city of Oulu, Finland (population of over 140'000 inhabitants). The two key locations where the observations took place are the Oulu's Market Square – city center/square occupied by the localas and tourist, and the near-by city library. The application was developed by Marc Langeinrich, Ivan Elhart, and me. I was involved in the concept, system, and evaluation design as well as data collection. The application was implemented by Andrea Michelotti, Matteo Bellan, and Thomas Selber, at the time Bachelor students at USI's Faculty of Informatics.

4.3   Evaluation of Autopoiesic Content in a Screen-saver Fashion

We deployed FunSquare in ambient mode in the above mentioned locations over two days[1] and observed the interaction of more than 50 passers-by with it (cf. Figure 4.4). Due to bad weather, evaluation at Market Square was cut short to one day only. At each site there was at least one researcher from FunSquare team taking notes and photos (e.g., when a person passes-by a display and a general description of his/her interactions with the application) and at least one Finnish native speaker

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[1]This was the maximum amount of time and displays we could get during the UBI-Challenge competition, as there are services and content that needs to run on UBI-Hotspots in order to create revenue.

(a) FunSquare game mode: Start new game.
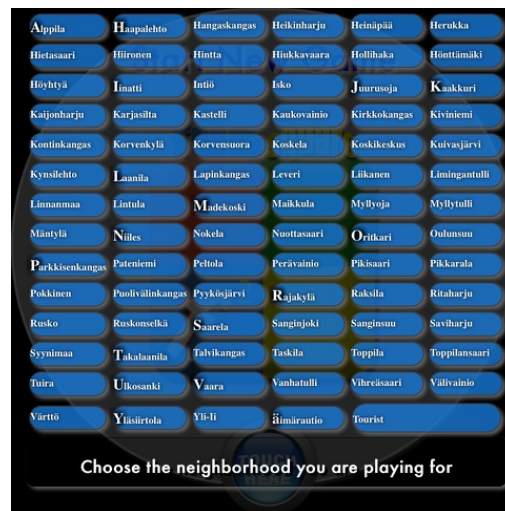
(b) FunSquare game mode: Players choose the neighborhood they are competing for.
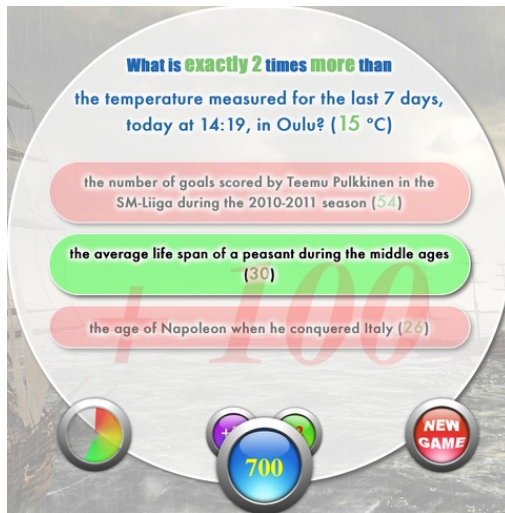
(c) FunSquare game mode: The more right answers a player gets in a row the more points the next question is. Also, the time the get to play the game increases.

(d) FunSquare game mode: Once the game is over players can leave their highscore and take the photo. They also get to see their ranking overall, for the month, for that display, and the ranking of their neighborhood and how much they contributed to it.

(e) FunSquare game mode: After a player enters the nickname s/he can "take" the score with her/him by scanning the QR code.
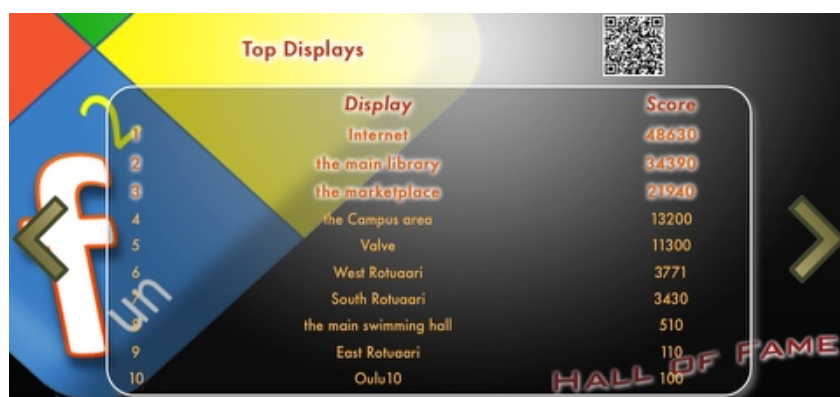
(f) FunSquare game mode: Global high score.

(g) FunSquare game mode: Neighborhoods high score.

(h) FunSquare game mode: Display high score.

Figure 4.3. FunSquare user interface in game mode.
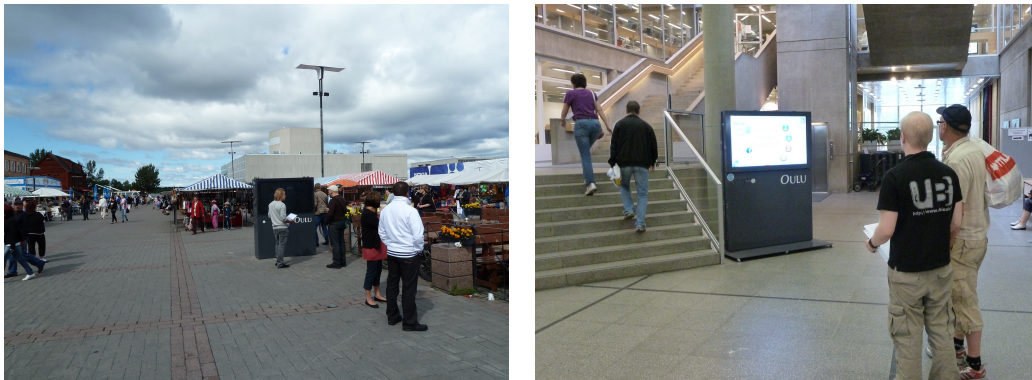
(a) FunSquare at the Market Square   (b) FunSquare at city library

Figure 4.4. FunSquare at a) Market Square and b) library.

who conducted open-ended walk-up interviews. Interviews aimed at assessing the experience with FunSquare application and its autopoiesic content. Overall we conducted 28 interviews and roughly 18 hours of observations. Thanks to our Finnish colleagues we were also able to listen-in on some of the conversations around the display. Data analysis was conducted in two phases. In the first phase I conducted a simple version of affinity diagrams using open ended coding of the interviews, photos, and notes in order to find similarities between people's opinions on autopoiesic content and FunSquare application. In the second stage the same data was analyzed in order to understand how people coordinate and engage around FunSquare application in the process of social triangulation. For this purpose field notes containing timings and people's actions were cross-referenced with photos and interviews in order to derive coordination and engagement model.

The quotes given below are identified by a two-letter code, indicating the interview location (L for the main library, T for the Market Square) and source (I for interview and C for an overheard user conversation). We interviewed over 35 of these passers-by in order to better understand their reactions to the application.

In the 18 hours of observations, roughly 130 people paused to read at least one fun fact. People read facts alone, in pairs, or in bigger groups, usually families (cf. Figure 4.5). Most of the people we interviewed characterized fun facts as 'nice', 'funny', or 'interesting' (LI1, LI2, LC1, LI3, LI6, LI7, LI9, LI12-18, TI3-5, TI8). Some people referred to fun facts as 'unnecessary information' or 'information snippets' (LI3, LI7) while others thought of them as questions (LI9, TI2, TI9). Interestingly, this type of content was also characterized as 'fitting with the city of Oulu' (TI3-5). After reading a number of facts for the first time, some people came back to read more, e.g., LI12:

LI12: 'If my parking meter would not run out of money I would not leave these premises the whole day.'

People stated they 'learned something new' (LI1) and said it was 'fun to play while

(a) Single   (b) Pairs   (c) Groups
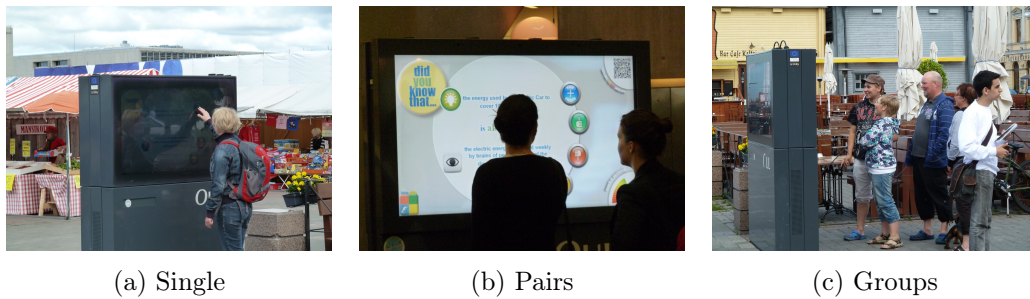
Figure 4.5. Interactions a) single, b) pairs, and c) groups.

waiting' for family members or friends (LI3, LI5, LI12, LI14, LI16). Some people said that they would share the newly gained information with people they know, e.g., family members, friends, and/or acquaintances (LI1, LI3, LI5, LI6, LI7, LI9, LI11, LI17, TI3, TI9). Some people went even further and explicitly said that this type of information would be very useful in schools (LI7, LI9, LI12, LI13, LI15).

Part of the interviewed people explicitly said they like the connection between the two pieces of information (LI7, LI11, LI15). One person commented that by combining static information, like 'big numbers and distances' with the real world data makes it easier to understand big things (LI7), while one found the connection between local and non-local information especially appealing (LI11). On the other hand there was a group of people who were 'puzzled' by the connection, or at least intrigued by the displayed content (LI10, TI7, TI9).

LI10: "How can you put together two facts that have nothing to do with each other?"

TI7: "Is this really true? Are these facts real?"

LC2: [Mom commenting on a fact 'The number of people in front of a display (2) is the same as an average price of a muffin in Euros (2)' to her daughter] "It's not true that all muffins cost 2 Euros!"

To a number of people the actual selection of information seemed random (LI3, LI5, LI6, TI9). The idea of categorizing information explicitly, i.e., having visible categories from which people could choose the information they want to see, was seen as desirable (LI3, TI9).

In general people expressed preferences towards certain categories of content (LI1, LI5, LI6, LI7, LI9, LI12-14, TI9). These preferences ranged from: 1) simply excluding some categories (e.g., LI1 said that everything but ice hockey is OK), 2) wishing to see more content from an existing category (e.g., LI5 wanted to see more environment and history, LI14 liked ice hockey particularly, while TI9 liked technology), or 3) displaying content from a new category that is currently not supported by the application (LI7 wanted to see "space, time, and other complex things" while LI9 wanted to see more information on politics, parties, the prime minister, etc.).

Although there was a group of people who wanted to see more information from a
certain category, there were also some who felt that information from some categories
came up too often (LI5, LI6, TI9). Similarly, while some people explicitly said that they
preferred information from a specific category, e.g., ice hockey (LI14) other explicitly
said that this category is the one that does not interest them (LI1, LI13, TI2, TI9).

While some people preferred content on a specific subject, others preferred the
locality of it and some even wanted to get more local content (LI5, LI9, LI14, LI15,
TI2, TI3, TI8, TI9). There was also a group of people who wanted to get both, i.e.,
localized information on a specific topic, e.g., local environment, history and events
(LI5), local politics (LI9), local ice hockey teams (LI14), or about Oulu in general
(TI9).

Overall the majority of participants appreciated autopoiesic content, as noticed in
the interviews (18/28 in the ambient mode) and observations (roughly one hundred
and thirty people read at least one fun fact in only eighteen hours).

LI15: "Full score for this application."

Even in cases where the content of a fun fact was not to the persons liking,
people still saw the benefit of autopoiesic information and asked for content of their
preference instead. For example, LI5 browsed through twenty or more facts although
she did not see the content from a category she liked.

4.4 Coordination and Engagement around Autopoiesic Content in a Screen-saver Fashion

Based on the two days of observations I developed a coordination and engagement
model for public displays. In particular, the model describes spatial and relational
processes accompanying social triangulation activities that 'weave' public displays
into 'the fabric of everyday life' [98]. The model also describes activities for *passive
engagement* with the environment, i.e, observing what others do in the space, 2)
active engagement with the environment, i.e., social triangulation, and 3) *discovery*, i.e.,
the desire for stimulation and delight that one experiences through new encounters.
Therefore the PACD model stands for Passive engagement, ACtive engagement, and
Discovery. Later on in Chapter 7, Section 7.3 this model will be mixed with other
existing coordination and engagement models in order to present a theoretical model
that generalizes behavior around public displays.

4.4.1 Passive Engagament

We noticed that some people interacted only briefly with the display: some people read
one fun fact and immediately left (42), some were reading the facts while engaged in
other activities such as talking on a cell phone (3), while others were more comfortable
with reading the fun facts from a distance (7). We call these brief reading sessions

(a) Market Square   (b) Library

Figure 4.6. 'Stop-read' at a) Market Square and b) library.

read'n'go interactions, as most of them were short and involved reading only a single fun fact: once the display changed to the next fact, people moved on as well. In several cases, people simply observed from afar others interacting with the display. Because these observations were relatively short as well, we group both read'n'go interaction and observations into what we call glimpse interactions.

While some people read one fact and left the display premises, others stop-read. By 'stop-read' we mean that they were on their way to pass a display, but once the facts caught their attention they slowed down and stopped to read (cf. Figure 4.6). This was behavior was most prominent at the library due to the display location, i.e., on the ground floor next to the only staircase leading to the upper floors (cf. Figure 4.4b). Some people would only slow down to read a fact, some would actually stop next to the display to finish reading, while others would even come back to read one or more facts after initially deciding to take the stairs. Overall we observed almost the same percentage of stop-reads at the library (33/99) as at the market square (6/20). One interesting thing to note is that we also had 2 instances where people who did neither speak Finnish nor English, yet still stopped to check out the application.

In some cases people touched the display out of curiosity to see what happens (7), engaging in a couple of button presses. We call these short interaction sessions curiosity interactions. Similarly to stop-reads, people were on their way to pass a display when they disengaged from the activity and engaged with the display. Because of this, we group curiosity interactions and stop-reads into what we call immersive interaction.

4.4.2   Active Engagement

In several cases we observed people reading two or more fun facts consecutively (10). The reading sessions were significantly longer than for both glimpse and immersive interaction and we call them active reading. In some cases (12) people started

Figure 4.7. The effect of 'social triangulation' between strangers.

interacting with the display after reading one or several facts. Since these sessions involved interaction after reading we call them read'n'interact. In cases where we were able to interview such users they described the content as 'interesting' or 'of one's interest' (LI1, LI7, LI14), 'funny' (LI3, LI15, LI16), or 'puzzling' (LI10), which we believe were the reasons for longer reading sessions. In one particular case where we were able to eavesdrop on the conversation after a longer reading session we discovered that it did start social interaction between family members. There were also some cases where the displayed content started social interaction (social triangulation) due to the need for extra explanation of the information presented (LI10, TI7, TI9) or interest in the topic (LI12). In one particular case (TI7) the session was not characterized as active reading but the content itself sparked the conversation. In other cases people were delighted with the presented content and were laughing (LI18, TI8, TI9), while in others they were intrigued with it and discussed it with people in their vicinity (LC2). In several cases we observed that people stopped to read a fact while others were engaged with the display, thus creating the opportunity for the effect of triangulation. One such instance occurring between strangers is shown in Figure 4.7.

Although we observed more situations where single people were reading facts (102 singles, 34 pairs and groups), people in pairs and bigger groups were more likely to interact with the display (26/34) than single people (15/102). In some cases people approached the display and started interacting with it immediately without engaging in reading first (32 sessions, 51 people). We call this type of behavior direct interaction. Children were most likely to start interacting with the display (18) as well as families (6 families, 19 people). The colorful design and animated buttons seemed to be appealing to children, especially the pulsing '+' button, which children tried to jump-reach. However it seems that they interacted with it without any particular goal: they would touch all buttons, they would try to 'move' the images, or select text, i.e., they touched everywhere in search for a reaction. Kids enjoyed interacting with FunSquare and saw it as a 'gaming machine' (LC4, cf. Figure 4.8).

LC1 [2 boys and a girl, after interacting with FunSquare]: "That thing was quite fun!"

In cases where children were accompanied by their parents their interactions would

Figure 4.8. Gaming machine.

create a 'honey pot' effect, i.e., they would lure their parents in (top part of Figure 4.9). Some kids simply approached the display (LI4, LI11), some asked their parents to read the facts for them (LI16), while others 'dragged' the parents to interact with the application. There were also cases where parents approached the display, which in turn prompted their kids to ask questions about the display. The 'honey pot' effect was also observed between strangers, i.e., if there was interaction in front of a display it would 'lure' others to interact with the display (bottom part of Figure 4.9). We observed both groups of 2-3 people (5 groups/11 people) and individuals (7) interacting with a display. In several cases direct interaction with a display sparked social interaction between children (LC1), friends/couples (LI18, TI9), and family members (TI8). There were also cases where the mix of direct interaction and displayed content prolonged social interaction (TI8, LI12).

4.4.3   Discovery

The interviews revealed that people did appreciate the intellectual challenge posed by the display. They either liked the content on a specific topic (LI1, LI5, LI6, LI7, LI9, LI12, LI13, LI14, TI9), the locality of it (LI5, LI9, LI14, LI15, TI1, TI2, TI3, TI8, TI9), or the obscure connection between the two pieces of information that comprise a 'fun fact' (LI7, LI11, LI15). Some people said that they would share some of the 'newly learned information' with people they know, e.g., family members, friends, and/or acquaintances (LI1, LI3, LI5, LI6, LI7, LI9, LI11, LI17, TI3, TI9) thus promoting the challenge from the environment. While some people stated that they would like to share the new information with friends and family, some went even further and explicitly said that this type of information would be very useful in learning environments, i.e., schools (LI7, LI9, LI12, LI13, LI15) where intellectual challenge plays a key role in the learning process.

When people were actively engaged with the display they also started discovery. We observed two things that people were interested in discovering: 1) content and 2) application information. The two strongest examples for content discovery were LI5 and LI12. LI5 browsed through 20+ facts. When asked about the content she said that
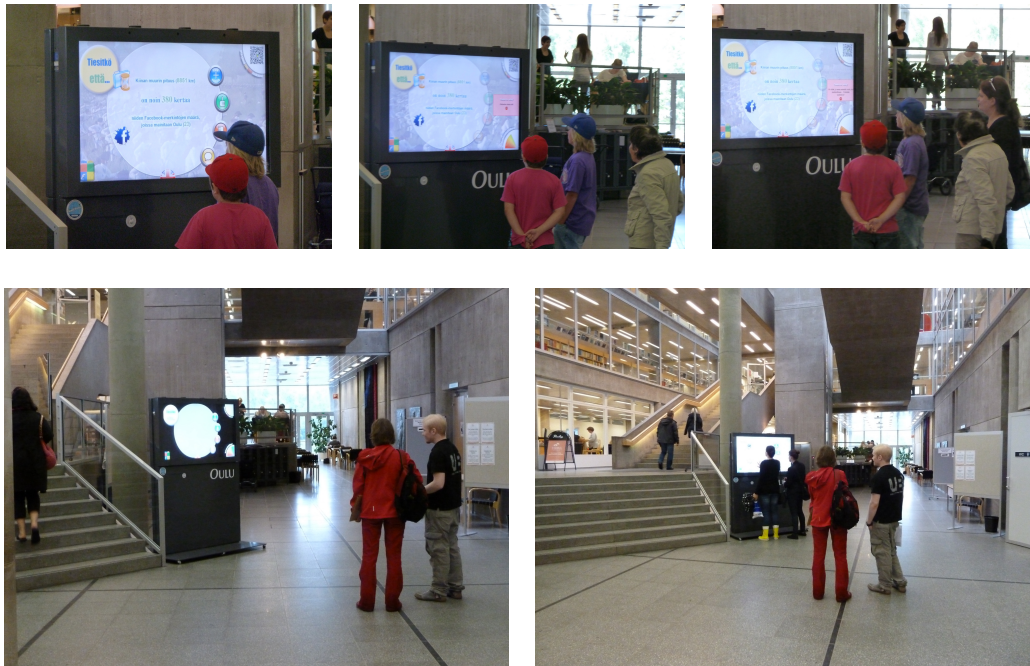
Figure 4.9. Honey pot effect between family (top) and strangers (bottom).

she was actually browsing to find the content that matches her topic of interest. She also wanted to find out more of a local content. Similarly, after the initial interaction with the content LI12 returned to interact with FunSquare because he was 'absolutely fascinated' with the application's content. People were also trying to learn more about the application when they were actively engaged with the display. They were either eager to uncover application's purpose (LI6, LI10, TI6, TI9) or its features (curious interactions, kids engaged in direct interaction with the display, LI17, LI18, LC4, TI2, LC1, TI3, TI4). For example, LI6 understood how to interact with the application and appreciated content that matched his interest. However during the interview he was mainly asking questions about the purpose of the application. He also noted that his interactions were geared towards discovering what the application does. On the other hand, TI2 was 'pushing buttons to see what will happen', i.e., he was interested in discovering application's features. Similarly LI18 interacted with the application although they characterized it as 'useless'. They pressed the 'thumbs up' and 'thumbs down' buttons in order to uncover the available variety of funny pop-ups.
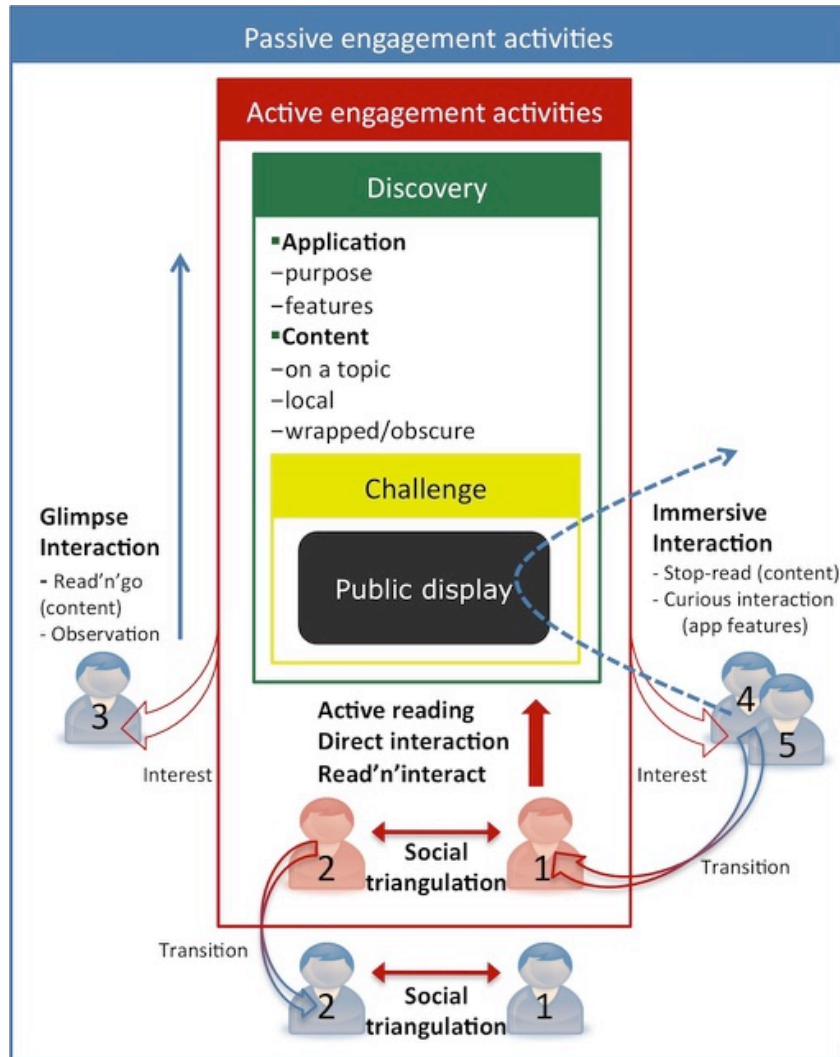
Figure 4.10. Engagement zones and activities around a display. Several transitions between both zones and activities are possible.

(a) Challenge stimulates interest for interaction.

(b) Active engagement sparks interest of others.

(c) During active engagement user is discovering the application/content.

(d) Discovery leads to 'social triangulation'.

(e) User turnover and the ones that queued start interacting.
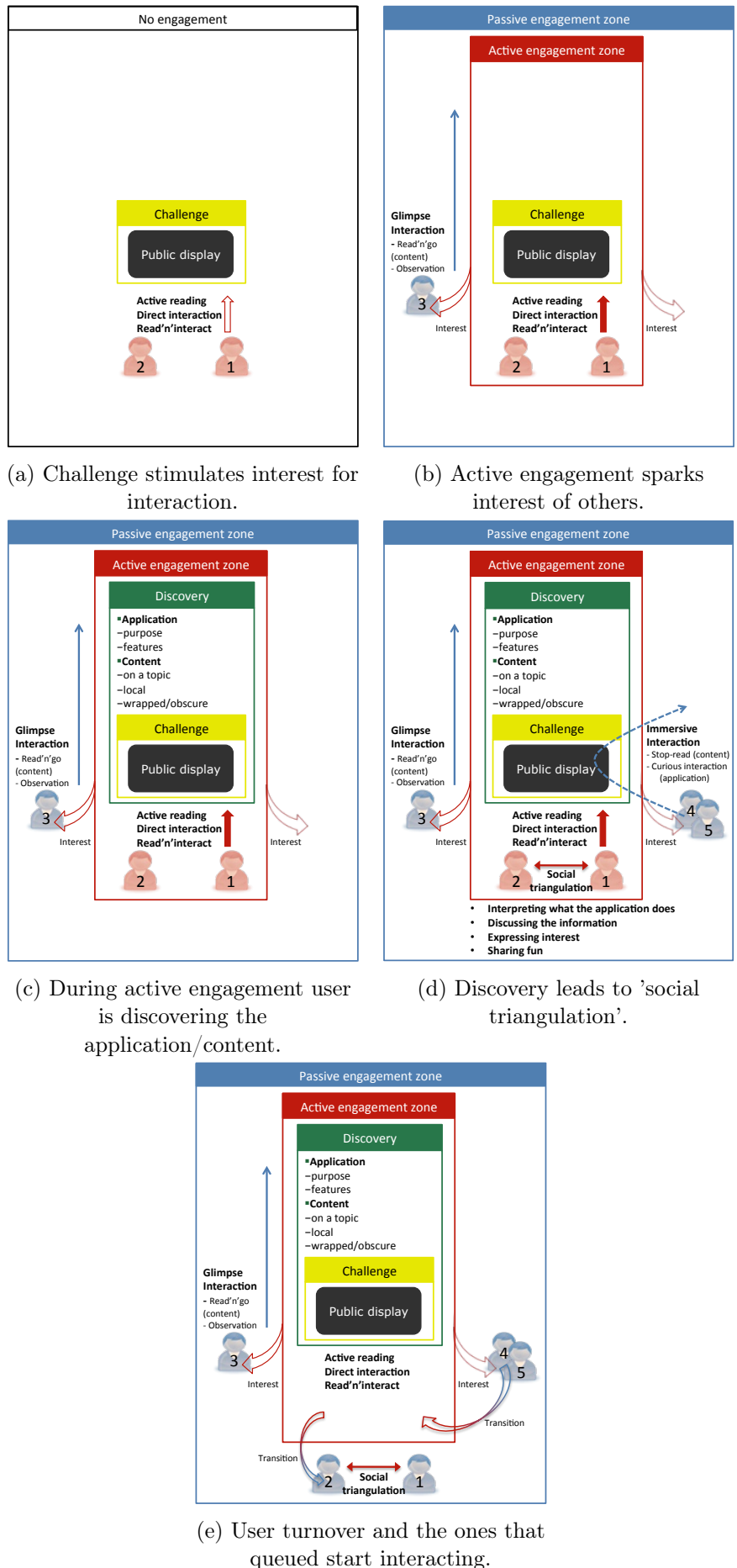
Figure 4.11. An Instantiation of the model: stages in engagement and coordination for social triangulation.

4.4.4   Conceptualizing Coordination and Engagement around FunSquare –
    the PACD Model

Overall, we observed people interacting with the displays in two zones (cf. Figure
4.10): the 1) passive engagement zone and the 2) active engagement zone. In the
passive engagement zone (roughly in the area 2-3 meters from a display) people
observed what others were doing in front of a display (observations) or they had
short interactions with it (read'n'go), i.e., they had very brief glimpse interactions after
which they left the display location shortly. Other had more immersive interactions
in this zone, where they interrupted their current activity and directed their attention
to the display. During our observations, activities in the passive engagement zone
did not spark any prolonged interaction with the display, i.e., active engagement with
the environment. For this reason they can be seen as passive engagement with the
environment.

In the active engagement zone (roughly between an arm length and 2 meters from
the display) users were engaged in a longer and more focused interaction, either
through active reading (where they would read more than one fact, which resulted
in a longer interaction), read'n'interact (where they read one or more facts prior
interacting with the display), or direct interaction (where they actively interacted with
the sparse display user interface). Since these activities involved longer engagement
with the display they can be seen as active engagement with the environment.
People would transfer from one activity to another. We observed two instances of
these transitions between the immersive interaction to active reading and one from
immersive interaction to direct interaction.

In several cases we observed social triangulation, i.e., social interaction occurring
within the active engagement zone (LI16, LI18, TI5, TI8, TI9). In cases when we were
able to eavesdrop on the conversation it was started because people were interpreting
the application (TI9). Unfortunately in other cases we were not able to understand the
conversation. However from the interviews we could also understand that people like
to discuss the information because they were puzzled by the content and would like
to get more explanation (LI10, TI7, TI8), or they would like to express their interest
in the content (LI12). In several cases we also observed that people were sharing fun
(LI18, TI8, TI9), i.e., they were connecting socially through laughter. In some cases
people continued their social interaction after they finished active engagement with
the display. In those cases they either commented on their experience (LC1) or they
discussed the content (LC2).

In addition to the two zones, our conceptualization comprises form the following
elements (cf. Figure 4.11, moving from 4.11a outwards): 1) an intellectual challenge
that sparks interest for interaction with a public display, 2) the discovery process that
allows one to discover application and its content, 3) active engagement activities
leading towards discovery, i.e., active reading, direct interaction, and read'n'interact,
4) passive engagement in the form of glimpse and immersive interactions, and 5)

transition between the zones (indicated by arrows). Figure 4.11 illustrates how public displays stimulate PACD in public spaces. At the outset there is no engagement and person 1 in the display vicinity notices it (cf. 4.11a). In the second step this person starts an active interaction with it, either through direct interaction, active reading, or read'n'interact. As soon as person 1 starts interacting with a display, a nearby person 2 follows, which in turn raises interest in the passive engagement zone and triggers a glimpse interaction by person 3, e.g., read'n'go (4.11b). Meanwhile, persons 1 and 2 engage in discovery (4.11c). Discovery can lead to spontaneous social interaction, i.e., social triangulation in the active engagement zone (4.11d). Other passers-by (persons 4 and 5) disengage from their current activity and engage in immersive interaction, e.g., stop-read (also 4.11d). Eventually, these passers-by then transition into the active engagement zone after it is vacated and start active engagement with the display (4.11e). Those who left the active engagement zone continue their social interaction. This exact series of transitions was observed in two instances.

4.5 Evaluation of Autopoiesic Content Displayed as a Game

FunSquare in game mode is available since early July 2011 on all UBI-Hotspots throughout the city of Oulu. The game can be found in the UBI-Hotspots standard menu, which requires users to press a generic menu icon in the footer of the screen and choose from a set of application categories in order to select one of 22 available services. For the first 10 weeks after the launch, however, the quick-launch menu of the UBI-Hotspots offered a direct link to FunSquare, as well as to three other applications, in a more prominent fashion. For the game mode, we conducted both quantitative and qualitative evaluation, i.e., 1) we logged all screen interactions within the game in the central server, and 2) we organized user trials in the wild where we distributed questionnaires to participants. Quantitative analysis was done using simple counting and descriptive statistics, while qualitative analysis relied on a simple version of affinity diagram and open ended coding.

4.5.1 Usage Statistics

The goal of logging all interactions within the game was to get insight on the amount and type of users' interest in the game. The log files that were analyzed ranged from July 15, 2011 until October 3, 2011, excluding any possible testing interactions on the UBI-Hotspots within the first week of the game deployment.

During the observational period of 81 days, the game was selected 2309 times from the UBI-Hotspots standard menu or quick-launch menu. 605 games out of all 2309 game sessions were completed (26%), i.e., the 'game over' screen was shown as the timer ran out. 150 games out of 605 completed games were submitted to the high score list (25%) where the users explicitly pressed the submit button. For

those 150 submitted games, only 42 gamers left their names and none of them left
their picture. In incomplete games (74%), users switched to other applications before
completing the game. This can be due to the exploration of the new applications shown
in the quick-launch menu, and the presence of UBI-Guides who were promoting and
explaining UBI-Hotspot applications to passers-by. A more interesting result are the
25% of all completed games that were submitted to the high score list. In those game
sessions users were fully engaged, stayed until the end of the game, gave answers to
all presented questions, and explicitly chose their score to be shown on the high score
list. Leaving a nickname on the high score list can be important for some players, but
the option for leaving a picture can be entirely omitted. Due to the users' engagement
during submitted games, those game sessions were further analyzed in order to reveal
the most used UBI-Hotspots for playing the game (Figure 4.12), the distribution of
submitted games per days (Figure 4.13), and the peak hours for playing the game
(Figure 4.14).

The most popular UBI-Hotspots for playing the game are the ones located in
the main swimming hall, the main library, the marketplace, and South Rotuaari
respectively (see Figure 4.12). On average there were 28.5 sessions per day, resulting
in 7.46 completed games and 1.9 submitted scores per day. The distribution of
submitted games per hour is shown in Figure 4.14. It shows three peaks around 10am,
between 12-1pm, and between 3-4pm.

Figure 4.15 shows the absolute performance per category. Overall the highest
number of right answers was given for questions on ice hockey (167/588), followed
by nature (117/367) and curiosity (98/376). This is not that surprising since these
categories also had the highest number of questions. However the highest percentage
of correct answers (cf. Figure 4.16) was for music (44.59%), weather (41.18%),
history (32.39%). The second graph may indicate that people are more interested
in some categories than other since they gave more accurate answers.

4.5.2   Questionnaire Data

We also organized user trials 'in the wild' with twenty seven participants. Ideally we
would have conducted a set of open-ended interviews, just as in the case of the ambient
mode, in order to get at a richer set of data. Unfortunately, scheduling constraints
made it impossible for us to perform the evaluation ourselves. We thus had to rely
on regular UBI-Guides – high-school students or undergraduate students without prior
experience in interviewing – to conduct it for us. In order to ensure comparable results,
we therefore decided to have UBI-Guides administer short questionnaires.

Questionnaires were distributed to 27 participants in two days at six locations.
Apart from basic demographic data, questionnaires elicited a participant's experience
with the UBI-Hotspots and then asked about the experience (positive and negative)
with the game. If the participant had not played the game before, we asked why they
had not played it yet. UBI-Guides actively approached passers-by and invited them to
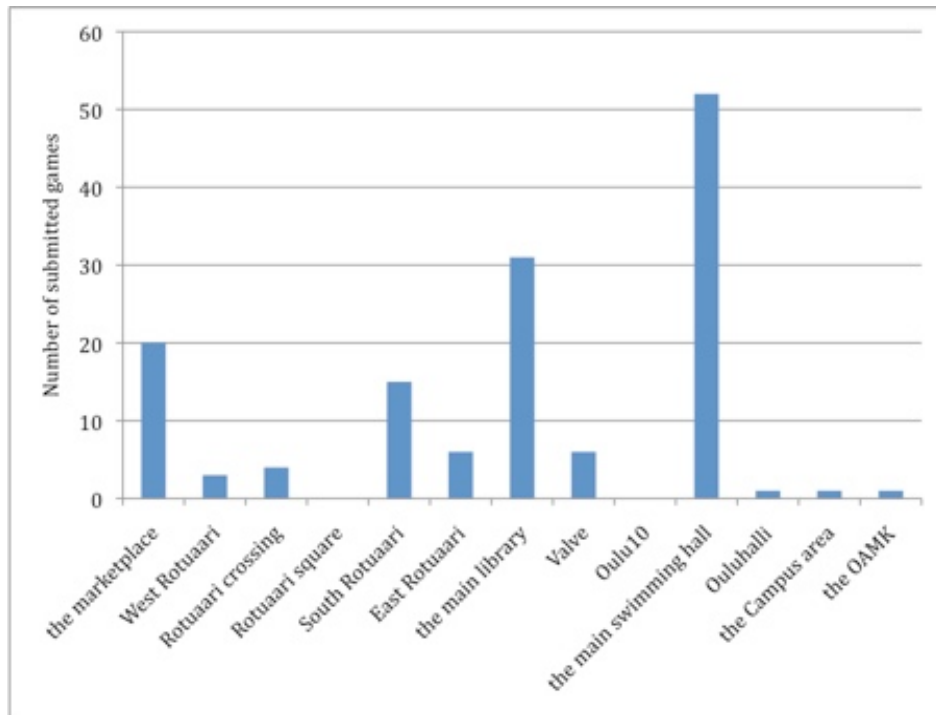
Figure 4.12. Number of submitted games per place.
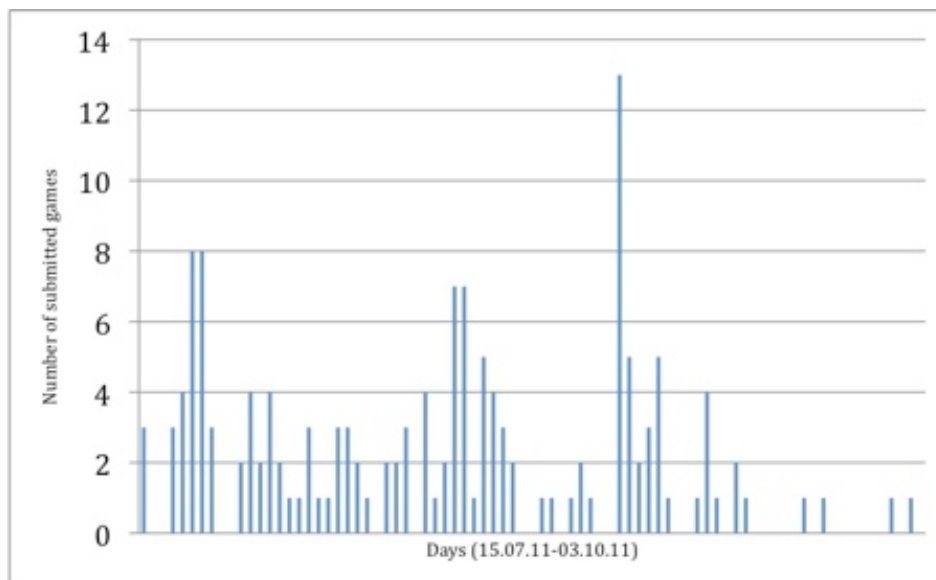
Figure 4.13. Number of submitted games per day.
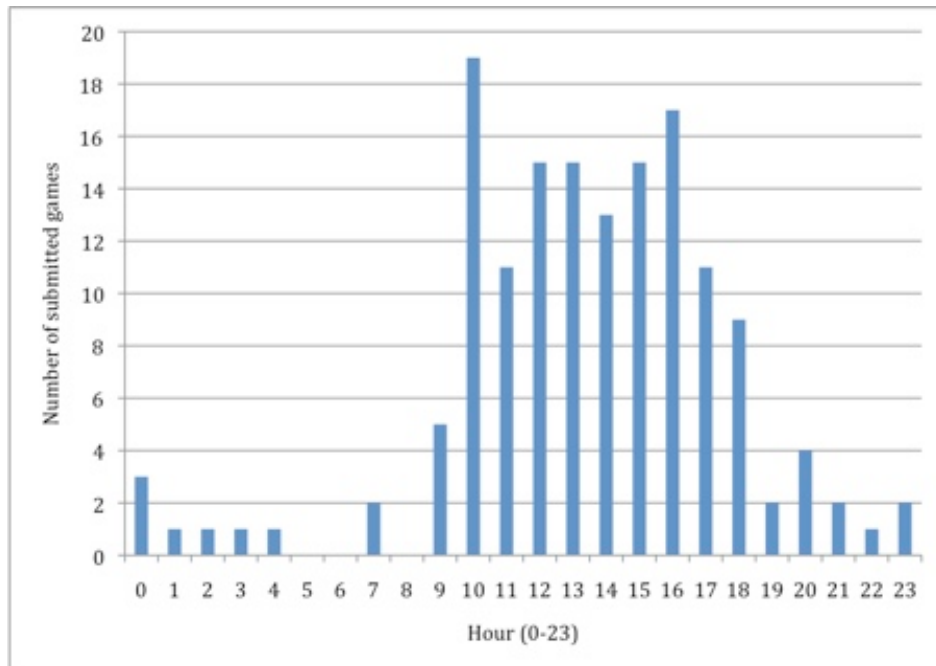
Figure 4.14. Number of submitted games per hour.
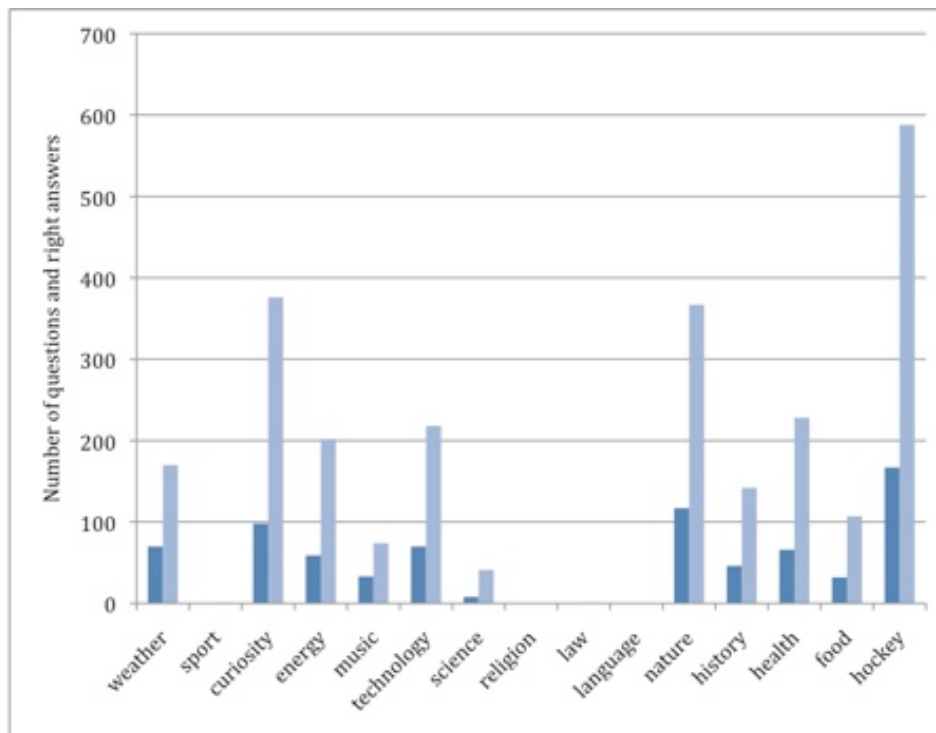
Figure 4.15. Number of questions and right answers per category.
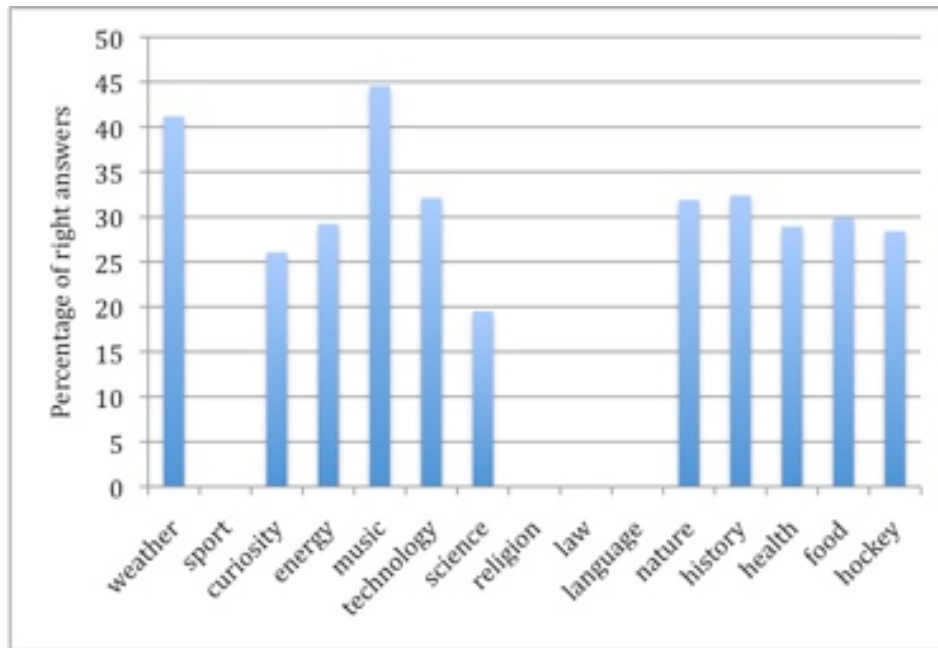
Figure 4.16. Percentage of right answers per category.

play, and subsequently administered the questionnaire. In return for their participation passers-by would get 1 or 2 movie tickets.

We had 13 male and 14 female players with an average age of 24. Most of the participants had used hotspots before, though rarely (n=15), while some of them had never used them (n=9). Two participants reported using hotspots a couple of times a month, and only one reported using them a couple of times a week. Only one of the users had previously played the FunSquare game, while all others had never played it. As the reason for not playing the game, the majority responded that they did not know about it.

Most of the players reported a positive experience while playing the game (n=16). Some of them described the experience as exciting, some thought the game was entertaining and fun, some appreciated learning a couple of amusing facts, and some felt like they got more familiar with UBI-Hotspots. Two players mentioned the locality of questions as a 'good thing' and felt that local questions were closer to them. However players also reported on negative experiences (n=15). Some players thought that display was not responsive enough (4) while others complained about the questions posed in the game: some thought the questions were difficult (n=8), some did not like that they did not know the answers (6), while some thought that there was not enough time to think and give a right answer (n=3). The overall negative experience from the game is nicely captured by one of the players:

'The questions are pretty fun otherwise, but there's not enough time to answer.

Questions and answers are obscure and pretty hard to comprehend quickly.'

Due to the novelty of autopoiesic content, understanding the information seems to have taken more time than we expected. Before deploying FunSquare in game mode, we tested it ourselves several times, which influenced our decision to limit the game to ninety seconds. We did not realize that during our in-lab trials we became expert users and understood the information faster than most of the people. We did test the game before deployment with people who were not involved in the project, however our tests were done with same group of people.

User trials revealed that most of the people had a positive experience with the game, with some people mentioning that the locality of question is a 'good thing' and that it made the questions 'closer to oneself'. Most of the negative experience was associated with 'difficulty' of the game, which stems from people not knowing the answers or feeling frustrated that they did not have enough time to think about the correct answer.

4.6   Chapter Summary

Overall, FunSquare evaluation pointed out the potential of autopoiesic content for stimulating social triangulation, as well as interest in playing the game and competing for a neighborhood. The study also showed that when this type of information is shown in a screen saver like fashion (ambient mode) it would be good to allow users to select information they find the most interesting: this ranges from information about the locality, to information on a specific topic, or combination of both – local information on a specific topic. Similarly, it is important to balance different pieces of information that make a fun fact. That can be said for both information that is sensed around a display and for information that is coming from outside of it. Simply put, if a certain category appears too much, users do not appreciate it. The study also showed other challenges in consuming autopoiesic content in both ambient and game mode. In both cases, some users complained that they did not have enough time to understand the information – in both modes users got thirty seconds to read it.

The issues that emerged during the FunSquare evaluation were the starting point for understanding challenges that arise in the process of designing, developing, deploying, and evaluating networked public displays that aim at connecting local community members. The FunSquare deployment will be analyzed later in Chapter 7, Section 7.2, together with two other applications, in order to portray the multi-faceted issues that emerge in these processes.

Chapter 5

Moment Machine Deployment

In this chapter I will describe the Moment Machine application and its deployment across the four locations in the UK – the Mill (London), Leytonsonte (London), Broadway (Nottingham), and New Arts Exchange Center (NAE, Nottingham). I will present the analysis of the Moment Machine's impact on the key community – the Mill community center. The analysis of the Moment Machine's impact on the community reported in this chapter comprises from three parts: 1) photo analysis that determined what kid of photos users took and how often users returned to interact with the application; 2) analysis of interaction log files that shows type and duration of interaction sessions; and 3) qualitative insights obtained from interviews conducted with 13 returning users/groups as well as observations taken over the course of 3 weeks. After that I will describe the analysis of interactions across the four locations and will present similarities and differences between them (between the locations).

5.1   Moment Machine Application

The Moment Machine [61] is a networked public display application that explored the concept of leaving a mark in the setting by allowing passers-by to simply capture their everyday moments by taking a photo through a display and leving it on the display network. The Moment Machine's user interface is shown in Figure 5.1. Its simple user interface was inspired by previous research that showed how passers-by do not spend a lot of time looking at public displays [33, 73] and that live video feed represent a good mean for getting their attention [72]. The Moment Machine's user interface shows a live video feed (1 in Figure 5.1) and allows passers-by to take an image by simply pressing a button (3 in Figure 5.1). Users can also change the "look" of their snapshot by selecting a filter before they take a photo (2 in Figure 5.1), somewhat similar to the popular social media application Instagram[1]. In order to give the passers-by enough time to prepare themselves, image capture is delayed by five seconds, which

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[1] http://en.wikipedia.org/wiki/Instagram

Figure 5.1. Moment Machine's user interface.

is indicated through a countdown timer appearing instead of the "hand" button (2 in Figure 5.1). Once the moment is captured users have thirty seconds to decide if they want to leave the image/moment on a display (shown in Figure 5.1). After that the image appears on the screen and across the display network (4 in Figure 5.1). Passers-by also have the possibility to browse through the last 100 moments captured at all locations (4 in Figure 5.1).

The Moment Machine application is deployed as of early March 2013 on four displays from the 'Screens In the Wild' project display network. The displays are located in London, at 'The Mill' community center located in Walthamstow neighborhood and in the public library in Leytonstone neighborhood; and Nottingham, at Broadway Cinema and New Arts Exchange (NAE), two cultural hubs of the city. The application was designed, developed, deployed, and evaluated in three one-month research visits to University College London.

The user requirements for the application came out of the (Mill) community's need to have their members put some sort of their content on the displays that would mimic Instagram. After discussing the possibilities with Ava Fatah gen. Schieck – the principal investigator of the 'Screens In The Wild' project – and the community representative we agreed that a photo booth like application that allows easy image taking would be the best option. I had help from Ava and her team in deploying the application and in conducting interviews and observations, namely, Efstathia Kostopoulou, Moritz, Behrens, Martin Traunmueller helped with the initial land later interviews, as well

Figure 5.2. Moment Machine at the Mill, London.

as from the other Screens In The Wild project partners in Nottingham, namely Holger Schnädelbach, Lei Ye, and Steve North in deploying the application across the network.

5.2   The Key Deployment Setting – the Mill Community Center

Due time and resource constraints the principal evaluation of the Moment Machine application took place at The Mill (shown in Figure 5.2), as the London's research team and myself had the most contact with the community. The Mill is located in a residential area on the way to the local school and a local park. It is a community center where diverse group of people come in order to organize skill transfer workshops (e.g., English classes, basic computer training) or to socialize with their group of choice (different ethnic and age groups are part of the community, e.g., Asian women support group and elderly Pakistani card players). The Mill also organizes a drop-in day care where passers-by can leave their children. Currently over 40 different groups gather regularly for different purposes such as poetry, knitting, photography or social life improvement for people over 65.

5.3   Analysis of the Photos Taken with the Moment Machine Applicaiton

As a first step in analyzing user engagement over 12 weeks I manually examined all the photos – 1189 – from the Mill. This was conducted in order to understand what age groups interacted with the application, how people used it to express themselves, and how many users returned to interact and how often. Each photo was labeled with 1) the number of people in it, 2) their estimated age group, 3) themes that describe the photo, e.g., "single portrait" if it is a single person's portrait or "showing objects" if people are showing objects, 4) if the photo had returning users – users who came back to interact with the application in two different days – his/her identifier would be written, and 5) sequential number/id of a photo session, where a photo session is
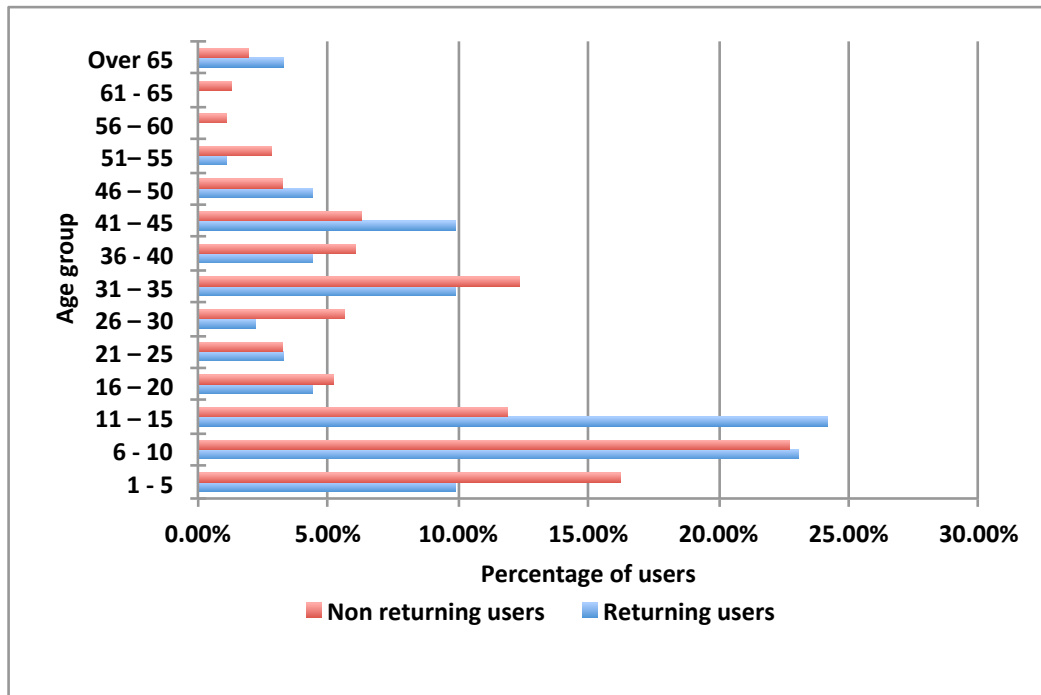
Figure 5.3. User age group distribution (estimate).

defined with same people appearing in the photo (and one session can have just one photo). The procedure was repeated several times in order to improve consistency.

Overall, in the manual analysis I counted 509 users on the photos out of which 93 (18.27%) were returning users. The estimated age group of both returning and non-returning users is shown in Figure 5.3. Most of the people in the photos were recognized as children, i.e., age groups 1 – 5 (16.23%), 6 – 10 (22.73%), and 11 – 15 (11.90%) followed by people in their early thirties (31 – 35, 12.34%). As shown in Figure 3 the largest portion of returning users are children in the age groups of 11 – 15 (24.18%) and 6 – 10 (23.08%). Most returning users returned once (54.84%), followed by users who returned 2 – 5 times (34.41%), while a smaller portion returned 6 or more times (10.75%).Some returning users returned at a standard time when they interacted with the screen, i.e., their returning times did not vary much (for (35.48% of users STD is <=5 minutes and for 50.54% STD is <= 20 minutes). Classification of returning users based on their return frequency is shown in Figure 5.4:

- Occasional users (24.73% of returning users) are characterized with returns that took more than a week. On average this type of users returned after 24.55 days (SEM 2.87 days) and they returned 1.26 times (SEM 0.15 times).

- Burst returners (50.54% of returning users) returned in periods less than a week, on average after 3.36 days (SEM SEM 0.33 days) 2.04 times in a row (SEM 0.33
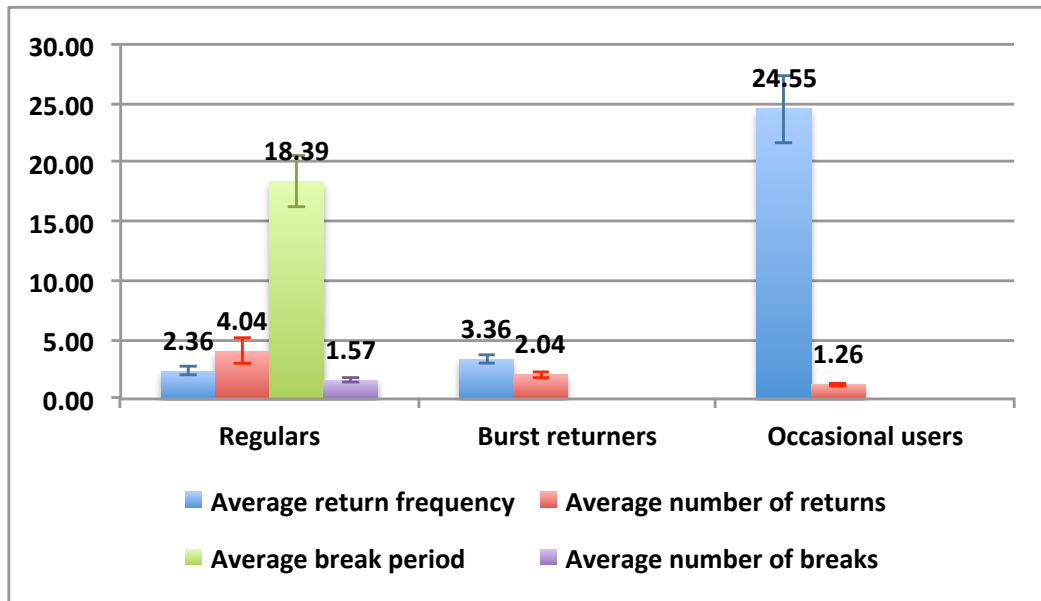
Figure 5.4. Three groups of returning users: a) regulars, b) weekly returners, and c) occasional passers-by.

times).

- Regulars (24.73% of returning users) has mixed behavior as the above two groups. They had periods when they returned on a weekly basis returning after 2.36 days (SEM 0.43 days) 4.04 times in a row (SEM 1.03 times). However they also have a "break" in interaction. On average this break lasted 18.39 days (SEM 2.2 days) and occurred 1.57 times (SEM 0.14 times). One of the reasons for such a behavior could be because of holidays (Easter) that happened during the deployment.

In total passers-by took 1189 photos: 51.39% were taken by returning users and 48.61% by non-returning users. Top contributors among returning users were school kids aged 11 – 15 whose interactions accounted for 22% of the photos produced. In order to better understand how the community used this medium I used open-ended coding to label all the photos with different themes that appear in them. Thirty-three labels were identified and then regrouped into 11 categories, 10 are shown in Table 5.1 in descending order from the top left corner (category "Empty" with no one in the photo is missing an example). A photo had multiple codes that describe it, so the sum of labels is more than 100%. Identified themes are:

- Action: a sequence of photos catching people in action. Most of the photos in this category were taken by a group of schoolboys (R1 mentioned later) that took the photos jumping in the air on their way back from school. Another big

portion of the photos in this category was taken during a community organized event – Star Wars day – where kids played around the screen and shot at it.

- Single portrait: a person having a portrait photo facing the camera frontally.

- Group portrait: a group of people having a portrait photo.

- Accidental: people being caught on camera while passing by or people who are not fully in the photo, looking down like they are checking out the user interface.

- Posing: striking a pose for the photo, e.g., acting like zombies or tuff guys. Mainly group photos.

- Facial expressions: having a facial expression in the photo, e.g., lolling/showing tongue out, making a silly face, or duck mouth. Similarly to category signs, these were performed in combination with single or group portrait.

- Signs: people performing signs with their hands. Signs ranged from waving at the screen/saying "hi"; showing peace or victory with fingers; giving bunny ears to another person; showing rock'n'roll gesture; thumbs up; and creating a heart with both hands. Mostly they were in combination with a single or group portrait.

- Showing objects: showing an object in the photo, e.g., a bottle, soda can, or notebook.

- Inappropriate: showing the middle finger or middle and index finger as well as "mooning".

- Affection: people showing affection to each other, for example kissing or hugging each other.

Action, 24.3%: being caught in action   **Single portrait**, 23.1%

Group portrait, 22.2%	**Accidental**, 8.6%: caught on camera by chance
Posing, 8.5%: striking a pose for the photo	**Facial expressions**, 7.5%: e.g., funny face, tongue out
Signs, 5.3%: signs with hands	**Showing objects**, 2.3%: e.g., cards, book, cans

Inappropriate, 1.5%: middle finger	**Affection**, 1.2%: kissing or hugging

Table 5.1. Photo categories with example image for each, their percentage in the photo corpus, and a short description.

5.4   Engagement during 12 Weeks from Interaction Logs

With the manual analysis conducted on the photos, described in the beginning of this chapter, I got very crude information regarding when a user starts and ends interacting, as I would only get their interactions when they took a photo (and sometimes it would be just one photo). Also, this excludes any other interaction that did not result with a posted photo, e.g., interactions that included only browsing the photos or exploring the UI without saving a photo. In order to get more detailed insights into users' interactions I automatically analyzed interaction log files, as we did not have video recordings of interactions (due legal constraints). I analyzed the "pauses" between touch events – periods of inactivity – in order to find the best time for determining when an interaction session starts/ends. I compared automatically classified sessions with manually labeled photo sessions – ground truth – to see the match between the interaction sessions. I did so by comparing filenames of the photos in the automatic session with filenames of the photos in the manually labeled one: if both sessions had the same photos this was then classified as an exact match. The best match was obtained with interaction pauses of 35 seconds having 69.26% of exact matches.

Session types and their properties are shown in Table 5.2. Besides exact matches there were three other types of sessions: 1) merged, i.e., two or more sessions that were manually labeled as different sessions were merged into one session in the automatic analysis (25.47%); or 2) they were split, i.e., manually labeled sessions were classified as multiple sessions in the automatic analysis (4.21%). A small portion
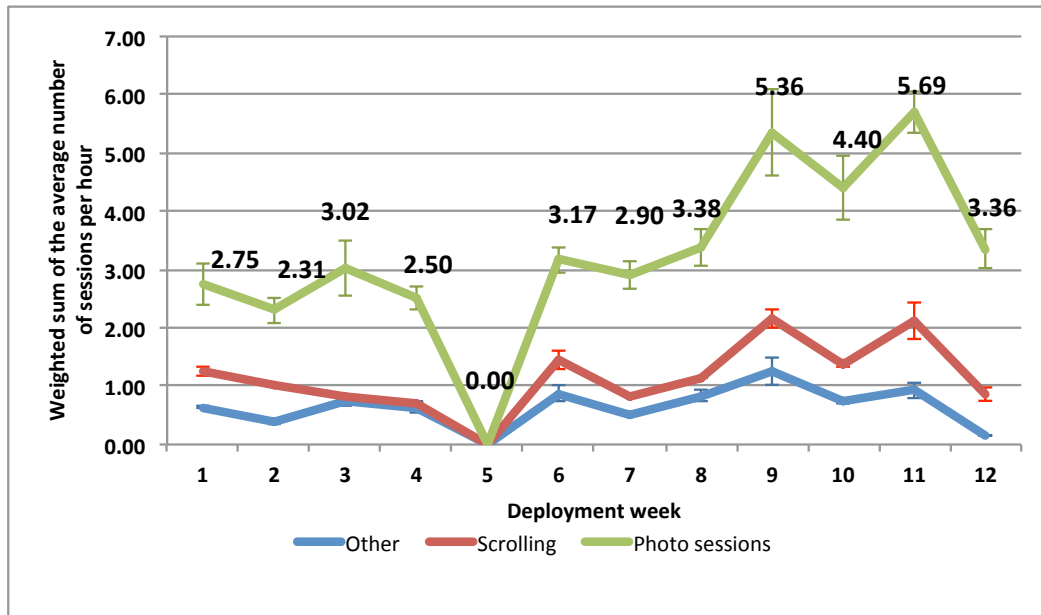
Figure 5.5. Daily engagement with the Moment Machine application over 12 weeks. The stacked graph shows weighted average of the normalized number of sessions for a day.
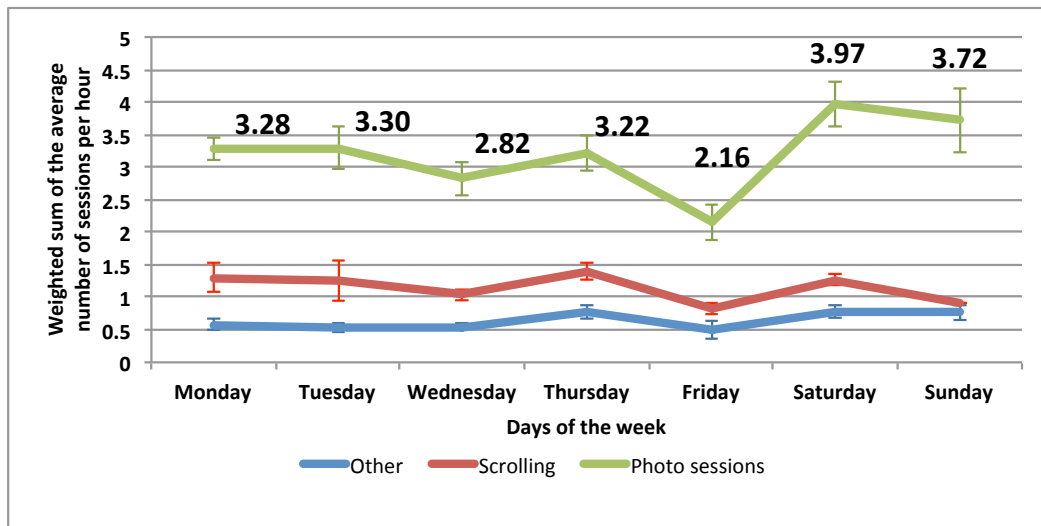
Figure 5.6. Daily engagement with the Moment Machine application over a week. The stacked graph shows weighted average of the normalized number of sessions for a day.

was both 3) split and merged with another session (1.05%).

Overall 671 sessions were classified that lasted on average 69 seconds (SEM 4 seconds). The majority of the sessions were photo sessions, i.e., 431 out of 671 (64.23%). Average photo sessions lasted 85 seconds (SEM 6 seconds), and had on average 2.76 photos (SEM 0.21 photos) and 36.67 scrolls (SEM 2.16) – number of times a user pressed the up or down arrow (5 in Figure 2-a). Out of 671 sessions 99 (14.75%) were "browsing only", i.e., users only scrolled and looked at the photos. These sessions on average lasted 72 seconds (SEM 10 seconds). There are also sessions that did not result with a photo nor were they browsing only (category "other" in Figure 5.5 and Figure 5.6).

Type	Property	Min	Max	Avg	SEM
Photo sessions (overall)	Duration	3s	1216s	85s	6s
	Photos	1	45	2.76	0.21
	Scrolling	0	415	36.67	2.16
Exact match	Duration	3s	677s	63s	5s
	Photos	1	26	1.99	0.13
	Scrolling	1	246	32.82	1.79
Split	Duration	4s	623s	107s	18s
	Photos	1	18	3.25	0.5
	Scrolling	0	200	43.10	6.49
Merged	Duration	21s	1216s	201s	33s
	Photos	1	45	7.32	1.36
	Scrolling	0	415	46.07	9.04
Browse only	Duration	1s	207s	40s	3s
	Scrolling	1	415	35.94	3.14
Other	Duration	1s	161s	40s	3s

Table 5.2. Session types and their properties: a) duration of the session is in seconds, b) photos in number of photos and c) scrolling in number of times "scroll" button was pressed.

In Figure 5.5 and Figure 5.6 we can see engagement with the application over 12 weeks and on a weekly basis respectively. The two graphs were obtained in the following way. After examining interaction events I determined there are periods with high and low interactivity that match different times of the day, i.e., morning (6AM – 12PM, low), afternoon (12PM – 6PM, high), evening (6PM – 12AM, high) and night (12AM – 6AM, low). In order to balance engagement between periods of high and low interactivity and have them in accordance, and in order to balance the

varying/different amount of time the application was running in them I divided all daily interactions into the 4 above-mentioned periods and normalized the number of interactions in them by dividing the number of sessions for a period with the number of hours application was running in it. As application schedule changed 11 times (full schedule is shown in Figure 5.7) and the application was not running always in all the periods I calculated the weighted sum of the average normalized number of sessions, in order to show average user engagement with the application for a deployment week and for a day of the week. I want to note here that results on engagement are descriptive.

For Figure 5.6 the weighted sum of the average normalized number of sessions for a day was calculated in the following way: if the application was running 2 hours in the morning I divide the number of interaction sessions by 2. Then I calculate the average number of sessions for that period for that week. Lastly I calculate a weighted sum of the averages to produce the one number shown in Figure 5.5. In Figure 5.5 weighting was done by multiplying the average normalized number of sessions for a period with a fraction representing how many times that period appeared in a week (e.g., if morning period appeared 2 times the average normalized number of sessions would be multiplied by 2/7). For example, this leads to 1.3 photo sessions in week 1 in Figure 5.5. In a similar way daily engagement with the application was calculated, which is shown in Figure 5.5. The average normalized number of sessions for a period for a particular day of the week was calculated. Weighting is done by multiplying the average with the number of times a period appeared for that day of the week during the deployment.

As shown in Figure 5.6 user engagement with the application varied from 2.31 (week 2) to 5.76 interaction sessions (week 9). In the last four weeks of the deployment users engaged with the application more, and engagement ranged from 4.4 to 5.76 interaction sessions. In week 5 there were no sessions because the application was not running for 4 days that week, while there was no engagement in the remaining 3 days. One of the possible reasons for no interaction during those 3 days is that it was Easter break during that week, and people were probably on holidays. In Figure 5.5 we see that on a daily basis application usage ranged from 2.18 sessions on Friday to 4.32 sessions on Saturdays. On average the application was used more in the weekend (4.11 sessions) than in weekdays (3.28 sessions).

5.5   Interviews and Observations

In order to understand the user experience around the Moment Machine application and its impact on the passers-by and the community I conducted semi-structured interviews with returning users. The interview questions revolved around 1) when and how the users encounter the Moment Machine application, 2) their impressions of the user interface and experience of interacting with the application, 3) how/in what
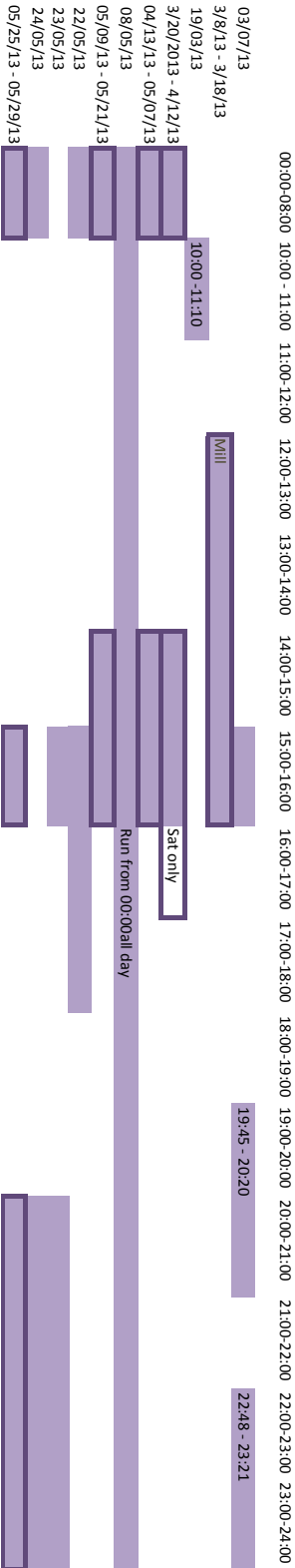
Figure 5.7. Moment Machine's schedule for the Mill. Cells with borders show at what time the application was running on the weekend.

way they interact with the application, and 4) any effects on community interaction and awareness, i.e., do they browse the photos, recognize someone on them, and recognize other locations. The full interview structure is available in Appendix C.

ID and description
R1: Group of 6 schoolboys age 11 – 15. Took the photos on their way back from school. Their interactions accounted for 15.31% of overall photos (182/1189). Mainly pictures of action, them jumping in the air. Returned 12 times.
R2: Two schoolgirls, age 11 –15. Take the photos on their way back from school, their interactions accounted for 3.53% of the photos (41/1189). Mainly group portraits. Returned 21 times.
R3: Mother, age 31 – 35 and daughter, age 11 – 15. Take the photos on a weekly basis before entering the Mill, group portraits with facial expressions. Returned twice, took 5 photos.
R4: Community champion, age 31 – 35, in charge of the Mill. Took 6 photos, single or group portraits. Returned 5 times.
R5: Schoolgirl, age 11 – 15, takes the photos on her way to the Mill where her mom (O1) works. Mainly single portraits, posing and silly faces. Sometimes group portraits with silly faces with O1. Returned 7 times and took 32 photos.
B1: Two schoolgirls, age 11 – 15. Take the photos on their way back from school. Group portraits, showing objects and posing. Returned 1 time and took 4 photos.
B2: Volunteer at the Mill, age 56 – 60. Takes the photos on his way back from a pub. Single portraits, sometimes with facial expressions. Returned twice and took 12 photos.
B3: Neighbor who lives across the Mill, age 41 – 45. Takes the photos on his way to the Market Square. Single portrait. Returned 4 times and took 7 photos.
B4: Worked for 2 weeks everyday on repairing the heating at the Mill, age 26 – 30. Group and single portraits, posing and facial expressions. Returned 6 times and took 9 photos.
O1: Woman, age 41 – 45, volunteer at the Mill. Takes the photos with her daughter R5. Group portrait and facial expressions. Returned once and took 2 photos.
O2: Man, age 35 – 40, working in the office space above the Mill. Takes the photos with his son, group portrait with action, on the way up. Returned once and took 6 photos.
U1: Family, woman 31 – 35, boy 11 – 15, girl 6 – 10. Part of the Mill community, take the photos before/after entering the space. Posing, action, and facial expressions. Took 16 photos.

ID and description
U2: Family, woman 31 – 35, boys 6 – 10 and 1 – 5, rents the office space on top of the Mill. Kid takes the photos when they application is running, action (fighting), took 16 photos.

Table 5.3. Description of interviewees. 'R' stands for regular, 'B' stands for burst returner, 'O' stands for occasional, and 'U' stands for unclassified.

We used a snowball recruitment approach starting with the community champion [90] (R4 in Table 2) – our strongest contact person in the community. With her I browsed the photos and found returning users with whom she could put us in contact. I then scheduled an interview with the person and also asked her/him at the end of the interview if s/he could recommend someone. Interviews lasted between 20 and 45 minutes depending on the interviewee's availability. Three interviews were conducted by chance, i.e., during our observations we noticed three groups of returning users interacting with the application (R1, R2, and B1). These interviews were shorter, between 5 and 10 minutes.

I conducted overall 13 interviews with individuals (7) and groups (6) and were able to capture 12 regulars (1 group of 7 users and 2 groups of 2), 5 weekly returners (1 group of 2 users), and 2 occasional users. Two groups were unclassified as they were not recognized as returning users through the photos, but they explicitly stated interacting with the application multiple times. I describe the interviewees in Table 5.3 and code them with a letter and number for identifying their responses later on.

Observations were conducted during 3 weeks in May, lasting 1-2 hours depending on the availability of the researcher. I observed information such as coordination, engagement, and social interaction around the application, and paid particular attention on spotting returning users. Data analysis of the interviews and field notes was done in the same fashion as for all other previous studies, i.e., I conducted a simple version of affinity diagrams using open ended coding, grouping the findings around the research questions of the study (that were also the main themes used for the semi-structured interview). Where it was appropriate photos taken by the users were used to illustrate the behavior. I summarize here the findings that came out of the analysis, i.e., 1) general impressions of the application and reasons for taking the photos, 2) social interaction stimulated by the application, 3) impact on community interaction and awareness, 4) properties that describe situated snapshots taken through networked public displays as a communication medium, and 5) networked aspects and connectivity with other places.

5.5.1   General Impressions and Reasons for Taking the Photos

Users found the application very easy and intuitive for use. Some participants thought it added more interactivity to the display (R4, O1, O2) stating "It's definitely made that screen far more interactive than it was before" (O2). As for the reasons for taking the photos we were able to distill 6 different ones. The strongest one is that the application is integrated into passers-by daily routine. Whenever s/he passed by the display the Moment Machine application would be running (R1, R2, R3, R4, R5, B1, B2, B3, B4). People would encounter the application when going to/from school/work, or when entering/leaving the community space. Taking photos was seen as part of a group activity (R1, R2, R3, B1, O1, O2, U1). As R3 stated "When we come on Tuesday we normally come a little bit early and she likes to take a few photos, pull silly faces, play with the different effects, see what other pictures people have taken." Also R1 is an example of this behavior: whenever they would pass by a display they took photos as a group.

Getting attention is another reason for taking the photos. The statement from R4 about R2 best captures this "Tall girl used to knock on the window and then stared and waved. [...] she wasn't trying to hide, she was trying to be annoying. But since the app was installed she stopped that." This was also confirmed by R2 who stated they "want to be seen and [they take photos because] we know others 'on the network' will see it". Curiosity is another reason for taking the photos. People were curious about the application or what the photos would look like (B2, O1). When asked about the reasons for taking the photos with his kid O2 replied "To be captured the same size like you really are. Literally like a mirror. Curious, both curios." Similarly B1 stated they "just wanted to see what the photos will turn out like."

Another reason for interaction is the honey pot effect. Honey pot effect was observed and also confirmed through the interviews. For example O2 notes "I just noticed them [a group of kids] taking the photos, not knowing much about it really. [I took the photos] Not far after them. I picked up my son about half past 3, walked into the studio and on returning the machine for taking the photos was on, so I just indulged to keep my son happy, he saw the children doing it. We both saw the kids". There are two interesting aspects of the honey pot effect that we noticed during observations and interviews. First, as noted in the above quote it is important to see people from the same age group interacting with the application. The O2's son saw other children interacting with the application and expressed a desire to interact with it. Similar example is illustrated in Figure 5.8 where we can see a little girl standing in the back next to the mailbox. She observed other children interacting. Once they were done she approached the display and started interacting. However, seeing people form other age groups than one's can repel people from interacting. This is best captured by a quote from B2 who commented on Moment Machine's ability to connect people "there's a fear element, maybe it's a generational thing, you see kids playing around with it, messing around with it". In other words, he hesitated from interacting with the application

because he saw children interacting with it. In general, seeing photos of others was a good incentive for posting the photo of yourself as explained by B2 "Certainly, if you see photos of other people instinctively you, well, I'm looking at you, well take a look at me and I want to look my best and that's the vanity thing."

5.5.2   Social Interaction around the Moment Machine Application

As mentioned previously taking photos was seen as part of a group activity (R1, R2, R3, B1, O1, O2, U1). In turn this stimulated social interaction between people that knew each other. Some of the interactions were quite local, e.g., talking with people from the community (R4, O1, O2, U1), while some went outside the community's locality, e.g., talking with other schoolchildren about the application (B1). For example, R4 stated "It's easy to talk to strangers when you're interacting with the application". Similarly U1 said "We have a reason, we have an excuse, to stand out there and take some photos outside. Sometimes the children are quiet/busy and you can linger a bit more. [...] You stop and got a few moments to kind of speak to people". U1 also mentioned that the application created time for adults with children to socialize: while the kids were playing with the application parents had time to talk to other people.

For kids the application stimulated play and imagination. Some interviewees explicitly mentioned their children love to "play with it" (O2, U1, U2), while others mentioned seeing children play (R4, B4, O1). Besides R1 who appropriated the application and took the photos jumping in the air, during observations we noticed two games children played. In one game kids pressed the hand button to take the photo and then rapidly pressed the filter button in order to randomize their picture, as the final filter of the photo would be made by chance. In another game kids would stand still in a place waiting for the counter to go down and then they would "duck" in order not be captured in the photo (Figure 5.9). These examples show how children easily embrace and appropriate the application. However, we also observed other aspects between R1 and R2, i.e., territoriality – defending their time to interact with the application. In one instance R1 were interacting and R2 asked them to use it. The boys said repeatedly "No" and the girls left. This shows there can be conflicts between groups who are at the display at the same time.

5.5.3   Community Interaction and Awareness

Taking situated snapshots had 4 effects on the community that we were able to distill: 1) stimulating different levels of community awareness, 2) creating memorable events and assisting in already ongoing ones, 3) stimulating interest in other communities and how this 4) enriched local life.

The communal nature of taking situated snapshots is best captured by U1 "[takes the photos] out of community spirit because you're really putting it out there for absolutely anybody to see it." When asked if they recognize someone in the photos

Figure 5.8. Honey pot effect working with the same age group.
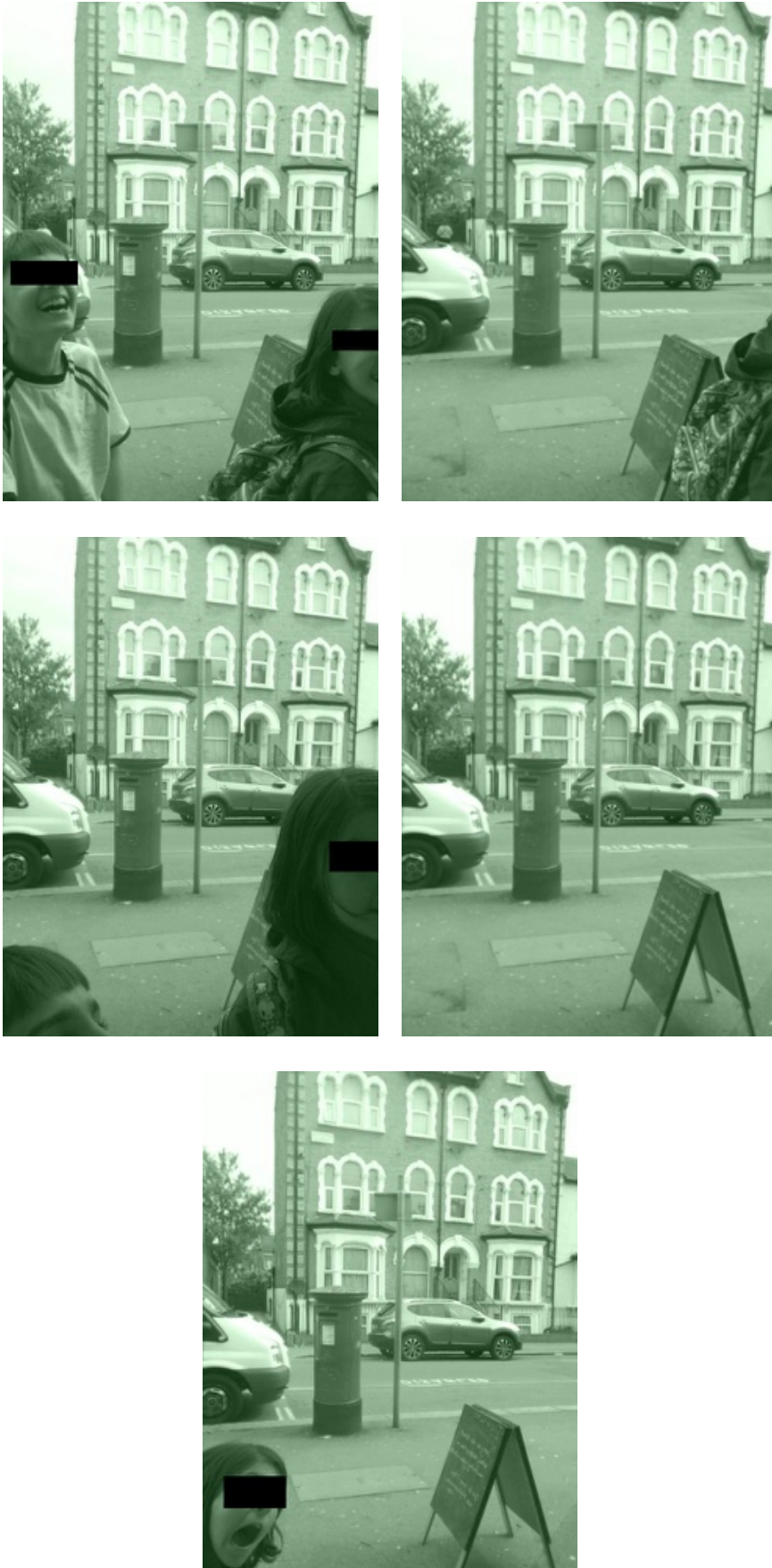
Figure 5.9. Kids playing the "duck" game.

interviewees gave different answers. For example, R4, R5, and O2 recognized R1, the most famous group of people on the photos who took 15.31% of the overall photos. Their impact on the display is best captured by a quote from R4 "The most obvious one is the group of young boys who come really every day after school and I mostly, usually hear them, they're quite loud, they're like a hurricane, you can hear them laughing, hitting the app, the window, a lot of that comes across the pictures but it's quite different when you see them. When they're around I know that the app is running". Others had a more general awareness of the application users. R3 stated seeing "children, typically school children who live here or elsewhere" while O1 identified more than a single user group "Regulars stopping there to take their picture every day, you get a lot of kids, a couple of teenagers, you get young adults, people in their 20s, 30s. A mixture, some of them are people that come to the Mill, some of them are from the area, and some of them are on their way to the park". These examples show how situated snapshots can stimulate different levels of awareness about a community.

When people talked about the Moment Machine application some of them mentioned events or photos they remembered (R3, R4, B1, U1). For example, R4 remembers talking to others about the application in general, but also about "the whole dog sequence, which I showed to everybody" – a sequence of photos where people held their dogs and took a photo with them. Similarly R3 remembered "a man pulling a stand, but that was ages ago". U1 was able to specifically remember when the event happened stating "two weeks ago I was out there with children and a cousin of mine passed and I told her she can take the photos". The strongest memory of a photo or event is connected with an event organized by the community. On Saturday May 4 (week 9) the community organized the Star Wars day where community members and kids dressed up as Star Wars characters. During the event people took the photos inside the Mill, but as they noticed the Moment Machine application running they went out and started playing and interacting outside. As O1 stated "[there was] a lot of action on Star Wars. [...] people came with their costumes and they wanted their photo taken." Similarly B1 notes "We had an event at the Mill based on Star Wars, I was dressed as a storm trooper, so let's let people know what's going at the Mill." The above examples show how situated snapshots help in creating shared memorable events for a specific location and enhance, stimulate, and aid in capturing ongoing ones.

5.5.4   Situated Snapshots as a Communication Medium

We distilled 3 properties of situated snapshots as a communication medium: 1) relevance of the locality for the medium, 2) democratic and egocentric nature of the use, and 3) communicating through situated snapshots.

This type of medium brings attention to the place where the display is located. As O2 stated "It's great, brings attention to the fun of the shop for children [referring to the Mill], which is also one of the goals. It's a great reactive element to the Mill, it's

perfect for the Mill. [...] The novelty wore off once it [the display] was installed, but since the first photography was installed that's much more interactive obviously." R4 had similar comments and saw engagement with the application as engagement with the place. However, this also means the reach of the medium can be quite local. Although there were school kids who talked to their peers about the application (B1) and came back with more friends thus bringing in new users, there were also others (R5) who did not talk about the application "because none of my friends live in the area." In other words, reach of the application with respect to social interaction can be quite local and depends if the users have friends in the area.

During the interviews a strong property of this medium emerged – its democratic but also egocentric nature of use. Regarding the democratic nature of the medium participants stated, "anyone feels like they can use" (O1), "this is your content" (R4), and simply "It's very democratizing" (U1). Although passers-by could browse the photos of others, some interviewees were more interested in looking at their own photos (R3, B1, B2, B3, O1, O2). We observed that after taking a photo people come back to browse and find their own photo as shown in Figure 5.10, occasionally bringing in more people to show them the photo(s) they took.

Communicating through this medium is done through replication, i.e., mimicking behavior of others. As R4 stated "I think one of the good things about the app is that it creates a conversation, people copy the pose, like the dog photos, something links spontaneously and people take photos". This can be connected to her previous statement where she said she likes New Arts Exchange (in Nottingham) because kids do similar things at the Mill. The overall impression about this type of communication is nicely summarized B2 "Not gonna save the world, maybe it could make a world a better place for us who live in it, i.e., by communicating it [the world]". The uniqueness of taking photos through the Moment Machine application is best captured by R4 "Less editorial control, it's the same location you always have the same backdrop you're always concentrated on the expression or the action. I find it difficult, I'm not great in being in photos, but children find it very easy as they are great with telling stories with photos". and O2 "This is a media without me having any sort of like interface, this is a media as in... percentages luck, that I'm passing the screen, percentage is luck that I know that's it taking photographs".

5.5.5   Networked Aspects and Connectivity with Other Places

The Moment Machine application was running in 4 locations in 2 major cities. While some did not know there were photos from other locations (O1) or there was no raised interest in them (B4), for others (R4, R5, B1, O2, U1) seeing images of people from those locations stimulated interest in them. For example, R4 stated "I recognize families from the neighborhood and people from the app, e.g., Leytonstone. I might not know them but I recognize them from the app. I've seen them historically from the other photos". U1 and B1 had similar comments. For example, U1 stated "It's nice to

Figure 5.10. B1 taking photos (top) and coming back the day after to browse (bottom).

have another place so close by because it's easy recognizable. It's so close by it may just happen to see faces of people who used the application, it becomes better known. It's nice that other camera is close by so you may come across someone." However, some showed interest in locations from Nottingham (R4) "Yes, I'm interested. I like the 2nd location [New Arts Exchange] in Nottingham, school kids do similar things to ours. They do similar things with application wherever they are." People noticed places that had similar age groups and behavior, but also ones that were different "[R4 continued] But the other location (Broadway in Nottingham) had a lot more adults and that's more unusual for us because we have more kids using the app'. This shows how the networked aspect of the application may help enrich local life. Other interviewees made similar statements as well (B1) 'More interest in Nottingham because I don't know about it, Leytonstone is too close". For some people interest was raised because of the activities at that location, e.g., (U1) stated "There are photos from people going ought late at night (Leytonstone) [...] That was kind of new, as we would usually see pictures of school kids, kind of boring; we want to know if something more exciting is happening". Furthermore, R5 was interested only in people and what they do, regardless of their location.

Some interviewees wanted more connections with physical places. For example R5 wanted more local displays, e.g., in the Market Square, school, and library at Walthamstow where she passes-by the most. Others wanted connections with places they visited in the past (B1, O2). When asked if they would like to access the photos through other means, e.g., Facebook, or have more displays R5 and B1 chose more displays: R5 stated "just like it the way it is", while B1 stated that this would give him connection to more people.

5.6   Analysis of Interactions at All Locations

In this section I will present how the Moment Machine application was used across all four locations. Overall 1189 photos were taken at the Mill (London), 1146 at Leytonstone (London), 877 at Broadway (Nottingham), and 178 at NAE (Nottingham). Four locations with the displays running Moment Machine are shown in Figure 5.11.

5.6.1   Photo Categories Across Locations

The most interesting graph is shown in Figure 5.12 and Table 5.4 where we can see the spider diagram of how photo themes were distributed across the four locations. For the purpose of creating this figure the same procedure was followed as presented in Section 5.3 where each photo was labeled with themes appearing in it (as previously mentioned this procedure was repeated several times to improve consistency). The biggest difference between the four locations is in the difference in the percentage of single and group portraits, posing, and action themes. We can see that the highest peak

(a) The Mill

(b) Leytonstone

(c) Broadway. Image courtesy of Lei Ye.

(d) NAE. Image courtesy of Lei Ye.

Figure 5.11. Moment Machine at four locations: the Mill (London), Leytonstone (London), Broadway (Nottingham), and New Arts Exchange – NAE (Nottingham). Images in 5.11c and 5.11d courtesy of Lei Ye.
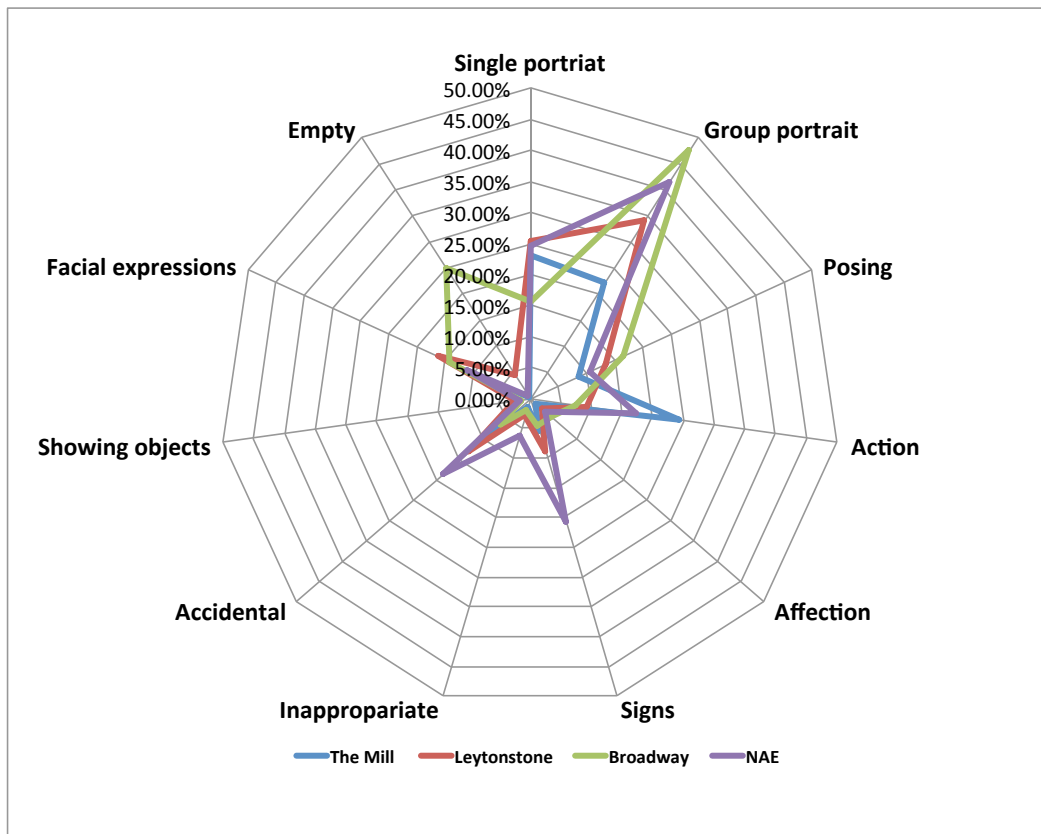
Figure 5.12. Spider diagram showing similarities and differences in photos taken across all locations.

for the group portraits is for Broadway, where the display was located next to a bar, and it declines as more as we move towards the Mill, where the display was located in a residential area. Also, the more we move from Broadway to the Mill in the single and group portraits themes, the more these two themes become equal – for Broadway single 15.62% and group 47.55%, the Mill single 23.13% and group 22.20%. This indicates that the more group portraits a location has the more outgoing it is, and the more we move towards a location that is residential, the more these two categories get into balance. This might have to do with the comfort level at a particular location, i.e., the more residential are it is, the more a person is comfortable to take a photo alone. At Broadway there was also a higher percentage of photos with people striking a pose (16.65%) in comparison to the Mill (8.49%), potentially indicating that the more outgoing location is, the more likely people are to perform.

The opposite can be said for the category action – the highest percentage of this category was for the Mill (24.31%), while the lowest was for Broadway (7.30%). The two locations with the most percentage of photos in this category are the Mill (24.31%)

and NAE (17.42%) when compared to Leytonstone and Broadway (9.25% and 7.30% respectively) – at both locations groups of school kids took the majority of photos for this category.

	The Mill	Leytonstone	Broadway	NAE
Number of photos	1189	1146	877	178
Single portrait	23.1%	25.39%	15.62%	24.72%
Group portrait	22.2%	34.03%	47.55%	41.57%
Posing	8.5%	13.53%	16.65%	10.67%
Action	24.3%	9.25%	7.30%	17.42%
Affection	1.18%	2.53%	4.45%	3.37%
Signs	5.3%	8.81%	4.56%	20.79%
Inappropriate	1.51%	2.88%	1.94%	6.18%
Accidental	8.58%	13.00%	6.39%	18.54%
Showing objects	2.27%	2.44%	1.48%	1.69%
Facial expressions	7.49%	16.32%	14.25%	11.24%
Empty	0.17%	4.62%	24.97%	0.56%

Table 5.4. Photo categories for the four locations.

5.6.2   User Behavior Across Locations

The overall number of users across locations is shown in Table 5.5. Leytonstone was the location with the highest number of users (842) and the Mill and NAE had the highest percentage of returning users (18.27% and 17.92%) respectively. At these two locations the percentage of photos taken by returning users was also highest – at the Mill 51.39% and at NAE 65.17%. As mentioned in the above section these two locations had big groups school kids as of returning users. The overall distribution of the number of returns is shown in Figure 5.13. We can see that most users returned at the Mill and Leytonstone where 10.75% and 6.67% of returning users came back more than 6 times.

   The behavior of the three types of returning users, i.e., the regulars, burst returners, and occasional users, as well as their distribution across locations is shown in figures 5.14, 5.15, 5.16, 5.17, and 5.18 . As can be seen in Figure 5.14 all locations had similar distribution of regulars – the Mill 24.73%, Leytonstone 26.67%, Broadway 26.09%, and NAE 25%. However, the situation is a bit different for burst returners and occasional users where The Mill, Leytonstone, and NAE had similar numbers of burst returners (50.54%, 45.71%, and 50% respectively) and occasional users (24/73%,
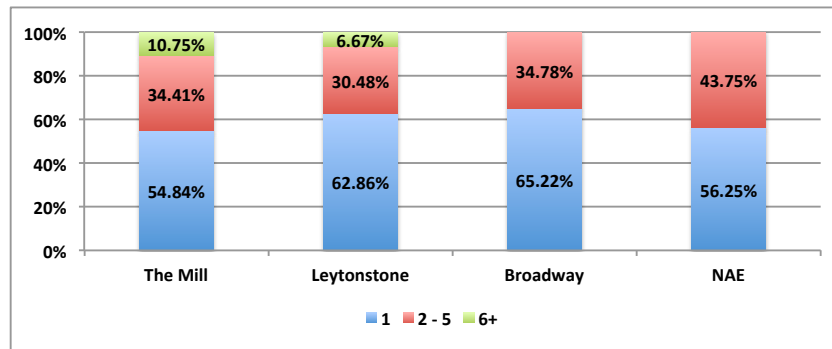
Figure 5.13. Distribution of the number of returns for the four locations.

27/62%, and 25.00% respectively) in contrast to Broadway (burst returners 17.39% and occasional users 52.17%). The higher number of occasional users for Broadway can be attributed to the bar where the display is located as more diverse groups of people would show – one thing to note again is that all four locations had similar number of regulars.

	The Mill	Leytonstone	Broadway	NAE
Total	509	842	389	106
Returning users	93	110	24	19
Non returning users	353	667	361	83
% returning users	18.27%	13.06%	6.17%	17.92%
% photos returning users	51.39%	34.99%	16.53%	65.17%
% photos non returning	48.61%	65.01%	83.47	34.83%

Table 5.5. Percentage of returning users and photos taken.

The behavior of the three returning user groups for the four locations is shown in figures 5.15, 5.16, 5.17, and 5.18. We can see that regulars for the Mill, Leytonstone, and NAE had somewhat similar behavior as they returned to interact after 2.36, 2.83, and 2.94 days coming back 4.04, 3.79, and 2.50 times in a row while regulars at Broadway came back to interact after 1.06 days coming back 1.5 times. When it comes to burst returners all four locations had similar behavior with respect to average return frequency, which ranged form 2.01 (Leytonstone) to the Mill (3.36). With respect to the average number of returns the Mill and NAE had somewhat similar behavior as their burst returners returned 2.04 and 1.75 times, while Leytonstone's and Broadway's burst returners returned 1.21 and 1.00 times respectively. Occasional users were quickest to come back at NAE (average return frequency 12.25), the Mill (24.55), Leytonstone (26.66) and Broadway (32.67) – overall their average number of returns was close for all four locations (the Mill 1.26, Leytonstone 1.10, Broadway 1.08, and NAE 1.25).
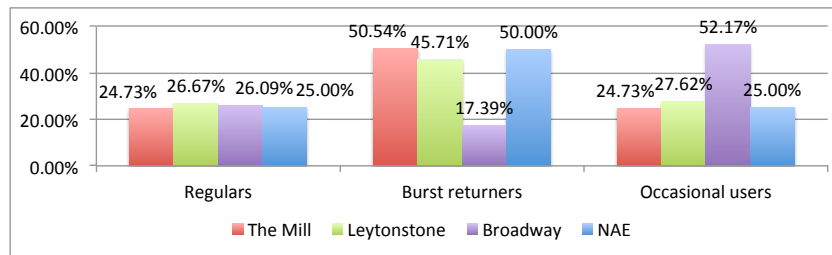
Figure 5.14. Distribution of the three groups of returning users for all four locations.
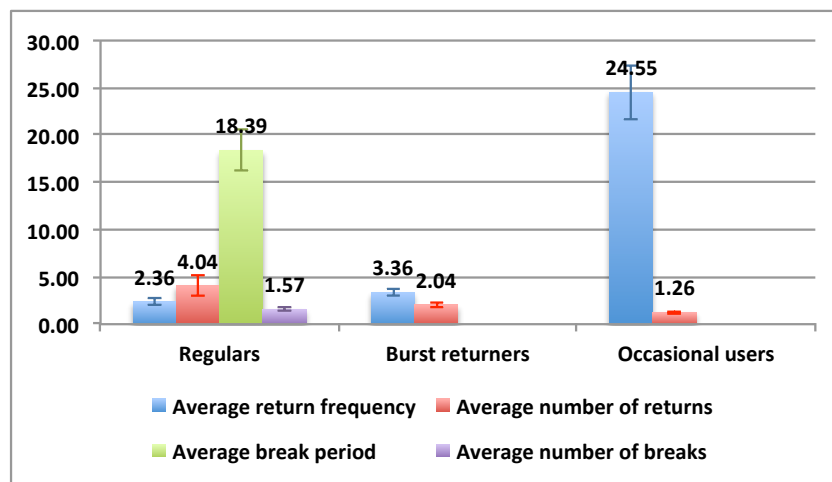
Figure 5.15. Three groups of returning users at the Mill, London.

Standard return times for the returning users at the four locations is shown in Table 5.6. We can see that for the two locations, the Mill and Leytonstone, users returned at a more "standard time" where standard deviation of 5 minutes covers 35.48% (the Mill) and 18.18% (Leytonstone); standard deviation of up to 10 minutes covers 41.94% (the Mill) and 38.45% (Leytonstone); and standard deviation of up to 25 minutes covers for 55.91% and 50.00% users respectively.

Accuracy of classifying interaction sessions using pauses between touch events – interaction pauses – for the four locations is shown in Figure 5.19, Figure 5.20, Figure 5.21, Figure 5.22, and Table 5.7. The best results for the four locations were achieved with thresholds of 35 seconds, 30 seconds, 25 seconds, and 25 seconds for the Mill, Leytonstone, Broadway, and NAE respectively. Respective accuracies were 69.05%, 81.83%, 95.64%, and 98.34%. Using the results of this classification we can see that the average duration for a photo session (for exactly matched photo session, i.e., for the session for which all the photos from the manual classification appeared in the automatic classification) ranged from 44 seconds (Leytonstone) to 63 seconds (the
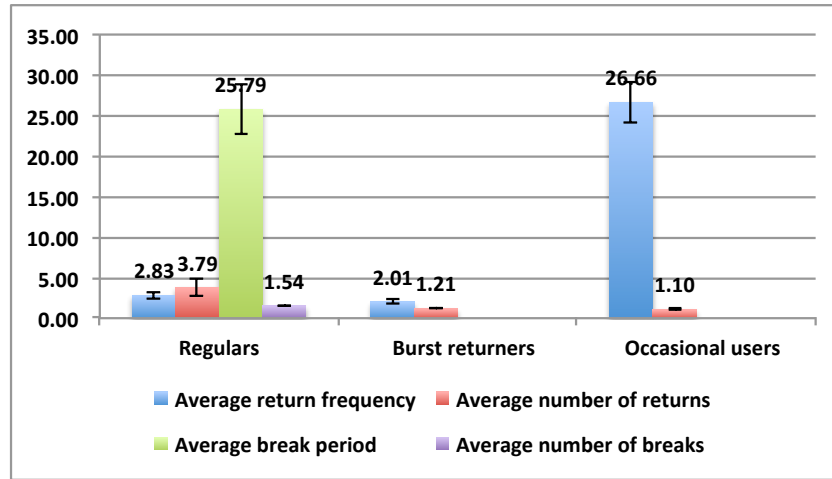
Figure 5.16. Three groups of returning users at Leytonstone, London.
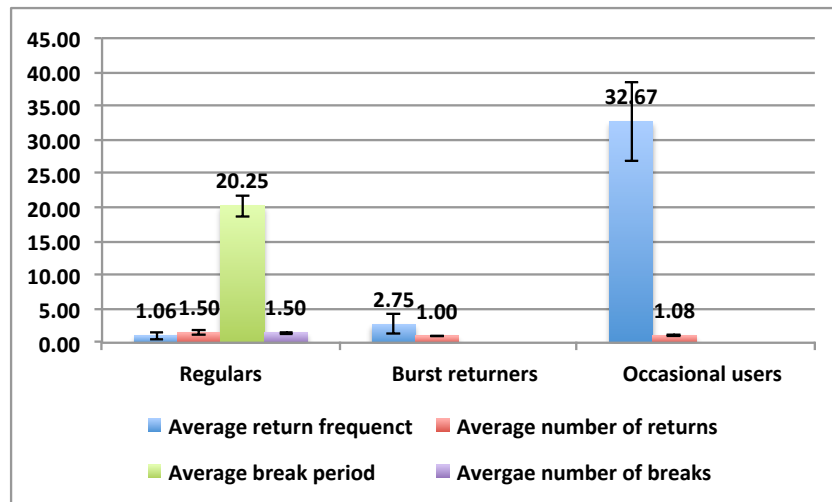
Figure 5.17. Three groups of returning users at Broadway, Nottingham.

Return time	The Mill		Leytonstone		Broadway		NAE	
	Percentage of users	Cumulative percentage	Percentage of users	Cumulative percentage	Percentage of users	Cumulative percentage	Percentage of users	Cumulative percentage
5 minutes	35.48%	35.48%	18.18%	18.18%	0.00%	0.00%	18.75%	18.75%
10 minutes	6.45%	41.94%	17.27%	35.45%	0.00%	0.00%	0.00%	18.75%
15 minutes	4.30%	46.24%	3.64%	39.09%	0.00%	0.00%	0.00%	18.75%
20 minutes	4.30%	50.54%	8.18%	47.27%	0.00%	0.00%	0.00%	18.75%
25 minutes	5.38%	55.91%	2.73%	50.00%	18.18%	18.18%	0.00%	18.75%
30 minutes	4.30%	60.22%	3.64%	53.64%	9.09%	27.27%	18.75%	37.50%
35 minutes	5.38%	65.59%	3.64%	57.27%	0.00%	27.27%	12.50%	50.00%
40 minutes	2.15%	67.74%	5.45%	62.73%	4.55%	31.82%	12.50%	62.50%
45 minutes	1.08%	68.82%	4.55%	67.27%	0.00%	31.82%	25.00%	87.50%
50 minutes	0.00%	68.82%	3.64%	70.91%	0.00%	31.82%	0.00%	87.50%
55 minutes	0.00%	68.82%	1.82%	72.73%	4.55%	36.36%	0.00%	87.50%
1 hour	4.30%	73.12%	1.82%	74.55%	0.00%	36.36%	0.00%	87.50%
1 hour +	26.88%	100.00%	25.45%	100.00%	63.64%	100.00%	12.50%	100.00%

Table 5.6. Standard return times for the four locations.
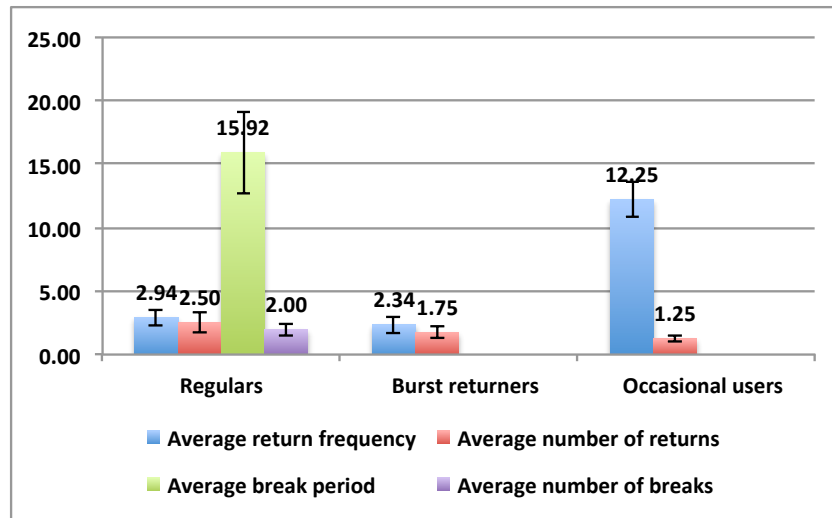
Figure 5.18. Three groups of returning users at NAE, Nottingham.

		The Mill	Leytonstone	Broadway	NAE
Accuracy		69.05%	81.83%	95.64%	98.34%
Threshold		35s	30s	25s	25s
Exact photos sessions	*No. of sessions*	328	486	206	46
	Average	63s	44s	49s	54s
	STD	91s	60s	63s	46s
	Median	119s	121s	140s	80s
	Min	3s	3s	2s	2s
	Max	677s	700s	412s	193s
Scroll sessions	*No. of sessions*	99	72	45	32
	Average	40s	22s	31s	41s
	STD	44s	32s	42s	49s
	Median	117s	120s	139s	80s
	Min	1s	1s	1s	3s
	Max	207s	168s	189s	196s
Other sessions	*No. of sessions*	141	209	310	60
	Average	40s	28s	19s	21s
	STD	32s	34s	24s	26s
	Median	119s	121s	140s	80s
	Min	1s	1s	1s	1s
	Max	161s	204s	204s	105s

Table 5.7. Interaction sessions for the four locations.
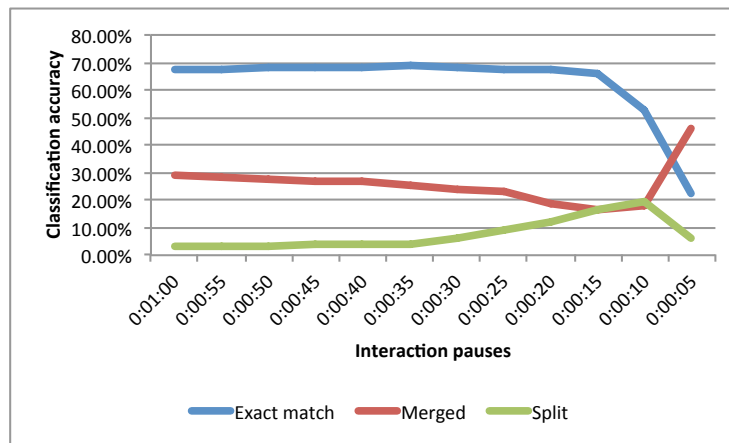
Figure 5.19. Classification accuracy for the Mill, London.
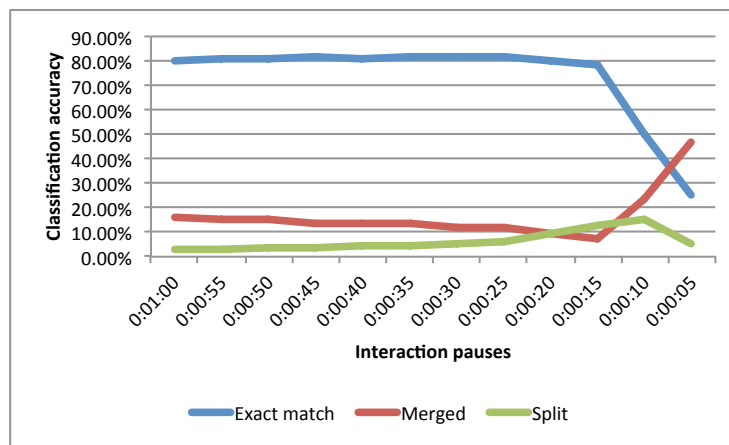
Figure 5.20. Classification accuracy for Leytonstone, London.

Mill). Duration of a session where users only browsed through the photos ranged from 22 seconds (Leytonstone) to 41 seconds (NAE). The average duration of an exploratory session, i.e., a session that did not result with a photo taken and did not comprise from solely browsing the photos, ranged from 19 seconds (Broadway) to 40 seconds (the Mill). Overall, user engagement was longest for photo sessions and shortest for exploratory sessions. However, if we look at median values of session duration, they ranged from 80 seconds (NAE) to 140 seconds (Broadway) for photo sessions; from 80 seconds to 139 seconds (Broadway); and from 80 seconds (NAE) to 140 seconds (Broadway); showing that duration of engagement within different session types might be more similar.
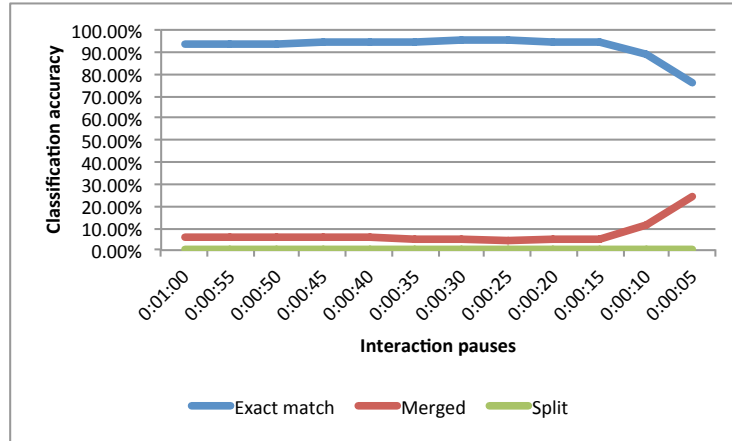
Figure 5.21. Classification accuracy for Broadway, Nottingham.
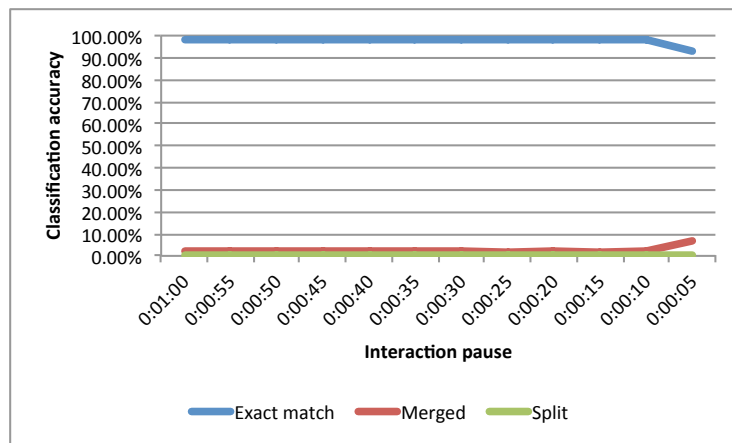
Figure 5.22. Classification accuracy for NAE, Nottingham.

5.7   Chapter Summary

The Moment Machine study showed how situated snapshots can stimulate community interaction and awareness, as well as how interactions via situated snapshots express unique characteristics of different place-based communities. The application stimulated community interaction in several ways, e.g., by stimulating social interaction between known and unknown members of the community. An important finding coming out form this study is that it is important to see members of the same age group if the honey pot effect or social triangulation is to work. The application also stimulated different levels of awareness – who is using the application around the place where a display is located (e.g., the Mill) – between the community members. Users use of the application is directly tied to their level of awareness – the more photos users took the more others were aware of their presence. Another way that the application stimulated community interaction is that it allowed capturing ongoing events happening at the place where a display is located.

The study is also the first one that showed frequency of returns for returning users. An important finding is that there are returning users, but they do not come back to interact every day, i.e., they have breaks in their interactions. Also, interactions with the Moment Machine application are quite short (cf. Table 5.7) – to the best of my knowledge this is the first study that quantifies interaction duration using the same application across four different locations.

Differences between place-based communities can be described through differences in photo themes (cf. Table 5.4 and Figure 5.12), distribution of different types of returning users (cf. Figure 5.14), the overall number of times returning users came back to interact (cf. Figure 5.13) – which is tied to the distribution of returning users, as well as returning users standard return time (cf. Table 5.6).

Overall, findings from the Moment Machine deployment supported convincing evidence that situated snapshots provide a good way of stimulating community interaction and awareness between members of a place-based community. As findings coming form the USI students' communicative ecology study showed that students would like to post and see photos that are tied to the community further developing Moment Machine (to tailor for the tech savvy student community) and having a feature where photos are also posted on Facebook (where students spend their leisure time) was the next logical step.

Chapter 6

Moment Machine 2.0 and Moments Gallery Deployment

In this chapter I will describe the Moment Machine 2.0 and Moments Gallery applications and will report on the analysis of their impact on the University of Lugano (USI) community. I will first present the overall application usage during the 15 weeks of deployment. Then, I will summarize experiences documented from 20 interviews conducted with the application users. Finally I will present the results of a survey (n=119) that examined the impact of the application within the community.

6.1   Moment Machine 2.0 and Moments Gallery Applications

Similarly to the Moment Machine deployment at the Mill, the Moment Machine 2.0 and Moments Gallery applications build upon the idea of leaving a mark in the setting. The user requirements for the two applications [59] came out of various short test deployments that were conducted at the University of Lugano as well as studies conducted for collecting user requirements described in Chapter 3. For example, the Moment Machine 2.0 application supports information take-away by allowing people to collect the photo on Facebook, and it also supports liking and commenting of the content. The test deployments were mainly conducted during USI's welcome events for the new students. For this purpose we used an Instagram application that displayed photos with a predefined hashtag. In order to provide an incentive for using the displays for more than just simple TVs that show images from Instagram, we switched to the Moment Machine application developed for the Mill's community. Unlike the community at the Mill whose members were not that much into technology, the student community at USI can be seen as "tech-savvy" whose communicative ecology is quite complex and diverse. For this reason the Moment Machine application was extended to the Moment Machine 2.0 that allows posting of images to Facebook, as this was seen as the place where students conduct most of their social activities and where they "hang

(a) Moment Machine 2.0 user interface: 1) button for changing the filters, 2) button to mirror the image, 3) button for stickers, and 4) button to take the photos.

(b) Moment Machine 2.0 user interface: 1) button to post the image to display and Facebook, 2) button to image to display, and 3) button to cancel the image.

Figure 6.1. Moment Machine 2.0 user interface.

(a) Moments Gallery user interface: viewing a single photo. By pressing 1) users can see who liked their photo on Facebook, by pressing) users can see who commented on their photo on Faceboook, and by pressing 3) users can give a local like to the photo.

(b) Moments Gallery : viewing likes.

(c) Moments Gallery : viewing comments.

Figure 6.2. Moments Gallery user interface.

out". Moment Machine 2.0's user interface is shown in Figure 6.1. In addition the application supports image stamping with a predefined community logo, thus allowing users to express to which community they belong to. For example in the context of USI community, users can stamp the image with the logo of their faculty pf provenance, e.g., Faculty of Informatics (INF), Communications (COM), of Economics (ECO), as well as to the university (USI).

Moments Gallery user interface is shown in Figure 6.2. The Moments Gallery application shows images that have been submitted through the Moment Machine 2.0. The application fetches and displays users' comments and likes. To be more inclusive of the passers-by and content viewers [65] Moments Gallery also allows users to express their opinion about the content through non-personalized "likes" of the images. The application also has a special "Hot4!" area that displays the most liked and commented images. While the rest of the images stay on the display only for a week, images in the "Hot4!" stay until they are replaced by an image with more likes and/or comments.

Moments Gallery application was initially developed by Ivan Elhart and supported showing of Instagram images and images posted from the display. With help of a Master student, Andrea Michelotti, I conducted a number of changes that allowed fetching and showing of comments and likes for the photos that were posted to Facebook. With the same student I also developed the Moment Machine 2.0. Both Moment Machine and Moments Gallery applications have been developed using the WE-BAT application template that allows easy integration of user-contributed content on networked public displays[16]. The WE-BAT template uses a web-based client-server architecture based on Java PLAY client-server framework[1] and consists of three main components: 1) hooks to online platforms – in this case Facebook – that allow easy collection and publishing of information, 2) application server that automatically pulls information from Facebook and stores it in a local database, and 3) application client that runs in a web browser and presents content on a display(s).

Both applications were deployed for the full academic spring semester (15 weeks) at the main campus of the University of Lugano. Overall, we deployed 4 displays in 3 buildings – ground and 1st floor of the Informatics building where Informatics' students have classes and where they have their open space (1st floor) free for their use; in front of the Mensa in the Main Building, which is the social hub of the campus where most of the community's social activities happen; and on the ground floor of the Red Building where students of Economics and Communications faculty have classes. During the first week of deployment only one of the displays was active – in the Informatics building on the 1st floor. In the second week we added the display in front of the Mensa in the Main Building, while in the fourth week of the deployment we added two more displays – one on the ground floor in the Informatics building and one on the ground floor in the Red Building. The 4 displays had a dozen of applications running on them ranging from university news and events to the local bus schedules,

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[1]http://www.playframework.com/
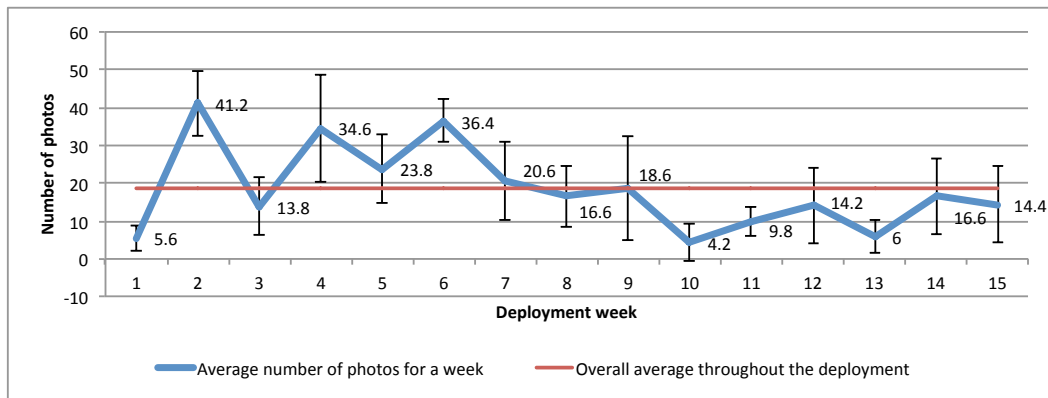
Figure 6.3. Average number of photos taken throughout the deployment per day per week. Error bars show standard deviation.

and included the Moment Machine and Moments Gallery.

6.2   Engagement during 15 Weeks from Interaction Logs

In order to understand trends in Moment Machine 2.0's use I conducted a quantitative analysis of interaction log files collected over the 15 weeks of deployment using descriptive statistics. In total 1382 photos were posted, 872 to Facebook (63%) and display and 510 just to a display (37%). The majority of the photos were taken through the display in the Mensa (845, 61.14%) followed by the display in the Red building (323, 23.37%). The two displays in the Informatics building were used the least (ground floor 127, 9.19%, 1st floor 87, 6.3%). The overall number of photos taken throughout the deployment is shown in Figure 6.3.

On average 18.43 photos were taken daily (STD 14.09) and received 3.52 local likes (STD 20.26). Overall, stickers were used on 46.89% photos, where the informatics sticker was used on 9.55%, economics on 9.70%, communications 13.46%, and USI on 14.18%. If we look at the number of photos that were submitted throughout the deployment we can see that interest in the Moment Machine 2.0 application was highest when the screen in front of the Mensa was introduced (week 2) when 41.2 photos were taken on average (STD 8.66). Also, we can note two periods of engagement: period of higher interests when the number of photos was higher than the average number of photos taken throughout the deployment – this is the first 7 weeks of deployment; and period of lower engagement – weeks 8 – 15. Easter holiday was in week 10 and we can see that it may have "reset" the interest in the application – if this is taken as a "starting point" we can see slow increase in the number of photos that were taken after it.

In Figure 6.4 we can see the average number of photos taken on a weekly basis.
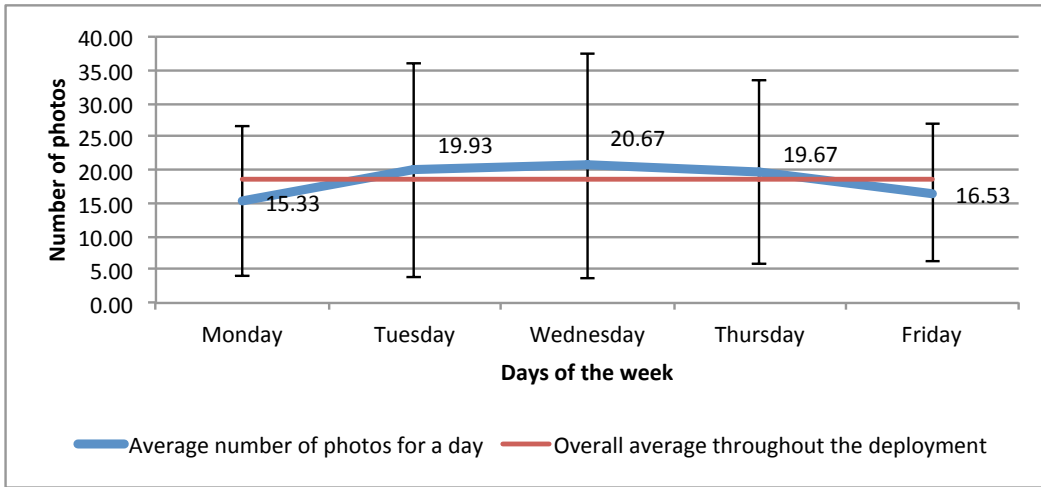
Figure 6.4. Average number oh photos taken on a weekly basis. Error bars show standard deviation.
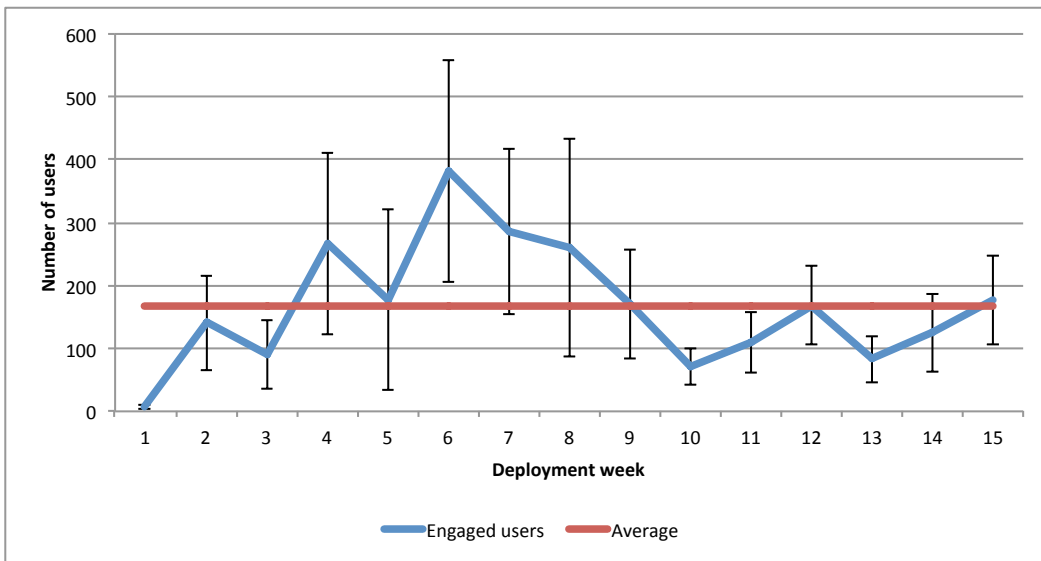
Figure 6.5. Average number of unique users engaged with the Moment Machine's Facebook page throughout the deployment. Error bars show standard deviation.
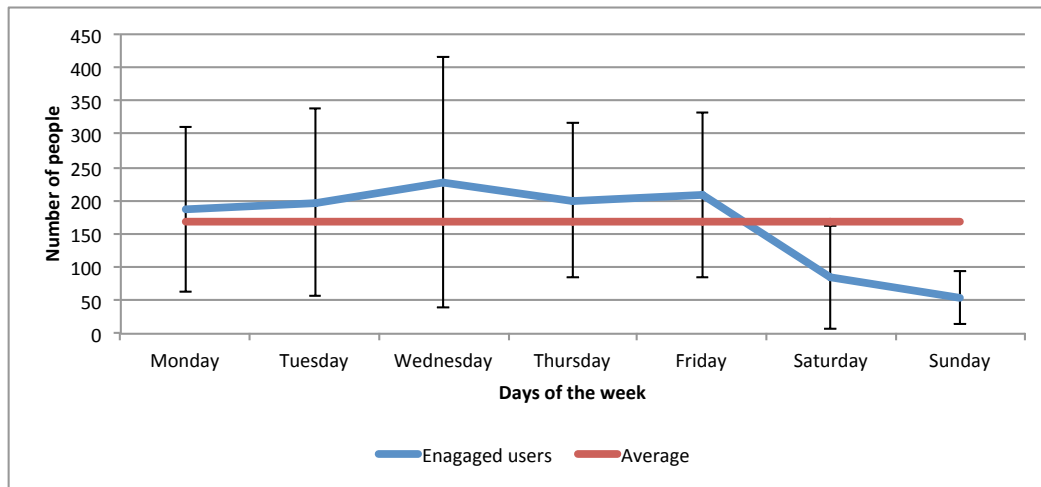
Figure 6.6. Average number of unique users engaged with the Facebook page on a weekly basis. Error bars show standard deviation.

There seems to be a slight increase in the interest in the application as the week goes on, reaching its peak on Wednesday and declining after that.

Engagement on Facebook is shown in Figure 6.5 and Figure 6.6, describing engagement throughout the deployment and on a weekly basis respectively. Overall, photos that were posted to Facebook were viewed 46.44 times on average (STD 38.58); received on average 0.40 comments (STD 0.93) and likes 3.11 (STD 4.36); and were shared 0.10 (STD 0.32) times.

On average 167.26 unique users were engaged with the Moment Machine's Facebook page (STD 139.06). From the beginning of the deployment engagement with the page was increasing and was highest in weeks 4 – 9 (all the time above the average). Similarly to situated engagement with the application, in week 10 engagement with the page was "reset" and was again increasing from that point on. On a weekly basis we can see that engagement with the page was equal throughout weekdays and declined on the weekend.

6.3   Interviews

After one month of the beginning of the deployment we started recruiting people to give us feedback and describe their experiences of interacting with the displays and the Moment Machine 2.0 application. The semi-structured interview structure that was used to collect the feedback and experiences with the Moment Machine application for the Mill community was updated to reflect some of the new features of the Moment Machine 2.0 and Moments Gallery applications. In the interviews we also collected standard demographic data, i.e., age, gender, nationality, what faculty they

attend/work at, how frequently they come to USI and how long they stay on average, how often they had interactions with the Moment Machine 2.0 (they could choose from regularly/weekly, sometimes/monthly, very seldom). We also asked about their use of social media, i.e., Facebook, Twitter, and Instagram (not being reported). As a trial question at the end of the interviews we also asked the following question "Overall, do you agree with the statement that having a Moment Machine application makes your time at this location/USI more social?". Interviewees gave their answers on a 5 point likert scale ranging from "Completely Disagree" to "Completely Agree". The complete interview structure can be found in Appendix D.

Overall we conducted 20 interviews, and interviewees' description is summarized in Table 6.1). We had 16 individual and 4 group interviews (total of 11 people), interviewing 18 females (3 aged between 16 and 20, 10 aged between 21 and 25, and 5 aged between 26 and 30) and 9 males (6 aged between 20 and 25, 2 aged between 26 and 30, and 1 aged between 31 and 35). Most of the students[2] were Economics students (12) and Communications students (9); we also had students from Informatics (4), USI staff members (4), and one person that was not associated with USI, but was visiting a friend who is a USI student (1). The number of Master and Bachelor students was quite equal (12 and 9 students respectively); we also interviewed a PhD student, a visitor, and staff members (4). Out of 27 interviewees 10 were locals, 6 were from a bordering country (Italy), and the rest were international. Most of the interviewees come to USI once a day (19) or a few times a week (6), while a minority comes about once a week (2). With respect to how long they stay at USI, the interviewees reported they stay more than 8 hours (3), between 8 and 6 hours (16), between 6 and 4 hours(4), between 4 and 2 hours (3), and less than 2 hours (1). We had equal number of people that had regular interactions with the Moment Machine 2.0, i.e., on a weekly basis (13) and sometimes/monthly (13), while one person had very seldom interactions (yearly).

ID and description
00: USI Staff member, aged 31 – 35. Comes to USI once a day and spends more than 8 hours on average. Interacts sometimes/monthly with the Moment Machine. From Italy.
01: Master student from Informatics, male aged 21 – 25. Comes to USI once a day and spends between 8 and 6 hours on average. Interacted with the Moment Machine very seldom/yearly. From Costa Rica.
01: Master student from Informatics, male aged 21 – 25. Comes to USI once a day and spends between 8 and 6 hours on average. Interacted with the Moment Machine very seldom/yearly. From Macedonia.

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[2]We had 3 students that were attending a joint program between the faculty of Communications and Economics and thus the number of students that were interviewed adds up to 30.

ID and description
04: PhD student from Economics and Communications and two USI staff members, females, two aged 21 – 25 and one 26 – 30. They come to USI once a day and spend between 8 and 6 hours on average. They interact regularly/weekly with the Moment Machine. One local, one from Italy, and one from Hungary.
05: Bachelor student from Informatics, male aged 21 – 25. Comes to USI a few times a week and spends between 8 and 6 hours on average. Interacted with the Moment Machine sometimes/monthly. From Greece.
06: Bachelor student from Communications and USI staff member, females aged 26 – 30. They come once a day and few times a week to USI and spend between 6 and 4 hours on average. They have regular/weekly interactions with the Moment Machine. Locals.
07: Four bachelor students from Economics, one female 21 – 25 and three males 16 – 20. They come to USI once a day and, three of them spend more than 8 hours and once spends between 8 and 6 hours on average. They interact with the Moment Machine regularly/weekly Two locals and two from Italy.
08: One bachelor student form Communications and one visitor, females aged 21 – 25. Bachelor student comes to USI once a day and spends between 8 and 6 hours on average, while the visitor comes to USI a few times a week and spends less than 2 hours on average. Both report having regular/weekly interactions with the Moment Machine. Both form Canada.
09: Master student from Informatics, aged 21 – 25. Comes to USI about once a week and spends between 8 and 6 hours on average. Interacted with the Moment Machine sometimes/monthly. From China.
10: Bachelor student from Economics, male aged 26 – 30. Comes to USI once a day and spends between 8 and 6 hours. Interacted with the Moment Machine regularly/weekly. From Italy.
11: Bachelor student form Communications, female aged 21 – 25. Comes to USI a few times a wek and spends between 6 and 4 hours. Interacted withe the Moment Machine sometimes/monthly. Local.
12: Master student from Communications, male aged 21 – 25. Comes to USI once a day and spends between 8 and 6 hours. Interacted with the Moment Machine sometimes/monthly. From Hungary.
13: Master student from Economics, male aged 26 – 30. Comes to USI once a day and spends between 4 and 2 hours. Interacted with the Moment Machine sometimes/monthly. From Azerbaijan.
14: Master student from Economics, female aged 26 – 30. Comes to USI about once a week and spends between 4 and 2 hours. Interacted with the Moment Machine sometimes/monthly. Local.

ID and description
15: Master student from Economics, female aged 26 – 30. Comes to USI once a day and spends between 6 and 4 hours. Interacted with the Moment Machine regularly/weekly. From Russia.
16: Master student from Communications, female aged 21 – 25. Comes to USI a few times a week and spends between 8 and 6 hours. Interacted with the Moment Machine sometimes/monthly. Local.
17: Master student from Communications, female aged 21 – 25. Comes to USI once a day and spends between 8 and 6 hours. Interacted with the Moment Machines sometimes/monthly. From Canada.
18: Master student from Economics, male aged 21 – 25. Comes to USI once a day and spends between 8 and 6 hours. Interacted with the Moment Machines sometimes/monthly. From Italy.
19: Master student from Economics and Communications, female aged 21 – 25. Comes to USI once a day and spends more than 8 hours. Interacted with the Moment Machines sometimes/monthly. From Italy.
20: Master student from Economics and Communications, female aged 21 – 25. Comes to USI a few times a week and spends between 4 and 2 hours. Interacted with the Moment Machines sometimes/monthly. Local.

Table 6.1. Interviewees and their descriptions.

The analysis of the interviews was conducted in the same fashion as for the Moment Machine study described in the previous chapter: I conducted a simple affinity diagram analysis using open ended coding on the interviews, and subsequently grouping and re-grouping in order to understand the similarity of the themes emerging in them. All the themes emerging from the analysis were then associated with research questions of the study, i.e., 1) general impressions of the application and reasons for taking the photos, 2) social interaction stimulated by the application, 3) impact on community interaction and awareness, 4) properties that describe situated snapshots taken through networked public displays as a communication medium

6.3.1 General Impressions and Reasons for Taking the Photos

Participants reported that they interact with the Moment Machine 2.0 application because it is *fun* (00, 02, 04, 05, 07, 08, 12, 13, 14, 16, 19) and convenient/easy to use (08, 10, 17). For example three female participants (04) stated "We take the photos out of enjoyment. It's a good idea.". Similarly participants (13) stated "We took photos with our colleagues and we posted it on the Facebook. Display as well and Facebook. It was just... we did it for fun.", or simply put (07) "It is a way to have fun!".

Some interviewees reported that they have used the Moment Machine application to capture "*our time*" at USI – time spent with different groups of people (04, 08, 11, 12, 18, 20). For example the group of female participants from 04 takes the photos every day while they are getting coffee:

04: "When we get the coffee we take a photo, every day. [...] We take the photos out of enjoyment. It's a good idea. We look at the improvement of our faces to work.[...] The photos are only for us, to remember the coffee we have every morning. [...] We take the coffee go out, then we return and control [if the photo is there]."

Similarly, one male participant (18) remembered one of the times he took a group photo at the end of the class project "[last time you took a photo] Actually it was yesterday because I did a group work and after it all the group members decided to take a picture together and I did it more than once. [...] I felt very relieved after this group work. Yesterday I was ready to start my holidays, I said let's do it, I'm free. They are my group mates. [Is this kind of a way to capture the end of the exams] Yes, I think it's also kind of way for group building, because we are all together we are tagged in the picture all together and we are more likely because it happened to hang out all together. The last time we did a picture, the time before, we did a picture and then we went to Oops and we took a beer all together."

One of the female participants from 08 stated that a reason for taking the photos regularly is to capture all the different people she is with "08: [reason for taking the photos regularly] you take it because it's free and easy, and you're with different people at different times, and you wanna do something else 'Oh let's do something fun this time'. Just a social thing. Yesterday for example my other friend came just to have lunch and she is also visiting [so I told her] 'You have to come see this thing; so it's just cool to show people and when you're with different people you wanna go, and if I was with same people I don't know I would take the exact photo each time, maybe space it out and take the photo after a while.". This was closely related to *keeping memories attached* to a place as stated by 14 "It's quite nice because you have a proper, most of the students if they want to take picture they are going to stay here I hope for a long time, so as long as they are not going to be deleted from Facebook, so I would do that because of that, to keep my memories attached through the university platform, not just an external one, which is a private one I might have 1000 of pictures with my friends here that having everyone on this thing on this platform, I felt like for me it's part of my university, my university culture."

Several participants have mentioned reasons for posting to Facebook, i.e., to get/share the photos with others (06, 15) and get the photo(s) for themselves (04, 06, 08, 15). This is best captured by 15: "Facebook, of course Facebook, I can't make these photos disappear!"

Overall, the status of the application was that "everyone knows about it" within the community, e.g., as stated by 12: "[did you talk to someone about the application?] Hmmm, we discussed it. I did not have to tell anyone because everybody met this

display or application and most of the USI students know about it, except those who are abroad or not on USI campus."

6.3.2   Social Interaction around the Moment Machine Application

Engagement with the Moment Machine 2.0 application stimulated social interaction between known groups, both situated social interaction (02, 04, 05, 06, 07, 08, 10, 12, 13, 14, 15, 16, 17, 18, 19) as well as on Facebook (02, 07, 08, 10, 12, 13, 14, 15, 16, 17, 19). For example a group of participants (7) described their interactions in the following way:

07: "Yes we usually talk to people and take pictures with friends. Once we found the picture of our friend Roberto and we copied it from Moment Machine's album and we inserted into our Facebook closed chat. We have a chat shared with few friends/classmates. It is a small group."

Student from 12 recalled that Moment Machine sparked interaction between the students and a professor during a class break:

12: "[Discussion with the professor] Emerging health communication law class. Possible issue could be the information that it's fine if I press the button and I'll be in the picture. But it's possible that others in the background will be in the picture. If I post the picture on the Facebook without them knowing it, it might be a personal issue for them because they do not want to be online or even if I take a picture with a friend of mine and I post it also, he might not want to share the photo but I will. These issues were discussed slightly."

Similarly, the two girls from 08 shared their experience on how the application stimulates social interaction between the group of people they know:

08: "[have you talked to someone about the application?] (Visitor): You've told me about the application (A): But I'm sure if you go back to Canada and people see "where did you take this photo?" you would say there was something here. For example when Eva was here I told her, come you have to see this, you have to take the picture. Like when I have a friend that does not know about it, I'm likely to tell them 'Come, come, come' I've been asked also to take a photo, you know the communication is there. It's very casual and informal, but yeah, let's go lets' see take the photo, see who's that, it's definitely conversation topic."

The application also stimulated interactions between strangers (04, 08, 10, 11, 14, 15, 18). Reasons for talking to strangers ranged from having fun (04, 08, 14, 15) or explaining to others how the application works (11). Most of the interactions with strangers were very brief/superficial and revolved around taking a photo with a stranger. For example, 04 remembers "It happened once that a boy was near us and we invited him. We did not know him. He was near the display and we asked him to take the photo with us. We haven't talked to him, we told him "Bye, bye"... And also a professor, we think he was a professor, he was an old man. We asked him if he would

like to take the photo. He was looking at the machine and we asked him if he would like to take the photo. We did not know these people."

Similar comments were made by the group of girls form 08: "(Visitor): I noticed people would take a group photo and also people walking by would kind of wave in the background, it's a really funny way to interact not only with the people directly but also with people around you. Because people are like "of what are they doing" and they would do silly things in the back. [Have you done anything similar?] Yeah, I photo bombed once. I think so, that was funny. (USI student): Me too, but people I knew. (Visitor): I didn't know them. But it seems like when people are here together they are laughing and smiling. And hence they are in a good mood, they are not angry and looking upset. [any interaction afterwards with the people] One guy that was in our picture, we looked at him and laughed, but we did not directly interacted with him. More like smiling and laughing."

Interviewees also reported on sharing their experiences with outsiders, e.g., friends and family who are not from USI (01, 04, 07, 15, 17, 19). Overall, almost all interviewees agreed that the application makes their time at USI more social as 23 out of 27 interviewees somewhat or completely agreed with the statement "Overall, do you agree with the statement that having a Moment Machine application makes your time at this location/USI more social?"

6.3.3   Community Interaction and Awareness

The application was highly successful in *stimulating sense of connectedness and community* as agreed by all the interviewees. Two of the strongest quotes come from interviewee 17, 19, and 08.

17: "The only thing that I really like about this photo sharing thing is that I don't know any other outlets that the university has on the same type of level. I come from a north American university background, this is something that would be so completely welcomed. It's social and people would get into it in a nice competitive way, taking cool photos and so forth and so forth. It is starting a little bit here, but if you don't have this I really don't know what other platforms student have to do that and it's nice because we're in an academic setting but doing something like this is fun and then it's just, you don't have to go out of your way to do it, it's on campus and you can do whatever you like and you can say look at my photos and yeah, we're here at the university with my peers and yeah it's nice. [Fun place within a serious space] Like a school spirit type of idea. Because I think that this university kind of lacks that, like school spirit is just kind of academic center and we leave, but this kind of thing brings nice social aspect to it. [It helps?] Yeah, definitely. I think it's working."

19: "Well, first of all it's nice because there is university logo and the faculty log and so maybe it's more like to be part of something and its different from making the photo with my mobile phone because that's just mine, with the university machine it's more like being part of something. "

All interviewees reported that this sense of connectedness was stimulated by looking at the photos of friends and colleagues, and for some the connection was quite "obvious" as they are looking at photos of USI students, taken by the USI Moment Machine at USI. This connection was also stimulated through the possibility to "brand" yourself through stickers (02, 05, 06, 08, 09).

08: "[USI student] Well the people in the photos are students here for the most part, and I like the stamps you can show which faculty you're in or just have the USI stamp. Kind of symbolizes being a proud USI student and happy to go here, see people laughing and smiling in the pictures, it's a good representation of the student body. You get to the faces to the students kind of thing, to the unknown. [Visitor] I feel the sense of togetherness. It's a small school. Seeing people together is really shows that students are close here and closely knit. And despite it being clicky, people still have, they are groups together as oppose to everyone being alienated on their own, it's a very nice way to showcase that."

02: "Yeah, I have played with it, they're quite fun, there's 4-5 filters, but the stickers are for me more important because they represent me as a student from informatics, or student from economics, you can brand yourself, and I think that USI filter should be on every picture in the corner, because it was taken with the USI Moment Machine."

The application stimulated group building between people who knew each other (11, 12, 18, 20), but also sense of solidarity between strangers (04).

20: "Last week we took a photo with my field project group mates. A funny group picture. At the end of the group meeting we took a photo and we posted it on Facebook. I always take funny pictures and we always post them on Facebook. I see taking a picture as a group activity."

04: "[Do you remember any photos?] (Laughing) Two girls in the red building that indicated their behinds. We said "Why have you done it?" We liked the photo. But for the solidarity. I don't like these pictures, the idea of this picture, but it's a young girl [they did not know the girls]."

Overall, the application allowed students to create their own space within the university – a *fun space within a serious place* (04, 08, 11, 14, 15, 17, 19). This is best captured with quotes from participants 11, 15, 04, and 01.

11: "'University life with a smile.' Here people are smiling. Usually when you think about the university you think about something boring but here, looking at the pictures, you have the impression of a positive environment where people are smiling and having fun. "

15: "[What things pop to your mind when you look at the photos] The first thing when I saw it is that everyone likes it a lot. Everyone is extremely happy. There's not such a face 'Aaa, I'm just taking a picture' and usually there's not just one person, there's much more, at least 2 or 3 people. It signals a lot because, of course we have the communication and the university, but this helps much more. [Is this helping the communication between the students?] Yes, a lot."

04: "I said that I liked this idea. Couple of minutes to try to create a lovely energy in the university. Perhaps after lessons, we work, but for the students after lessons, if the class was hard, or strange, could be a nice idea. [To take the photo after classes] To have this possibility, it seems that this is a little area where you can enjoy the university, because for me university is serious, it is a little area where you can have fun in the university."

01: "[...] it definitely shows people that study here and what you can see, here you can see that everyone is making jokes and fun and it creates a nice overall experience, people are having fun and if you're not having that much fun than you say 'Oh why I'm not having fun, they are having fun, let's have fun' and then everyone is happy, it creates a good state of mind."

One of the interesting purposes that emerged from application's use was a fun people directory (02, 11, 14, 15). Students reported recognizing friends and others they know on the photos, but also they would use the application to get more information about people they do not know. In other words, people would use the photos captured through the Moment Machine 2.0 application as a reference point: when they see someone they know or like they would often get more information about that particular person on Facebook. As captured by 02 and 11:

02: "[...] it's quite convenient if I find a girl that I like there [referring to the photos on the Moments Gallery], you just go and check who liked the photo from a computer and usually the girl liked the photo of herself, so I can find her and get in touch with her. That's the only use that I have [from the Moment Machine]. [Can you tell me a bit more about this] If I'm here walking and I see a cute girl over here [pointing to a display], or a cute girl that I've seen before and I see her photo there [pointing to Moments Gallery] I know that I can easily get in touch with her, because either she liked the photo or re-tweeted the photo, or whatever. That's the most useful thing that can come out of the Moment Machine."

11: "Boys use it in a special way: if they see a nice girl they try to find her contact by asking friends about the picture(s) [...] For example, I was just talking with a friend that liked a girl a lot and he is trying to understand how to contact her. He didn't succeed yet."

The fun people directory also allowed friends to "catch up" with each other (18), but also to uncover who are the newcomers at the university (14).

18: "What I've noticed was that when I took a class with some roommates we took pictures together. Now we are doing, following, different courses and we're taking different pictures. It is also because we have different schedules, different time tables, but sometimes I saw, oh look at there, they are all my friends, but I'm not there because I was following another course at that moment."

14: "[...] I see someone who's quite funny in the pictures so I check the pictures of that person, just to see if he is really like that, or maybe he might be looking even better. It's just curiosity. As I said, I just came back [from an exchange program] so there are a

lot of new people, new faces here. [So Moment Machine served for catching up?] Not even, not even, but at least you know who are the newcomers here. Being here, when I was from the first year on, in a while, in a few months you know a lot of people. You see the faces and you know that these people are here, these are the students and there are not maybe. But coming back from the exchange you might not know, and the same for the people who start for the first semester, they might see the people and faces straight away, maybe even those people they have never encountered during the classes or somewhere, but they stayed here so they might know the students."

Moment Machine 2.0 also stimulated a sense of privilege (14, 15) and students saw it as improving USI's image as an institution (02, 06, 18). Students liked that the application was personalized for USI – there is the "USI Moment Machine" in the title and photos can be personalized or "branded" – and that they are attending the only university that has it (02). Also, interacting with the application was sometimes seen as an exclusive action 11: "Like this is perfect, having just a few displays make it special. You have to fight to take a picture during the pause and that's cool."

06: "It is an added value. Displays are used a lot for taking pictures, but I don't know how many people use the other services. However we believe that having such technological thing at USI is nice and it can improve USI's image. "

02: "It's fun as well, and I'm sure it promotes USI because people have their logo here [pointing to a photo] and they retweet [the photos] and USI gets a huge promotion on social media."

As shown by the above quote from participant 06, Moment Machine was the main application used on the displays. This also had an effect that people tied the use of the displays solely to the Moment Machine (00, 04, 06, 10, 13, 14, 17).

04: "We don't look at other applications. We never use them. When there are other applications open, perhaps the map of the building, we change it immediately to the photo [Moment Machine 2.0], we go get the photo, get the coffee, and check the photo on our way back. We don't have a lot of time, we take a picture, take a coffee and go. It's an experiment from USI? Will it be removed? No, no, no, stay, stay, we like it, it's a good idea. For me it's a good idea, I like so much this idea. "

17: "But maybe because I see a lot of people standing here and taking pictures that my mind thinks this is like an interactive photo booth type of thingy. I don't know if I actually recall seeing people here and being like 'Oh let me see the public transportation' and so forth. Like, if I think of this structure I think of the Moment Machine."

6.3.4   Situated Snapshots as a Communication Medium

Students also commented on their experience of taking situated snapshots through a display attached camera in comparison to other similar media, e.g., mobile phones, Instagram, or digital cameras. The main characteristics of having photos taken through

the Moment Machine 2.0 application was that it was similar to taking a selfie[3], i.e., a self portrait photo, but it was characterized as a more "social" and "group" selfie, almost like an anti-selfie (02, 05, 12, 14, 16, 18, 20). This is best captured by a quote from participants 02 and 16.

02: "This is much more fun because you don't take a photo by yourself, you take a photo with your friends, you have fun and you laugh about the photo, then you share the photo, then you post comments about the photos [...] it encourages social interaction between people that took the photo and it's fun for them. With my phone I just take a photo and post it on Instagram and over there it's [interaction is] finished."

16: "I think here you have the possibility to interact better with your friends, to put the filters. When I use my phone I never feel like checking the filters and this kind of stuff, while here [Moment Machine 2.0] I stay a long time and check everything. It was fun. In my opinion the displays are more social because you interact with people in two ways, through the display but also directly. As I said before, you are in a group, you play with the displays, so maybe someone that you don't know comes and joins, while on Instagram, as I use it, I never share, almost never share any content. I look at other people's pictures."

Another property of taking situated snapshots through the Moment Machine 2.0 application was that it supported taking unconventional photos and photos that one would not usually take (04, 10, 18, 19). As stated by 04 and 10:

04: "If you take a photo with the phone you take the photo with this [showing her phone]. Sometimes, I never take a photo with my phone. Not usually, but with this machine I like. I never take the photos with my cell phone every day. No, just with the Moment Machine. Just for this reason. If there was no [Moment] machine I would never take the photo in the morning."

10: "Moment Machine is very practical. You pass in front of it, you push the button and the picture is done. You see the camera and you wish to take a picture. Nice unconventional pictures that you would never take with your phone."

As mentioned in the previous section, taking photos with the Moment Machine 2.0 was seen as something very exclusive and personalized just for the USI community – it was seen as something that others do not have. This is also something that made the experience different in comparison to other media. For example, as stated by participants from 07:

07: "Facebook and Instagram are more personal. Moment Machine is a closed network where just we can see the pictures, and we can publish weird pictures [...] Moment Machine is complementary to Facebook but different. I cannot use one instead of the other. I won't publish these pictures on Facebook, I took these to have fun. If I publish something on Facebook it is much nicer than this."

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[3]http://en.wikipedia.org/wiki/Selfie

6.4   Survey

We distributed a short survey within the last two weeks of the deployment. The goal of the survey was to reach a wider audience and capture their experience with the Moment Machine 2.0 and Moments Gallery applications. The survey was informed by the survey used to evaluate the CoCollage display system [49], as this system is somewhat similar to the two applications – the CoCollage displayed statues updates, pictures, and messages on a public display posted by the users of the CoCollage social networking site. The questionnaire that was distributed in the CoCollage study can be found in Appendix F, while the online survey used for evaluating the impact of the Moment Machine 2.0 and Moments Gallery applications can be found in Appendix G. Overall, the survey had 36 questions that asked:

- Participant's demographics, i.e., gender, age, faculty they are attending/working for, and student status or role

- How often they come to USI and how much time they stay at it

- How many times they interacted with the applications, how often, and at what locations

- How often they interacted with the Moment Machine's Facebook page, how often they liked, commented, tagged, and shared the photos from the Moment Machine's Facebook page

- Overall, how many times they have interacted with the Moment Machine

- With whom and how often they took the photos, i.e., alone, with friends/classmates, acquaintances, and strangers that could have been around a display

- How often they used the stickers to express community membership

- Whether they looked at the photos on Facebook or display, and whose photos were they looking at

- How much features of the Moment Machine 2.0 and Moments Gallery applications affected their sense of community (e.g., taking photos, using stickers, posting the photo(s) to Facebook, seeing photos on a display and Facebook, liking photos, getting the photo into 'Hot4!', etc.)

- How much the applications affected awareness of, interaction,s and relationships with their colleagues, friends, and acquaintances

- Overall, if the applications were able to reflect USI as a community; if using the Moment Machine 2.0 was becoming a common practice within the community;
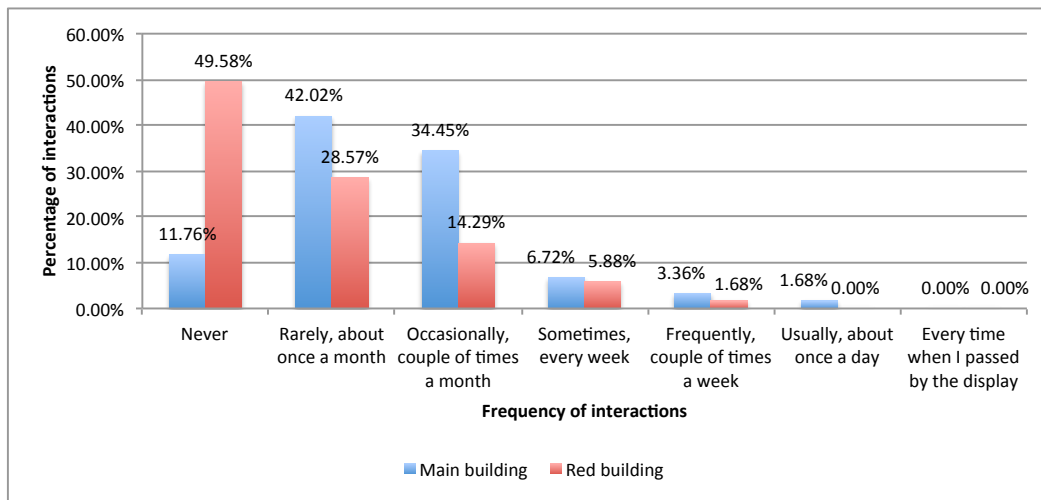
Figure 6.7. Reported frequency of interactions at the two locations – display in front of the Mensa in the Main building and display in the Red building.

and if the application was able to affect the elements that comprise the sense of community according to [53], namely membership, influence, integration, and shared emotional connection

- Open-ended feedback that gave the participants the opportunity to share what they liked and disliked about the applications, e.g., how can they be improved, were there any good or bad memorable experiences they can remember, or any other feedback they migh have had

The complete survey can be found in Appendix E.

Overall, we received 141 survey responses out of which 105 were considered useful, as 36 participants reported that they have never interacted with the applications. Survey responses were analyzed using descriptive statistics. Survey respondents were mainly Master (42%) and Bachelor students (39.5%), while a much smaller portion were staff members (7.56%), PhD students (5.88%), postdocs (1.68%), and professors (1.68%). Most of the participants were from the Faculty of Communications (36.97%) and Economics (35.29%), followed by participants from Informatics (20.17%) and USI staff (7.56%). Most of the participants come to USI on a regular basis ("About once a day" 84.87% and "A few times a week" 11.76%) and spend more than 6 hours at its premises ("Between 8 and 6" 41.18% and "More than 8 hours" 30.25%).
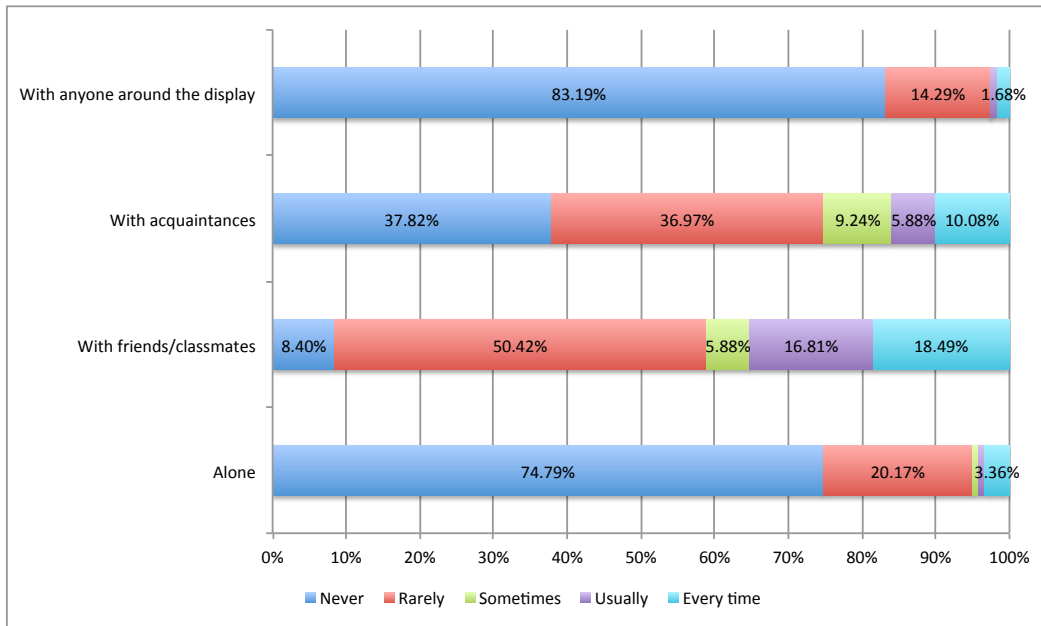
(a) Most of the survey respondents take photos through the Moment Machine 2.0 with their friends/classmates and acquaintances.
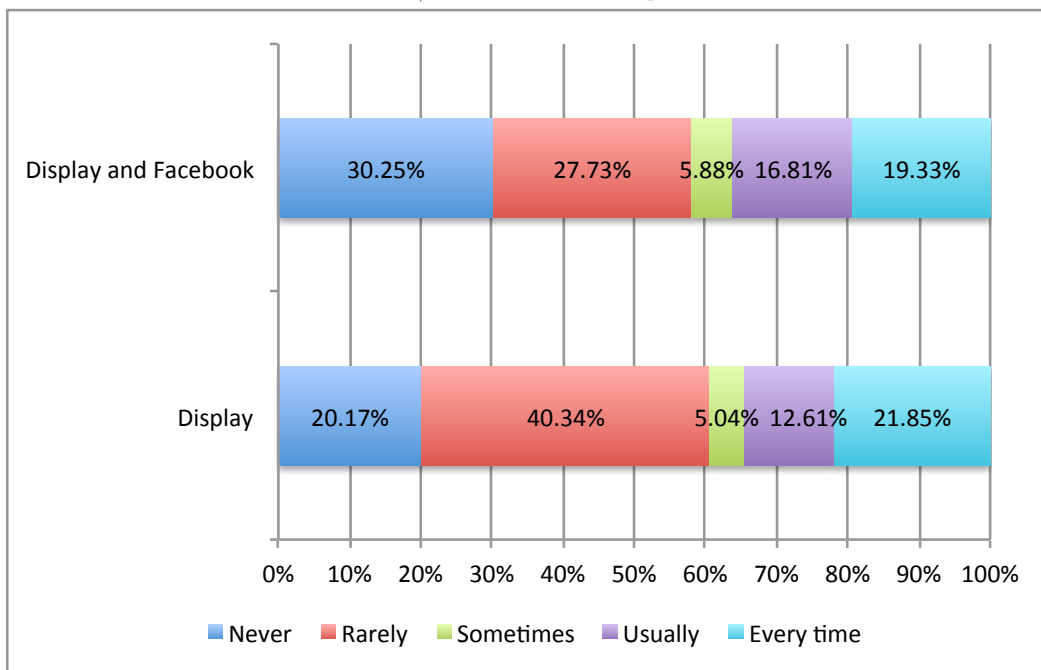
(b) Most of the survey respondents state that they post the photos to a display, which is on contrast with the analysis of interaction log files, which shoes that most of the photos are posted to display and Facebook (almost two thirds or 63%).

Figure 6.8. Most of the survey respondents report taking the photos with their friends/colleagues and acquaintances and post them to a display.
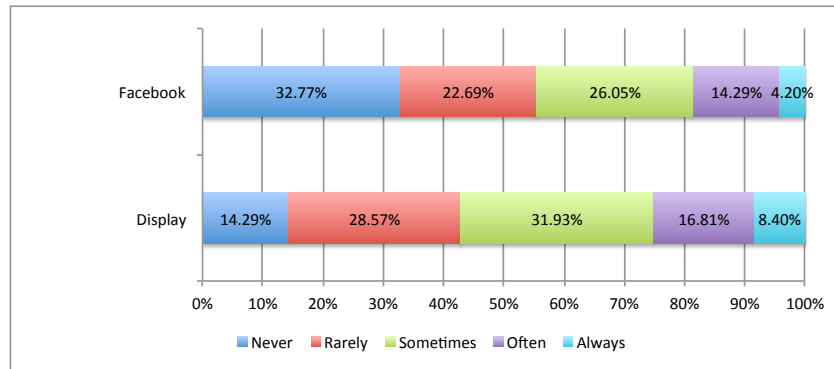
(a) Most of the survey respondents look at the photos on the display.
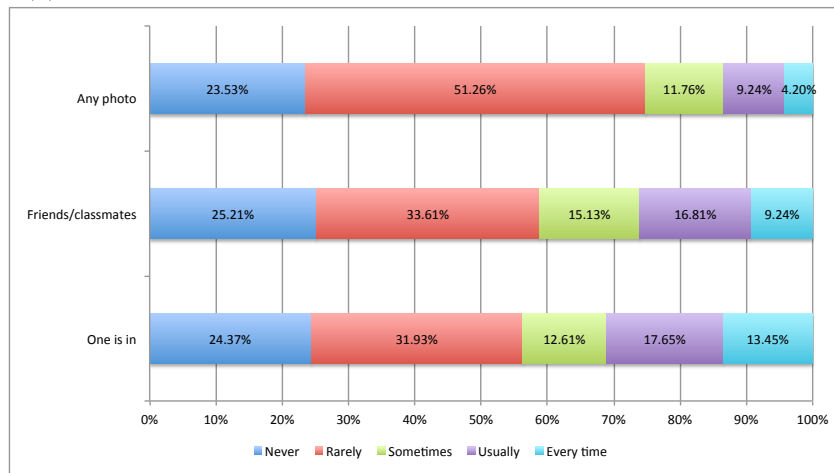
(b) Most of the survey respondents look at the photos on the display of themselves or of their friends/acquaintances.
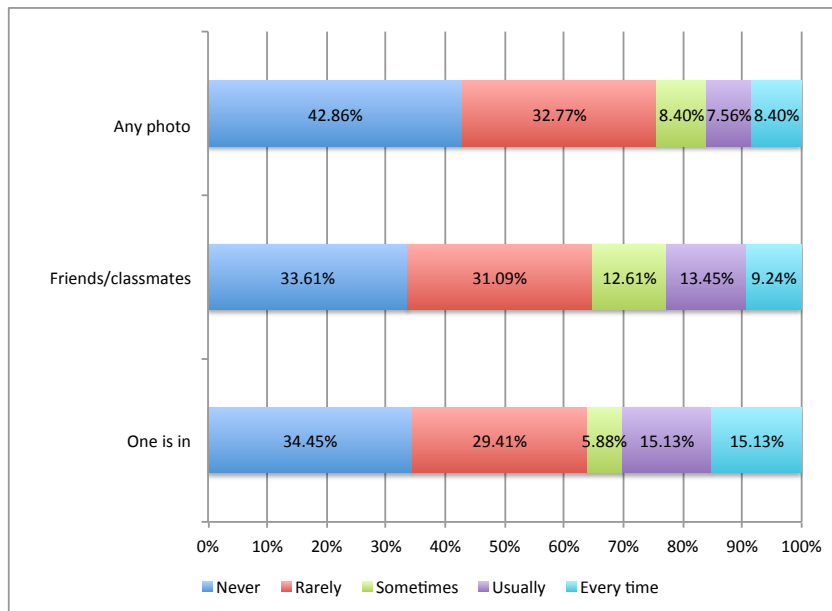
(c) Most of the survey respondents like at the photos on Facebook of themselves or of their friends/acquaintances.

Figure 6.9. Most of the survey respondents look at the photos of themselves and of their friends, both on the display and Facebook. Overall, most of the respondents look at the photos on the display.
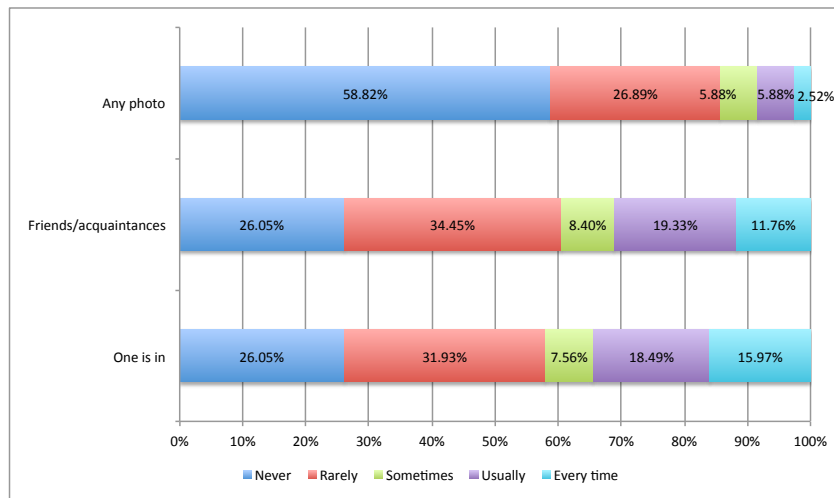
(a) Most of the survey respondents like the photos of themselves or of their friends/colleagues on the display.
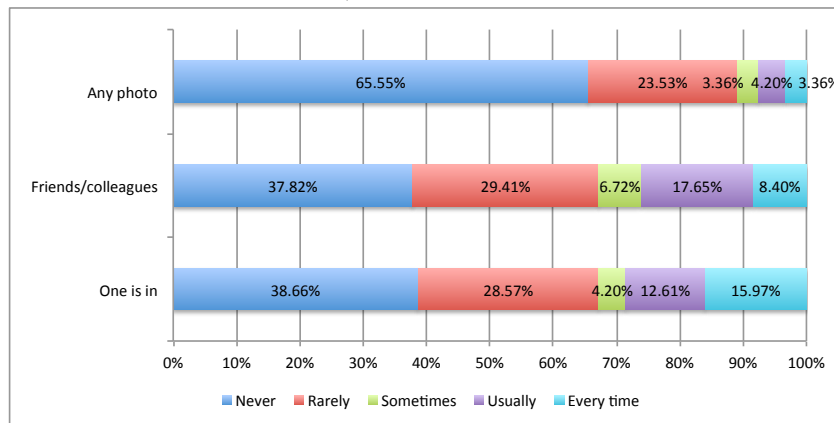
(b) Most of the survey respondents like the photos of themselves or of their friends/colleagues on Facebook.
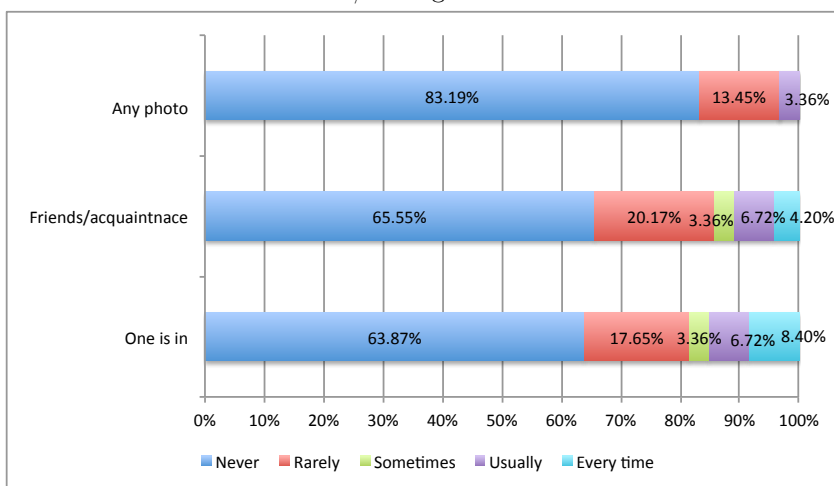
(c) Most of the survey respondents comment on the photos of themselves or of their friends/colleagues on the display.

Figure 6.10. Most of the interactions with the photos, i.e., situated liking and liking and commenting on Facebook was on photos where one is in or photos of their friends and colleagues.

6.4.1   Interactions with the Moment Machine 2.0 and Moments Gallery

Most of the survey participants interacted with the display in front of the Mensa (88.24% participants reported interacting with it) and in the Red building (50.41% reported interacting with it), while the displays in the Informatics building had the lowest engagement (ground floor 28.57% and 1st floor 23.53%). Frequency of interactions for the two locations – display in front of the Mensa and in the Red building – is shown in Figure 6.7. The figure shows that for both locations interactions were on a monthly level ("Rarely, about once a month" and "Occasionally, couple of times a month"). Most of the respondents interacted between 1 and 5 times with the Moment Machine (55.46%). Some reported interacting between 6 and 10 times (22.69%), and between 11 and 15 times (15.97%), while a small portion reports interacting more than 15 (5.88%).

Participants reported that when they take the photos they take them mainly with friends and acquaintances, as shown in Figure 6.8a. In contrast to the analysis of interaction log fies, most of the participants reported that they post photos only to a display, as shown by their replies in Figure 6.8b. When they look at the photos on the display they are almost equally looking at any photo on it, photos they are in, or photos of their friends/acquaintances (cf. Figure 6.9b). However, when they are looking at the photos on Facebook they are looking more at the photos they are in or photos of their friends and classmates (cf. Figure 6.9c). When it comes to liking the photos participants stated that they are more willing to like a photo on the display than on Facebook (58.82% vs. 65.55% for the category "Never" in figures 6.10a and 6.10b respectively). In general, they prefer to like the photos in which they are in or photos of their friends and colleagues. Overall, participants reported that they were more willing to like the photos than to comment.

6.4.2   Impact of the Moment Machine 2.0 and Moments Gallery Applications

At the moment the strongest indicator of the overall impact of the Moment Machine 2.0 and Moments Gallery applications comes from the last section in the survey, which asked the participants for their level of agreement/disagreement with the statements that reflected the applications' impact on the sense of community. The statements asked for:

- the applications' ability to reflect the USI community (1st statements) and

- the applications' integration as a tool within the community (2nd statement),

- the applications' ability to affect membership (3rd statement, reflecting McMillan and Chavis's membership), integration and fulfillment of needs (4th statement, reflecting McMillan and Chavis's integration and fulfillment of needs), influence (5th statement, reflecting McMillan and Chavis's influence), and shared emotional connection (6th statement).

Also, participants open ended feedback confirmed some of the previous insights that came form the interview analysis.

In Figure 6.11 and Table 6.2 we can see that majority of the participants agreed with all the statements, thus showing the success of the Moment Machine 2.0 application. In other words, the application reflected USI community (60.5% of the participants agreed) and posting photos through the Moment Machine 2.0 was seen as a common activity for the members of the USI community (52.94%). The majority of the participants also agreed that by posting photos through the Moment Machine 2.0 application they are expressing membership to the USI community (57.14%), they contribute to USI's image as an institution (50.24%), and thus influence its image (44.54%). Finally, the majority of the participants agreed that looking at the Moment Machine 2.0's photos evokes an emotional connection with USI (56.3%).

The survey also asked the participants about the effects of interacting with the applications on community interaction, i.e., the effect of the application on social interactions, relationships, and awareness of friends, colleagues, acquaintances, and strangers at USI. The participants could answer about each of the interactions on a likert like scale where responses were "No affect", "Minor affect", "Neutral", "Moderate affect", and "Major affect"[4]. Detailed responses are shown in Table 6.3 while in Figure 6.13 the items "Minor affect", "Moderate affect" and "Major affect" were merged into one group "Affected". Overall, the application had affected the most the sense of belonging to USI community (66.39%), awareness of others/strangers (65.55%), awareness of friends and colleagues (62.18%) and social interactions with them (friends and colleagues). This confirms some of the interview findings on how the application stimulated interaction and awareness (application's use as a reference point).

The survey also asked the participants about particular features of the Moment Machine 2.0 and how much each affected the sense of belonging to USI community. The participants could answer about each of the features on a likert like scale where responses were "No affect", "Minor affect", "Neutral", "Moderate affect", and "Major affect". Survey responses are shown in Table 6.4, while in Figure 6.13 the items "Minor affect", "Moderate affect" and "Major affect" were merged into one group "Affected". From Figure 6.13 we can see that features that influenced the sense of belonging the most were taking photos (68.91%), looking at the photos on a display (56.30%) and Facebook (51.26%), and using stickers (50.42%). This confirms interview findings on what interactions were seen as the most valuable in stimulating community interaction and awareness.

Open-ended feedback further confirmed some of the interview findings. For example, the Moment Machine 2.0's ability to stimulate the sense of community – "captures emotions throughout the day, and the feeling of a connection with USI", "In a sense brings people together at least for a moment: 'C'mon gys, lets take

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[4]These items were taken from "Affect on X" from from [95]

a photo together"' and " It is the fact that it is a moment of leisure that mostly shows friendships within the university.". Open-ended feedback also confirmed the application's capability to capture everyday moments at USI "Possibility to capture some of the most interesting moments: birthday of my friend, post-exams...", "The fact that you can take a photo in different times of the day with your friends and classmates.", "Possibility to keep/remember those moments from everyday life from USI.". Overall, the application was seen as allowing the community to *preserve its memories at USI*: "The memories that remain: even though they are simple photos I will remember years spent at USI, my classmates...etc.", or "captures emotions throughout the day, and the feeling of a connection with USI". Participants also commented on using the application as a *stress relief* form their work: "To see happy faces even when it seems that everything around is difficult. Realizing the vitality that we young people have.", "It's fun to pass by and see the photos that makes you laugh and makes you forget the university stress at least for a brief moment.", "It is a distraction from the hustle of university life by taking a photo with your friends/classmates.", and "Possibility to see all the photos taken from people whom I may not know, but they make you smile." There were also comments on the application's use for the promotion of USI and its life "Thanks to the Moment Machine we've demonstrated through Facebook the world of USI to our friends/families".

There were not that many negative comments for the Moment Machine 2.0 application. When they did appear they mainly went on speculating what the application does or what is its purpose: "Maybe there is a video camera that before taking a photo records a movements in front of the display." or "I don't understand usefulness of this Machine, nobody has explained what is its purpose." There were also comments on how to improve the application's technical aspects, e.g., filters and responsiveness of the touch screen. A very interesting comment was on how the application's use is sometimes blocking the pathways in front of the Mensa and in the Red building "it is blocking the way to Mensa" or "It is an obstruction on the way to the Mensa or in the Red building, especially when large groups try to take a photo."

The two applications were overall well received, as best captured by this quote "Good job guys! Congratulations, and I hope the Moment Machine will stay around a little bit more."
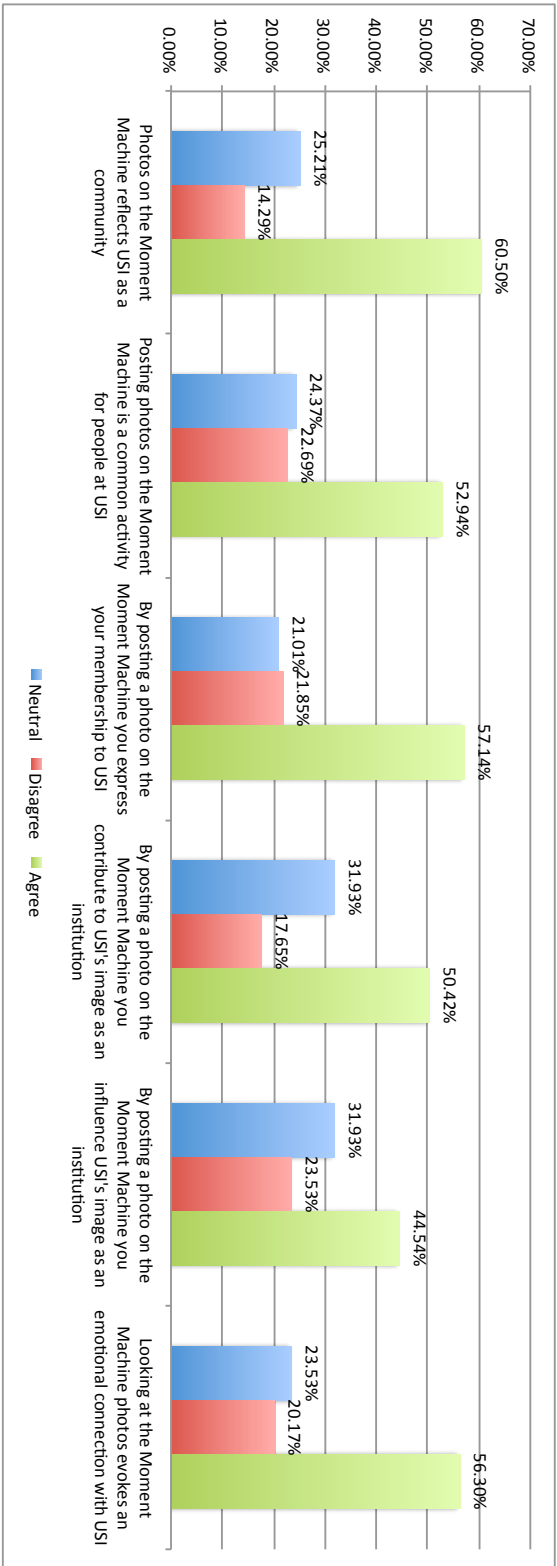
Figure 6.11. Level of agreement on the overall influence of the Moment Machine 2.0 application on the sense of community. Statements were targeting the application's ability to reflect the USI community (1st statement), its integration within the community (2nd statement), its ability to affect membership (3rd statement), integration (4th statement), influence (5th statement), and shared emotional connection (6th statement). All levels of agreement and disagreement were grouped.

Statement/ level of agreement	Strongly disagree						Strongly agree
1. Photos on the Moment Machine reflect USI as a community	5.04%	5.04%	4.20%	25.21%	36.13%	18.49%	5.88%
2. Posting photos on the Moment Machine is a common activity for people at USI	5.88%	6.72%	10.08%	24.37%	33.61%	15.97%	3.36%
3. By posting a photo on the Moment Machine you express your membership to USI	6.72%	4.20%	10.92%	21.01%	36.97%	15.97%	4.20%
4. By posting a photo on the Moment Machine you contribute to USI's image as an institution	6.72%	5.88%	5.04%	31.93%	30.25%	15.13%	5.04%
5. By posting a photo on the Moment Machine you influence USI's image as an institution	6.72%	9.24%	7.56%	31.93%	29.41%	14.29%	0.84%
6. Looking at the Moment Machine photos evokes an emotional connection with USI	5.88%	6.72%	7.56%	23.53%	35.29%	13.45%	7.56%

Table 6.2. Level of agreement on the overall influence of the Moment Machine application on the community. Statements were targeting the application's ability to reflect the USI community (1st statement), its integration within the community (2nd), its ability to effect membership (3rd statement), integration (4th statement), influence (5th statement), and shared emotional connection (6th statement).

Statement/ Answer	No affect	Minor affect	Neutral	Moderate affect	Major affect	MED	AVG	STD
My awareness of friends and colleagues at USI	24.37%	24.37%	13.45%	28.57%	9.24%	Moderate affect	2.74	1.34
My awareness of others	18.49%	29.41%	15.97%	32.77%	3.36%	Moderate affect	2.73	1.19
My social interactions with friends and colleagues	24.37%	30.25%	15.13%	23.53%	6.72%	Minor affect	2.58	1.27
My social interactions with others	32.77%	27.73%	9.33%	16.81%	3.36%	No affect	2.30	1.19
My relationships with friends and colleagues	31.93%	26.89%	11.76%	22.69%	6.72%	No affect	2.45	1.32
My relationships with others	38.66%	23.53%	18.49%	15.97%	3.36%	No affect	2.22	.21
The sense of belonging to USI	17.65%	25.21%	15.97%	28.57%	12.61%	Moderate affect	2.93	1.32
USI's image as an institution	20.17%	25.21%	20.17%	21.01%	13.45%	Minor affect	2.82	1.33

Table 6.3. General effects of the Moment Machine 2.0 and Moments Gallery applications on the community.
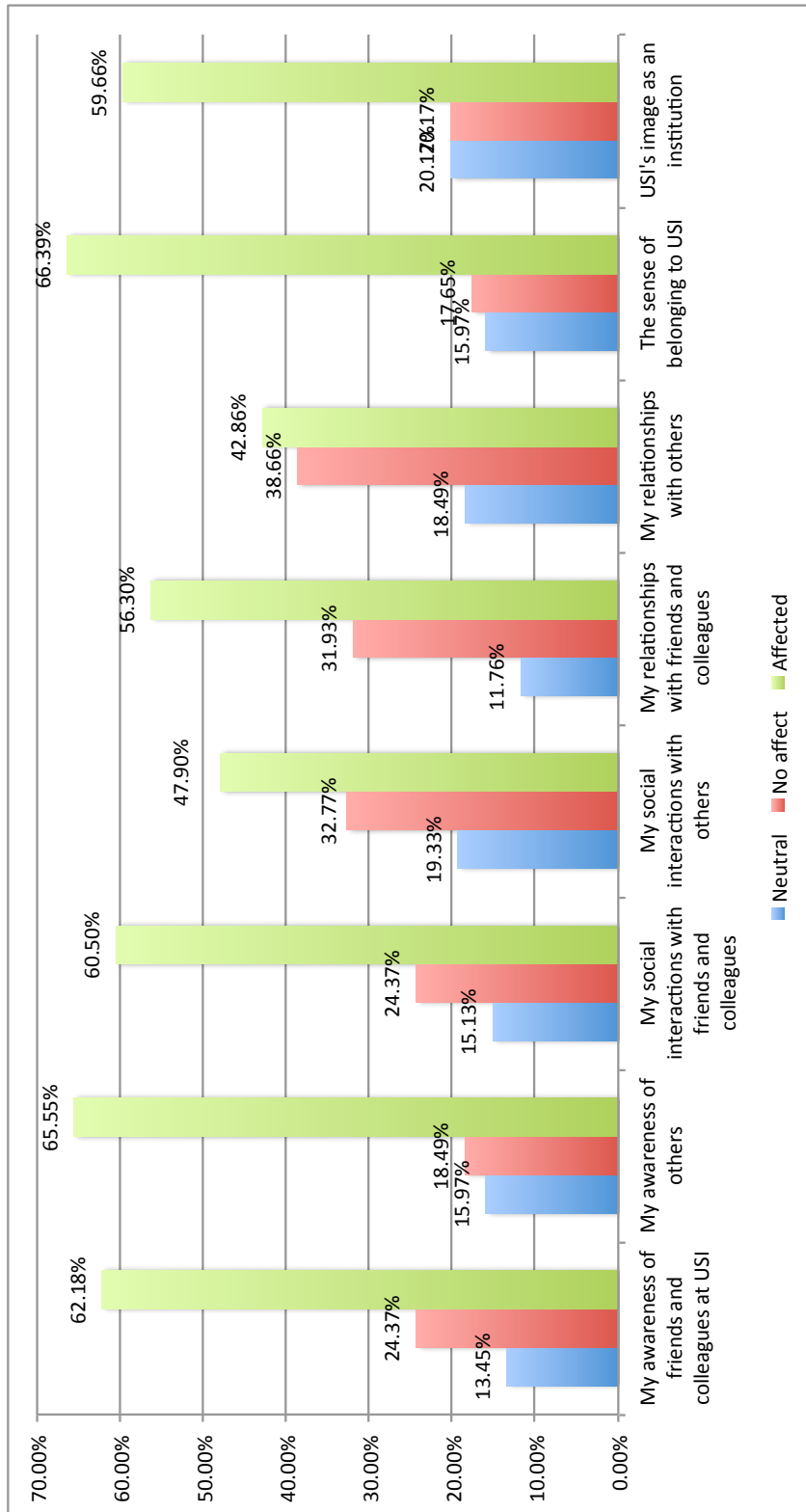
Figure 6.12. Effects of the Moment Machine 2.0 and Moments Gallery applications on community interaction.

Statement/ Answer	No affect	Minor affect	Neutral	Moderate affect	Major affect	MED	AVG	STD
Taking photos	16.81%	22.69%	14.29%	32.77%	13.45%	Moderate affect	3.03	1.33
Looking at the photos on the USI Displays	25.21%	19.33%	18.49%	25.21%	11.76%	Moderate/ no affect	2.79	1.37
Using stickers to express community membership	34.45%	13.45%	15.13%	18.49%	18.49%	No affect	2.73	1.54
Liking the photos on the display	36.97%	15.97%	21.01%	18.49%	7.56%	No affect	2.44	1.35
Competing with others to get into Hot4!	55.46%	11.76%	14.29%	10.08%	8.40%	No affect	2.04	1.36
Getting your photo to Hot4!	55.46%	11.76%	15.13%	7.56%	10.08%	No affect	2.05	1.38
Looking at the photos on Facebook	33.61%	18.49%	15.13%	22.69%	10.08%	No affect	2.57	1.41
Liking the photos on Facebook	40.34%	15.13%	15.97%	19.33%	9.24%	No affect	2.42	1.41
Commenting the photos on Facebook	43.70%	15.97%	13.45%	20.17%	6.72%	No affect	2.30	1.38
Tagging the photos on Facebook	41.18%	13.45%	13.45%	19.33%	12.61%	No affect	2.49	1.49
Sharing the photos on Facebook	38.66%	15.13%	12.61%	21.85%	11.76%	No affect	2.53	1.47

Table 6.4. Affect of the Moment Machine 2.0 and Moments Gallery's features on the sense of belonging to the USI community.
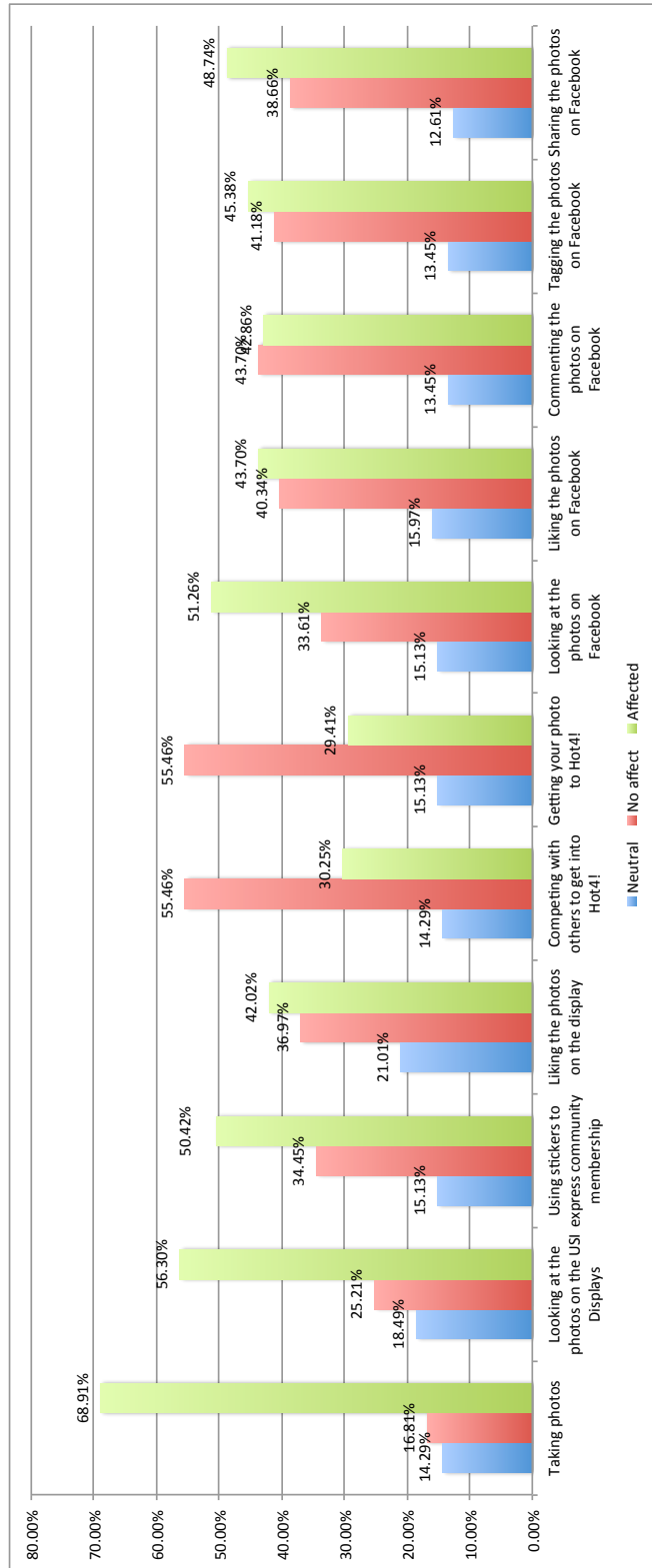
Figure 6.13. Effect of each of the interactions with the Moment Machine 2.0 and Moments Gallery applications on the sense of community.

6.5   Chapter Summary

The study on the Moment Machine 2.0 and Moments Gallery application went beyond the study of the Moment Machine described in the previous chapter and looked into capturing the effect of posting and viewing situated snapshots on the sense of community as defined by [53]. According to them the sense of community is comprised from membership (feeling of being a member of the community), influence (how much a person influences the community and vice versa), integration (person's willingness and need to belong to a community leading to reinforcement of needs), and shared emotional connection (shared notion of community's values). In addition this study also examined the capability of situated snapshots to reflect the USI community as well as if posting photos on the Moment Machine 2.0 is a common activity for the members of the community. In order to assess these questions we distributed a survey and received n=119 responses. The six questions were assessed through a Likert scale response and showed that for all of them survey respondents agreed that Moment Machine reflected USI community and posting photos was seen as a common activity as well as that it had an impact on the four parts that comprise the sense of community according to McMillan and Chavis.

Also, the interviews conducted in this study showed that deployment and use of the application changed students view of USI. While before the Moment Machine deployment USI was seen as a purely academic setting, somewhat distant from the student, Moment Machine application allowed them to create their own space within the university – "fun space within a serious place" – and bring them closer to USI as an institution.

Chapter 7

Conceptual Tools for Design and Analysis of Interacting Places and Lessons Learned

While the previous chapters summarized the motivation behind the three applications, as well as the process and experience of designing, developing, deploying, and evaluating them, this chapter will summarize some of the general lessons learned in the process. These lessons are summarized through: a holistic design/conceptual space of Interacting Places applications that can help designers and developers make decisions on what applications they want to make – the Interacting Places Framework; the P-LAYERS framework that summarizes the layered structure of the problems designers and developers of Interacting Places face when conducting "in the wild" deployments; a general model that describes coordination and engagement around public displays; and the commonalities in using situated snapshots for leaving a mark in the setting and the effects it produces.

7.1   The Interacting Places Framework

With the gained knowledge from the literature review [63, 62, 64], study on public notice areas [2], USI students' communicative ecology, and FunSquare deployment [58] I wanted to provide an integrated framework that would cover overall aspects of applications that stimulate community interaction and place awareness (in the following abbreviated 'CIPA') through networked public displays. This would allow designers and developers of future networked public display applications to have a holistic view on the possibilities involved around developing applications that would stimulate CIPA and would also allow them to position and focus their work and efforts. For the above mentioned reasons I, with the help of my advisor Marc Langheinrich and Florian Alt from University of Munich, created the Interacting Places Framework
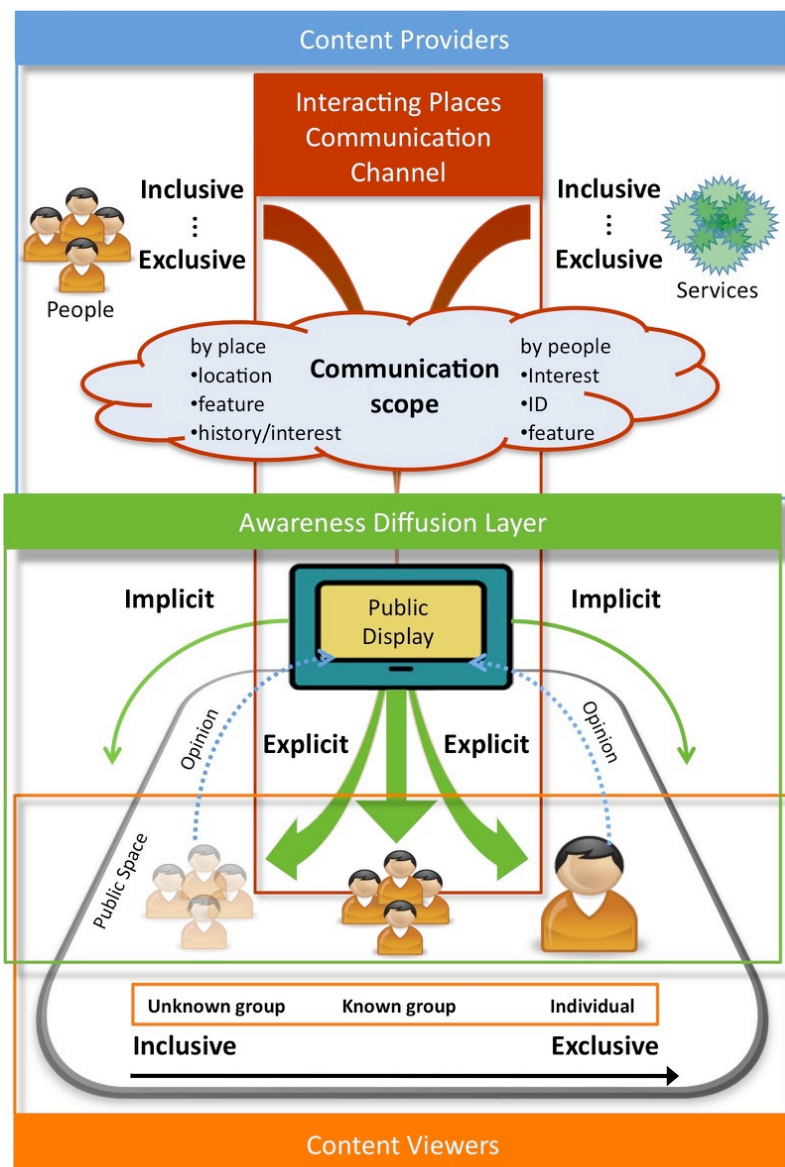
Figure 7.1. Interacting Places Framework (IPF). Content providers can be seen as both people (i.e., individuals) and services (e.g., Facebook). A communication channel carries content that is either open/understandable for everyone (inclusive) or only for a few people (exclusive). However, even if explicit communication takes place, the nature of a public display will implicitly diffuse awareness of even opaque content to local bystanders. The explicit recipients of content may be individuals, known groups, or even unknown groups.

[65] which provides a holistic view on the challenges and opportunities for CIPA applications. Orinigially, for the purpose of constructing the framework Digifieds application was analyzed [1]. In this section I will however use examples from the Moment Machine and Moment Machine 2.0 deployments as the are similar in nature as Digifieds – they are all applications that support user-generated content. Also, some parts of the work are updated based on the gained experience of deploying Moment Machine and Moment Machine 2.0.

7.1.1   Content Providers

Content providers for Interacting Places are the same as the ones that can be found on the web, where both user-generated content (e.g., Facebook, Craigslist) and service-generated content (e.g., weather.com, finance.yahoo.com) can be found.

The two types of providers were also confirmed in the study on student's communicative ecology, i.e., current practices surrounding today's ICTs: students either saw content as coming from people, e.g., Facebook postings, email and IM exchanges, or they saw it as coming from a service. However, even though many sites actually feature user-generated content (YouTube, Twitter, or SlideShare), students perceived these as being distinct from, e.g., Facebook postings or IM chats, and rated these as service-originated content. In this categorization, Moment Machine can be seen as an example for application that allows people to provide content for public displays, while FunSquare is an example of a service generated content.

7.1.2   Communication Channel

No matter where the content is coming from, may it be people or services, it is distributed through a networked public display channel. As previously defined in Chapter 3, Section 3.2.5, a networked public display channel to be a uni- or bidirectional medium/carrier for transmitting multimedia content to its intended audience. While existing ICT channels are typically structured around protocols (e.g., email, IM) or individual services (e.g., Facebook, Skype), channels are characterized by a particular set of features that support conveying content from a source, i.e., provider, to a destination, and optionally preferences of the respective communication partners for doing so.

An inclusive channel carries content that is open-for-everyone, i.e., anyone can understand the meaning of the content. Both FunSquare and Moment Machine and Moment Machine 2.0 portray information through the inclusive channel: photos and information about display surroundings are meant to be seen by anyone. Both applications are bi-directional channels as they allow people to express their opinion about the content, thus giving feedback about it. In case of the Moment Machine 2.0, people could comment on the content posted to Facebook and they could also indicate their preference towards photos through both personalized (Facebook) and

anonymous likes. Similarly, FunSquare also allowed people to like or dislike content, thus expressing their opinion towards different content categories (e.g., weather, history, science, etc.). Additionally people could also leave more detailed opinions through comments that are related to a specific information.

An exclusive channel allows a directed message to be transmitted to selected recipients. As public displays are by definition public, exclusivity must be ascertained through other means. For example, for the Moment Machine an exclusive stamp could be designed so that it bears a menaing just to a certain group or even an individual. Also, people could use avatars and pseudonyms to leave messages for the intended recipients ('@R2D2: meet you for lunch at the canteen. Yours truly, C3PO.'), or they could use other mechanisms to provide the exclusive channel. Although exclusive channels were not investigated in this thesis some private/exclsive interfaces have already been proposed in the literature [38, 41, 81].

In both cases (inclusive and exclusive), transmitted content would go to a certain place or to a certain group of people, i.e., communication could be scoped through people and/or places. A desired recipient for the content can be a particular person that can be reached by his/her ID, or a group of people who share the same interests or features at a particualr location. For example, we can imagine sending a photo to our beloved ones (ID), or posting a photo from a footbal match or a rock concert and distribute it to places where there are people with the same interests, or we could post a photo from London with a message "Happy New Year Lugano" to a display in Lugano (feature). Interacting Places could even exchange content automatically through services based on the above-mentioned parameters, i.e., ID, interests, and features.

7.1.3 Awareness Diffusion Layer

To recap, an Interacting Places display application can transmit content over a range of channels that go from inclusive, i.e., open-for-everyone, to exclusive, i.e., one that supports communication with selected recipients. However, it is important to note that not all potential viewers of such a display may be able to explicitly make sense of this content, in particular when local language, symbols, or codes are being used. I stipulate that in such circumstances, an implicit diffusion of community awareness is taking place.

For example, while foreigners might not be able to understand that "Barca" refers to a football club, or even a sports club altogether, they might still realize that its community is very active in a place due to the number of photos posted bearing the "Barca" logo. Similar implications may be drawn from the artwork and typography associated with the communication: a visitor to a bar may not understand who is posting what on a screen, but might perceive the design as either very professional or very homely, thus getting a sense for a very professional or very caring community, respectively.

An important concept from the work on communities of practice of [99] can be applied to Interacting Places' awareness diffusion layer – the concept of legitimate peripheral participation and situated learning. Originally these terms describe how in communities of practice non members and newcomers learn about the community and its practice from a far by observing how more experienced members do their work. In the context of Interacting Places legitimate peripheral participation and situated learning play important concepts as they allow implicit learning about the community by observing the display's content as well as how people coordinate and engage around it. Observing display's content is important for the process of leaving a mark in the setting, as non members, newcomers, as well as community members, can learn about the community and its values by looking at how a community expresses itself on a display (Moment Machine application) or by learning in general about the place where the community thrives (FunSquare). To a certain extent the same can be said about observing how a community engages and coordinates around the display – this has a rather truly situated impact as it aids in the process of social triangulation where passers-by engage in watching how people interact with the screen.

The implicit and explicit CIPA diffusion can also be seen (a) through content that originates from the environment, i.e., from a place, and (b) through content that originates from people. FunSquare is an example of an application that presents content originating from the environment, i.e., it portrays information about a display's surrounding. For this type of content, CIPA is usually being achieved implicitly by stimulating the effect of 'triangulation', an effect where particularities of the physical space act as links between people [8]. Content originating from people, on the other hand, explicitly achieves CIPA by promoting community values through content that expresses the attitudes, beliefs, and ideas of individual community members.

In addition, content on a public display provides information about the preferences and interests of people within and without the display surrounding. This will provide different opportunities for people to become aware about communities within and without public spaces as defined in the research agenda of Interacting Places (cf. see Section 1.1), i.e., it would provide awareness about the local community as a whole and diverse communities in the locality, distributed communities within a certain geographical region, as well as information about unknown communities that are diverse from the local one (where a particular display is installed).

7.1.4 Content Viewers

In the study on student's communicative ecology we could see that content was delivered to 1) an unknown group of people, e.g., through YouTube videos, tweets, and SlideShare presentations, to a 2) known group of people, e.g., friends, family and acquaintances, or to 3) individuals (directed message). I foresee that content on a public display will potentially be viewed also by the same three types of viewers. Some people might not necessarily understand the content and see it just because they

are situated next to a display; others might be recipients of a message and would understand the content; and in some cases it might be a single individual who is the sole recipient of a message.

We can also connect these groups with the inclusive and exclusive channels: the inclusive channel carries content that is open-for-everyone and its designated group of viewers is unknown. On the other hand exclusive channel would allow a closed group communication with a known group or an individual. However this classification is not very strict. For example, we might use the exclusive channel to contact a known group of people, e.g., friends or family members, but we might also use the inclusive channel to contact another known group of people, e.g., people with whom we share the same interests. For example, we might use the exclusive channel to send a photo with a stamp "Wolverine" having meaning only to a known group or individual, or we might use the inclusive channel to send a photo with a stamp "Forza Inter" to all the places that have a majority of Inter Milan supporters, i.e., to a known group of people who share the same values as we do.

7.1.5   Use of the Interacting Places Framewrok

Overall, the Interacting Places Framework helps designers and developers of networked public display applications to plan application development and think about:

1. content provider for their application i.e., is the content provided by people or a service;

2. type of channel that would deliver the content, i.e., from open and discussion oriented – inclusive – to closed grouped and message driven – exclusive;

3. type of community interaction and awareness they want to support, i.e., is it going to be interaction and awareness between members of the same community within and without public spaces, awareness about the diversity of communities in the locality, and infusion of diversity within the local community, as well as how the interaction will always have both an explicit effect (with the target viewers) and an implicit effect (with non-community members); and

4. who will be their target viewers, i.e., unknown and/or known group or individuals.

7.2   P-LAYERS Framework

The P-LAYERS framework [67] shows the complexity of creating engaging networked public display experiences for communities "in the wild". The framework is based on development and deployment of three public display applications: FunSquare, the

Wray Photo Display [90], and Digifieds [1]. The P-LAYERS framework was created with help from my advisor Marc Langheinrich and three external collaborators – Keith Cheverst from the University of Lancaster, Nick Taylor from the University of Dundee, and Florian Alt from the University of Munich. In this section I will describe the P-LAYERS framework and its use. Before that I will briefly describe the two other systems and their respective deployments that were used to design the framework.

The Wray Photo Display is a public display system that shows photos uploaded by the Wray's community members. The system also supports moderation and categorization of the uploaded photos. The Wray Photo Display is based on a technology probe based approach [90], which was used to co-designed the system with the local community. The system was initially designed for a single display using off the shelf components that can be found at a common computer store. The Wray Photo Display was deployed in 2006 in the Wray village and is still up and running. Initially the goal of the deployment was to examine how sharing and viewing photos on a public display impacts the sense of community in a rural setting. Evaluation of the system was based on both quantitative and qualitative analysis of the data. Qualitative analysis was based on the data that was collected from focus groups and design workshops, as well as a comments book that was placed next to a the Wray displays. Quantitative evaluation comprised from interaction log file analysis as well as analysis of the photos (up until now over 2200 photos have been uploaded, and 36 photo categories have been created). One thing to note here is that researchers working on the Wray Photo Display had full control of the hardware and designed system architecture, and overall had no external constraints when it comes to the design of the system. The system has been revised several times based on user feedback since its initial deployment.

Digifieds [1] system was based on the user requirements study presented in Chapter 3, Section 3.1, and supported similar functionality as traditional PNAs, i.e., uploading and showing of classifieds and ads on a display network. As previously mentioned, the study of traditional PNAs showed their value and importance for place-based communities (cf. Section 3.1.4). Like FunSquare, Digifieds was deployed as part of the UBI-Challenge competition. The system was evaluated through field trials that lasted two weeks.

Overall, the difficulty of stimulating, capturing, and examining the effects of networked public displays on community interaction "in the wild" is perhaps best captured with a quote from a FunSquare game user: "OK idea, bad execution." We were able to identify five main challenges researchers need to address in "in the wild" deployments. In many cases, the hardware hindered the smooth operation of the system. Also the complexity of the system architecture was sometimes underestimated.
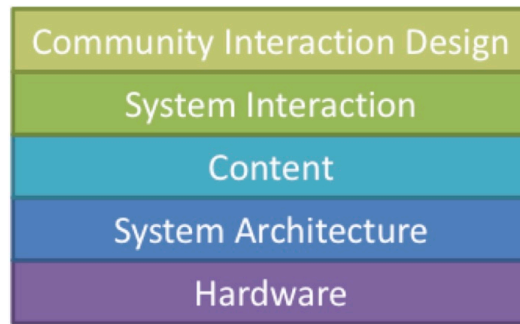
Figure 7.2. P-LAYERS framework for addressing the multi-faceted issues facing community-supporting public display deployments. Image courtesy of Marc Langheinrich.

Also, getting the appropriate, fresh, and appealing content for the community can be quite challenging. Similarly, offering intuitive ways of interacting with the system – in particular for passers-by – continues to be a problem. All of these factors affected what we were primarily interested in evaluating: actual effects of the networked (and single) public display systems on community interaction. These five factors are layered into a framework that describes challenges of building and evaluating public display systems that support community interaction: the P-LAYERS framework (from "Public display LAYERS", pronounced 'players'), as shown in Figure 7.2.

7.2.1 Hardware

Hardware is of fundamental importance for a networked public display deployment – if it fails to satisfy user's (as well as researchers') expectations it can affect all the layers above it. There were three main insights that came from the FunSquare, Digifieds, and Wray Photo Display deployments:

1. The importance of matching development and deployment hardware

2. The importance of communicating screen affordance, and,

3. The reliability of hardware components and availability of replacement parts

Having the same development and deployment hardware is critical since any differences between the two can lead to contrasting user experiences. For example, the Wray Photo Display had exactly the same hardware for development and deployment. In contrast, for FunSquare and Digifieds, the hardware used for development in the lab was different from that used during deployment. These differences between lab and "in the wild" setup resulted in very different user experiences in the two settings. In the case of FunSquare, once the application was developed and moved from the

lab setting to the UBI-Hotspots installation, one of the most frequent complaints from users was that the touch screens were "inaccurate, hard to use" or that the application was "nice, but reacted a bit slowly". These problems were hard to spot during our test trials in the lab, since the lab had a later version of the hardware and a more reliable Internet connection (which was required by the FunSquare application).

Once the system is rolled out "in the wild", proper performance depends on the reliability of the hardware components. For example, in all three deployments there were considerable issues with Internet connectivity that impacted user experience. Both FunSquare and Digifieds were using the publicly available panOulu free Wifi network. Occasionally, bandwidth decreased or connectivity broke during peak hours, i.e., when the citizens used the network most – these peak hours usually overlapped with those of the UBI-Hotspots. Since fresh content was fetched over the Internet, lower network throughput created "jittery" interaction with the system, which lead to a frustrating user experience. Similar problems were encountered in the early phases of deployment of the Wray Photo Display, where an experimental mesh network was used in the village and the early system architecture required good levels of connectivity.

The central hardware component in the system is the display itself. Therefore it is important to consider how to communicate its affordance to users. For example, the resistive touch input featured on the UBI-Hotspots in Oulu were very much in contrast to what can be found on today's smart phones and other personal devices that have high-quality capacitive touch screens. Most users expected to get the same user experience as they had with their mobile phones and were not satisfied if the screen did not provide the same experience. User expectations might have been better aligned with the displays' capabilities if the design was such that users were aware that the touch screens were not as sensitive as the ones they are used to [9].

However, even reliable hardware can break, and thus it is important to consider having replacement parts. When it comes to long-term deployments, e.g., as in the case of the Wray Photo Display that is still up and running, this is especially important as hardware failure can impact the relationship between the research team and the community [92]. For example, one of the hard drives in the Mac Minis stopped working: in turn this caused issues when the system was about to be turned over to the community. This example shows that hardware that is critical for display operation is under warranty or its replacement is quickly available.

7.2.2   System Architecture

Although system architecture for a networked public display system that aims at supporting community interaction might looks trivial – a touch screen, a display-attached computer, and a web server – this changes significantly if we go beyond traditional digital signage systems that show power points, images, and videos. In our deployments we encountered four problems that impacted system architecture:

1. System scalability

2. Agility to follow changes in third party services/browser

3. The challenge of finding the right level of complexity

4. The challenge of supporting appropriate interaction modalities

The two deployment settings – Wray and Oulu – best portray the problem with system scalability. While FunSquare and Digifieds were designed for a display network from the beginning the Wray Photo Display was not. As previously mentioned, the focus of the Wray Photo display deployment was on iterative user centered design process and the whole system was initially designed for a single display. However, when the opportunity for having another display occurred the whole system architecture had to be redesigned and accommodated for decision making of where the content will be shown. System scalability can go beyond just deciding where to show the content and can have other aspects, e.g., scaling to support a hundreds or thousands of users, which would require a cloud based or professionally managed service and not a single server.

However relying on third party services carries its own issues. In order to access available sensors from the UBI-Hotspots, FunSquare relied on custom made RESTful APIs, one per sensor. During the FunSquare development the APIs were further developed and updated. This meant that whenever there was a change in the parameters received from the respective service this had to be reflected in the code in order to ensure that content coming from the service would be received. Also, UBI-Hotspots were running on a specific browser version of the Mozilla Firefox browser (3.6). This also had to be reflected in the code. If the browser version on the hotspots was updated this change would also have to be reflected in the code as well. Upgrading to the latest browser version on the UBI-Hotspots would allow the use of the latest web technologies, e.g., HTML5 that was used for the Moment Machine 1.0 and 2.0 and Moments Gallery applications. However, considering that the system architecture of the UBI-Hotspots was built when the specific version was the latest one (and that all the applications running there are built for it) upgrading to the latest version would cause major problems for the system. These examples highlight the need for agility to follow changes in third party services and software, e.g. browser versions.

The above examples also illustrate some of the choices that can influence the complexity of the system architecture. A simple rule of thumb for finding the right level of complexity would be to start simple and add complexity later. This was most evident with our FunSquare ambient mode deployment. During development, we spent a considerable amount of time brainstorming on how to display the most appropriate "fun fact" for a given situation. The ranking system we came up with (for more details see [58]) ended up using a large number of factors (unit, numerical magnitude, timeliness of the context information, overall usage of a content category, number of

uses of a particular content fragment, and user feedback). This added to the complexity of the overall architecture, both in terms of the decision process (algorithm) as well as for data management (meta data). In our subsequent lab tests, the selection procedure seemed to work well. However, during observations and interviews, it turned out that most people had clear preferences towards certain categories and would have liked a simple category-selection mechanism (as mentioned in Section 4.3). While the complex selection process worked, a much simpler manual system might have worked just as well, with much lower complexity and more sustainable durability.

The above examples also illustrate some of the choices that can influence the complexity of the system architecture. An obvious rule of thumb for finding the right level of complexity would be to start simple and add complexity later. This was most evident with our FunSquare ambient mode deployment. While developing the FunSquare application we spent a considerable amount of time brainstorming on how to display the most appropriate "fun fact" for a given situation. The ranking system we came up with (for more details see [58]) ended up using a large number of factors (unit, numerical magnitude, timeliness of the context information, overall usage of a content category, number of uses of a particular content fragment, and user feedback). This added to the complexity of the overall architecture, both in terms of the decision process (algorithm) as well as for data management (meta data). In our subsequent lab tests, the selection procedure seemed to work well. However, during observations and interviews, it turned out that most people had clear preferences towards certain categories and would have liked a simple category-selection mechanism (as mentioned in section 4.3). While the complex selection process worked, a much simpler manual system might have worked just as well, with much lower complexity and more sustainable durability.

In order to ensure that a networked public display system is used and that its durability is long appropriate interaction modalities are needed, i.e., finding suitable ways of where and how to show the content. For example, Digifieds presented content differently depending on a device that was used to show the application: if the content was shown on a display it would include high-resolution images, while on the mobile phone lower resolution images would be displayed. Also, display user interface had various controls that were not available on the mobile phone, e.g., the like and abuse button. In this way transferring unnecessary user interface elements from the server to the client was avoided, thus ensuring fast display of the mobile user interface.

7.2.3   Content

As pointed out by Clinch et al. [12] creating high-quality content for public display networks takes resources and the amount of effort (e.g., money, people, or time) it takes to make it is often underestimated. In the three analyzed deployments four challenges arise when it comes to content:

1. Finding and accessing appropriate sources for content.

2. Determining a suitable content format.

3. Identifying the meta-data requirements for the content, given a particular setting.

4. Managing content, both by users and by system administrators (moderators).

Appropriately seeding content needs to be resolved before a public display systems rolls out into "the wild". The three services that we worked on portray two different choices of seeding content. FunSquare represents a public display application that uses content from a service by connecting two different content items (i.e., information that is sensed within the display and information that is stored in a database). On the other hand, both Digifieds and the Wray Photo Display relied on people/user-generated content. Both approaches have advantages and disadvantages and neither of the two choices is inherently better suited or easier to use. User-generated content requires an initial seed phase where the system is seeded with content, as users are less motivated to fill an empty system [90]. A service-based content system, on the other hand, needs to ensure that its content stays fresh and relevant, as it does not enjoy the benefit of community members themselves updating it.

Understanding and determining what is a suitable content format is equally important as making a decision what is the appropriate content source. As mentioned previously, in the case of Digifieds different resolution of images was used depending on where the content was accessed from – high resolution images were shown on a diisplay while low-resolution images were shown on the mobile phone client. Another thing to note when it comes to content is that both Wray Photo Display and Digifieds supported open and commonly used standards such as JPEG, which in turn ensures widespread use. Considering the support for the latest content types is also important since it can have a big impact on the system architecture. For example, if an application requiring HTML5 content, e.g., audio or video through the getUserMedia tag (as for the Moment Machine 1.0 and 2.0), was about to be deployed in Oulu the system architecture would need to change to the latest browser version that support this.

In order to ensure that content is adaptable for different displays, communities, and settings, (e.g., in Wray or Oulu) we can augment it with meta-data. Meta-data can allow for: 1) better content distribution, i.e., the correct content appearing on the correct display; 2) expressing a community's content preferences explicitly (e.g., FunSquare's 'thumbs up/down', Digifieds' 'abuse' button, or opinions posted as comments on the Wray Photo Display); 3) assessing community content preferences implicitly (e.g., in FunSquare meta-data about the number of times a fun fact was shown or downloaded); and 4) allowing personalized content labeling (e.g., tagging content in Digifieds). Identifying the right set of meta-data has obvious implications for neighboring layers (system architecture, system interaction).

All three applications supported content management. Although both Digifieds and Wray Photo Displays supported same type of content they had different ways of content management, i.e., pre and post moderation. While Digifieds allowed any user to report inappropriate content by pressing the 'abuse' button (post moderation), in the Wray Photo Display a more centralized solution was implied where the owner of a particular category would decide if the content would be posted or not (pre moderation).

in contrast to user-generated content moderation where the inappropriate content is an issue, the service-generated content used in FunSquare required a dynamic content management module that would ensure that content would not repeat itself too often. The module would also allow explicit moderation, as users could use "thumbs up" and "thumbs down" buttons to express their preferences for particular content items. However, much of the content management architecture that we initially devised turned out to be of only moderate use, as users ultimately preferred to manually select content categories.

7.2.4   System Interaction

In order to ensure that the system is actually used by the community appropriate interaction with it is needed. We uncovered three main challenges in our deployments:

1. Where to place the display? The location and exact placement significantly affects how users approach and interact with a display.

2. Which level of complexity is appropriate? Complex user interfaces support more powerful applications, yet can make interaction less obvious.

3. How should interaction be triggered? Users might not directly understand the interaction capabilities of a display, in particular when it involves subtle cues or advanced technologies such as NFC or Bluetooth.

In the case of the Wray Photo Display activities at the location where the display will be installed directly informed system interaction. After examining all possible locations the most desirable locations for the display were narrowed down to a village hall, post office, and a café. At these locations people would spend a significant amount of time queuing or waiting, either for a doctor's appointment in the village town hall or in the post office waiting to get to the counter. This informed system interaction and decision was made that initially it should be built around this behavior and should be lightweight. In other words, people could simply look at the content that changed every twenty seconds. If they found the content interesting they could engage with the display more actively and could browse the categories, select images, and see their descriptions.

Overall, all three deployments supported lightweight interaction with their content in the form of content browsing. In FunSquare's ambient mode users were able to

click on the "next fun fact" button, while Digifieds and the Wray Photo Display allowed users to switch between different categories as well as browse back and forth between them. Although this allowed users to select the exact content they wanted, as it was categorized, it also added more complexity as users had to perform several clicks in order to get to it.

Not all interaction capabilities might be immediately obvious to users. For example, FunSquare had a timer in the lower right corner that showed the time left for a particular fun fact to be displayed. However, not all users understood what the timer meant. Similarly, some people did not realize that display was interactive and some understood that buttons were clickable, but did not know what they did. Several FunSquare users stated that they would prefer if some instructions about the meaning of the buttons had been present. In case of more homogeneous communities, very specific or simple metaphors could be used to communicate the meaning of the buttons. Yet, for a general audience, textual descriptions or explicit help buttons might be required. For example, we tried to use a QR code in FunSquare's ambient mode, which featured a surrounding text "Take this fun fact with you". Apart from the QR code itself, no other explanation of how this fact could be retrieved was offered, as we assumed that users would be familiar with the codes. However, most users ended up trying to click on the code.

One thing to have in mind when placing interaction elements is that – depending on the display's size and position – there are display areas that users do not perceive. For example, in FunSquare's ambient mode (see Figure 4.2 at the beginning of Chapter 4), some people did not notice the timer in the lower right corner. In the game mode, where the timer was located in the central lower area, it was similarly overlooked:

"Big screen, you have to play too close. I didn't notice the time."

Similarly, for the early version of the Wray Photo Display users did not notice navigation controls that were located in the center of a display. These examples show that although there is a lot of user interface space only certain areas are in the user's focus.

7.2.5   Community Interaction Design

The top layer of the framework is what researchers are usually interested in evaluating, i.e., how the design of their networked public display system impacts community interaction. Even if all underlying layers are done well, there are still challenges remaining at the top layer. We encountered four challenges at this level

1. Communicating the value proposition of the application to the users.

2. Avoiding a negative impact on the community.

3. Considering interaction between different communities/stakeholders.

4. Designing for system sustainability.

The fact that a user can understand an application's interaction capabilities is not enough to ensure that they can also understand the community interaction design. An example observation from our FunSquare deployment illustrates this: a father and his daughter browsed through a number of facts and voted ("thumbs up") for almost all of them. In the subsequent interview, both stated that they understood how to interact with the application. Yet, they could not understand the meaning of the application. FunSquare's purpose was to serve as a conversation starter and its value was in stimulating social interaction. However this type of value is obscure and has to be wrapped in a more concrete and straightforward goal. For example, the accent could have been put more on the learning potential of the application. We tried to do this through the heading text "Did you know that...". However, having something more explicit, e.g., "Learn new facts about Oulu" might have made the value proposition clearer.

FunSquare's game mode was much easier to understand, yet its concept of "playing for a neighborhood" also had some unexpected consequences:

[How did you feel about your contribution to the neighborhood's score?]: "Not good because I didn't get any question right."

The above quote shows how the intended community interaction might actually have a negative effect if it is not achieved. While it is unclear whether such negative experience actually lowers people's involvement with a community, it might certainly deter frequent use of the application. One option might have been to provide some points for successfully completing the game, independent of the performance. Another user pointed out an additional unanticipated effect of the neighborhood game concept:

"Fun to see how own neighborhood is doing in comparison with the others. On the other hand, could aggravate the relation between the areas."

The above concern from one of the FunSquare users was also manifested in the Wray Photo Display deployment. The two locations where the displays were located were the post office and a café. In April 2010, the post office started selling coffee, and this new endeavor was advertised through the display network. In other words, the post office's advertisement also appeared in the café – this caused a stir in the community and ultimately the café's owner requested that the advertisement is taken down. This example shows that "in the wild" different interests that thrive in the community need to be taken into account and that, although a community might not be big in terms of its numbers or geographical area, it still might not be a coherent entity.

The above two examples can be connected to previous research that pointed out that intra-community competition might have negative effects on the sense of community and that inter-community competitions tend to have more positive effects [45]. Also, if we look at the Figure 6.13 competing to get into and actually getting into the "Hot4!" was reported as having no impact on the sense of community. The lesson

learned here is that when stimulating community interaction it is important to consider if a competition between the community members will evolve: if so members should be united to compete against another community that is not close by and neighboring, in order to stir more positive effects

Finally, it is important to consider ways that will allow system sustainability and each of three systems had different approaches. For FunSquare, system sustainability was reflected with the type of content that was displayed – autopoiesic content – which was generated "on the fly". This approach ensured fresh content in the long run. The Wray Photo Display and Digifieds systems had different approaches. System sustainability for the Wray Photo display was conceived through the participatory design process where the community and its opinion played a key role for every revision of the system. This way the community also felt a sense of ownership for the system. Allowing community members to create and own picture categories further stimulated the sense of ownership. Digifieds adopted a similar approach for achieving system sustainability. As described earlier, classifieds uploaded to Digifieds could be restricted to a certain area where displays were available. However, such geographic grouping and filtering was actually supported in a very generic fashion, potentially allowing for arbitrary grouping and filtering (e.g., all displays in the vicinity of churches). This conscious design decision was made in order to support more finegrained community information dissemination along a variety of factors. We believe that allowing for self-organization/appropriation by the community is key for an application's acceptance and system sustainability.

7.2.6 Interplay Between the Layers

Problems happening in one of the layers often affect neighboring layers. In other words, if an issue happens in one of the layers it often propagates upwards and/or downwards in the P-LAYERS framework. In this section I provide a couple of examples that illustrate how issues at individual levels can impact neighboring levels of the framework.

Starting from the System Interaction Layer In the FunSquare game mode, community interaction was designed around a game. The game was limited to ninety seconds and users would receive an additional five seconds for each correct answer. This time limit was introduced to raise the competitive spirit and excitement within the game. However, for some users this had a very negative consequence: "Had to hurry up when answering. The alternatives were hard to understand." This aspect of system interaction had a direct impact on the community interaction, as users felt rushed and did not feel comfortable playing:

"Playing for a neighborhood is a pretty interesting idea. There could be more time to answer the questions."

"[You] don't want to betray your own neighborhood, but [instead] get the best points you can. An OK idea, [but] bad execution."

These examples illustrate again the need for professional support. As none of the researchers involved in FunSquare had any experience in game design, the community interaction design did not live up to its full potential. Involving game designers prior to the deployment might have significantly altered the community interaction experience.

Starting from the Content Layer While the Wray Photo Display was a novel system for the respective community, both FunSquare and Digifieds were running on previously deployed hardware where users were familiar with existing display content. In one particular case, two occasional UBI-Hotspot users refrained from interacting with the FunSquare application because display content was different from the one they were used to, i.e., issue at the content layer propagated to the community interaction layer. A very simple solution could have prevented this from happening if we have had simply paid attention to users who have prior experience with the UBI-Hotspots . For example, adding a user interface element that states "Novel UBI-Hotspots service, try it out!" could have informed experienced users that new services are deployed.

Starting from the Hardware Layer A good example comes from the FunSquare and Digifieds deployments, as one of the display locations where observations were made was outdoors (in the city center). At that particular location, the sun created a lot of glare on the screen. This in turn made it hard for people to interact with any of the applications on the display. During the FunSquare observations, we noticed several instances where people pressed the '+' button repeatedly in order to see what would happen. However, because of the heavy glare they did not notice that the displayed facts changed (more on the environmental influences in urban settings on passers-by awareness of the display can be found here [69]). In other cases, people did not notice certain user interface elements, e.g., the timer. This shows how improper hardware can cause problems on content and system interaction layers. When these two are broken, it is much more difficult to stimulate community interaction through public displays.

Displays input capabilities are equally important as its output. For all three deployments input and situated interaction with a display was touch based. As today most of the smart-phones and tablets afford touch interactions this creates certain user-expectations when it comes to this type of interaction. In other words user expect the same high-quality interactions with a display as with their mobile devices. As public displays used in the FunSquare deployment were resistive the user experience they created was quite different from the one users would get with their mobile phone. We received comments that "the touch display is inaccurate, hard to use", that the game had "stiff controls", and that the overall experience with the game was "frustrating" or even "boring". In other words, the hardware had direct impact on interaction and community interaction layers.

A typical hardware issue that occurred in all three deployments was unreliable Internet connection. In turn this had a direct impact on system architecture as it required that the system(s) support offline content access. For FunSquare (in both
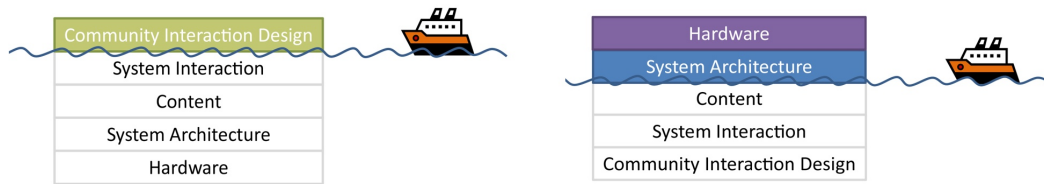
Figure 7.3. The two examples indicate how P-LAYERS framework can be used for self-assessment and understanding of the challenges in having a successful deployment. Image courtesy of Marc Langheinrich.

modes) this meant storing ample supply of fun facts locally on each display. Similar solution was implemented for the Wray Photo Display where a local server was used instead of university one. In case of unreliable or no Internet connection for Digifieds this meant that no content would be shown on a display. However, content retrieved on a mobile phone would be available offline.

7.2.7   Use Of the P-LAYERS Framework

The P-LAYERS framework can be used (1) to evaluate one's awareness of various issues in the deployment. In the process (or separately) it can also be used to (2) write down issues at each of the layers and understand if and how the issue propagates. Also, (3) different shapes can be used to indicate efforts that a researcher or research team wants to put for each layer.

Using the P-LAYERS Framework to Self-Reflect on Individual Awareness and Interests

The framework portrays layered challenges that emerge in the design, development, and deployment of networked public display systems that stimulate community interaction. It can be used for self-assessment of awareness of these issues, as well as of research output one is interested in. For example, as shown on the left part of Figure 7.3, a researcher interested in creating and evaluating an engaging community interaction design might underestimate the amount of work and effort s/he needs to put into other layers. The right side of Figure 7.3 shows that there is no strict order in which these layers appear and shows how a researcher (or research team) interested in developing a robust system architecture might look at things.

The P-LAYERS framework can also be used in an iterative design process to re-examine one's interests and awareness of issues happening at each layer (or layers of interest).

Tabulating Issues to Uncover Follow-Up Issues

The framework can also be transformed into a Table as shown in 7.1 and used to write down issues happening on a layer, in order to understand if and how a particular issue affects other layers. Also, the Table can be used to enter more general problems that impact all the layers (the leftmost column). In an iterative design process the Table can be filled in after each iteration.

An example of a general issue that had an impact on all the layers comes from the FunSquare and Digifieds deployments, where we encountered several passers-by that avoided the public displays due to their prior negative experiences with the system:

"I don't use the displays because in my experience they don't work."

Such issue can be entered in the appropriate column in a table (cf. the first row of Table 7.1) and then the research team can brainstorm (or conduct more in-depth investigation) about possible causes that lead to it. For example, content might not be suited or it can be even inappropriate for the target community; system interaction might be awkward and embarrassing for the users; or the community interaction design evokes prior negative experience.

In the below paragraphs I provide a couple of more examples of how a general issue makes an impact on all or some of the layers.

– Changing Consumer Technology. While consumer technology can be changed fast, e.g., buying the latest mobile device, the same cannot be said for networked public display systems deployed "in the wild". This means that after a while displays become outdated and cannot compete with the latest technology and user's expectations. This was evident in the FunSquare and Digifieds deployments where users complained about the slow or unresponsive touch screens, which could not compare with the slick touch interaction provided by their smart-phones. As a consequence, users were underwhelmed with the interaction experience as it did not live up to their expectations.

– Changing third party services. In order to ensure that enough (and interesting) facts are being generated FunSquare used a variety of information. Some of it came from third party services such as Yahoo!Weather, Twitter, and Facebook. This meant that we had to pay particular attention if any of these services became temporally (or permanently) unavailable. Our solution for this was similar to the solution for handling disruptive Internet connection, i.e., we stored every piece of intermediate information that was coming form a third party service. This way we ensured that we can overcome a short(er) service disruption – ideally we would have used multiple sources for the same type of information in order to assure information availability. Additional problem lies in changing APIs and other parts of the code (e.g., access tokens) that allow access to a third party service.

Third party services come not only in the form of APIs and are used on different layers as well. For example a free WiFi service that was used by a display might suddenly become unavailable as it moved to a payment model. Similarly, a café owner

Issue	Layer				
	Hardware	System Architecture	Content	System Interaction	CI Design
Lack of contextual acceptance			Inappropriate content	Embarrassing interaction style	Prior negative experiences
Changing consumer technology	Supporting new features/sensors, e.g., NFC, Kinect. Fast aging hardware	Symbian, J2ME vs. Android, iOS	Content quality in contrast with what's on the market (e.g., 2MPX pics vs. 20MPX). Impacts, e.g., new photos (larger photos = more space needed to store photos.	System interaction broken down because of the file size of the photos = more speed and bandwidth needed).	Wrong assumptions about availability of smart phones among target community, or lack of data plans for mobile connectivity
Changing 3rd party services	Free Wi-Fi suddenly becomes one that you have to pay for	Service replacement, or new service integrated	Disappearing content, e.g., weather service	Disappearing social media service that was used to gather user input to the service	Cafeé closes or rearranges furniture. Display not appropriate anymore
Limitations of physical space	Influences the type of hardware to be used	Competing services	Too small font given viewer distance. Short content glimpses due to movement speed of the passers-by	Fit with physical installation in the environment	Narrow hallway makes lingering in front of display socially awkward, as it blocks thoroughfare
Professional support	Maintenance	Buying licenses (e.g. middleware).	Content design	Hiring a professional interaction designer	Bringing in a community worker

Table 7.1. Use of the P-LAYERS framework for uncovering root causes and/or follow-up issues. Filling in an issue into the appropriate layer column helps brainstorming about how similar issues can affect other layers.

might decide to re-arrange its setting and that a display might not fit into the place's new décor.

– Limitation of physical space. As a physical element public displays need to fit into the environment and its architecture. This can potentially create issues, depending on the available space where a display can be installed – for example in a small space a display of a certain size can be used only, thus creating issue on a hardware level; or if the only available spot where a display can be put is a high corner it creates a limit on system interaction as it rules out touch-based interaction. Also, adequate interaction modalities have to be put in place if a display is to fit in: while in a more social settings like alumni events large gestures would be appreciated and acceptable [85], these would be very disruptive in a more serious place like a post office. In contrast, a touch-based interface suitable for quiet interaction in a small post office might not be the best interaction modality for a noisy student reunion wit a lot of "distractors" [69].

Once a public display application is deployed it starts competing with other elements in the environment. For example, deployed applications might compete with other applications and content that is running on the deployed hardware. This was the case for FunSquare and Digifieds deployments where both applications were hidden behind the commercial digital signage system and would only became visible after users approached a display. This lead to an exposure time of less than 10 percent of the overall display time. Going outside of a public displays as a setting, public display applications also compete with other types of interactive components of urban environments. For example, while we were conducting observations of the FunSquare application a couple of street performers came to the statue, located close to the display and started performing. People immediately started turning their heads and diverted their attention to the performers. More information about these "urban distractors" and how we can fit public displays into the environment is available from the Moment Machine deployment in Leytonstone and can be found here [69].

– Professional support can be crucial in many situations. The first version of the FunSquare's user interface was developed by the research team, however its quality was not satisfactory. In order to improve it we turned to a professional designer who then created its attractive look. Similarly, while the first version of the Moment Machine's user interface was developed by the researcher, later versions were created by a professional. Professional support is also helpful in other aspects of design, e.g., for FunSqaure's game mode we could have leveraged from the help of a professional game designer. Another type of professional support comes from the Wray Photo Display deployment where, in order to avoid showing an empty screen, photos that were used to populate it were made by a professional. In turn this helped to create a "buzz" around the system.

As "in the wild" deployments compete with professionally created consumer technology, professional support will become even more important for all the layers as user expectations are high. Although the way we design and develop networked public
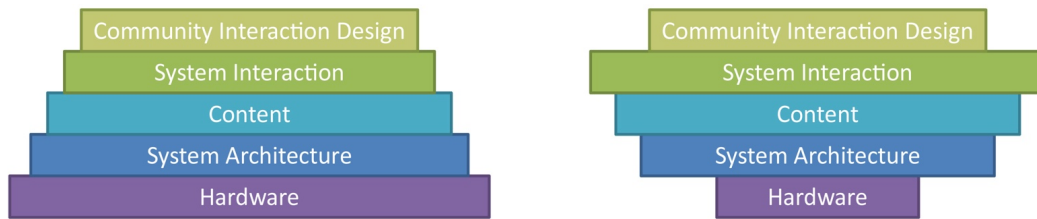
Figure 7.4. Two different shapes of the P-LAYERS framework in order to incorporate expected effort – resources, costs, or time. Image courtesy of Marc Langheinrich.

display systems might not change a lot, i.e., we start developing in the lab and then move the system into the wild, every change needs to be tested in the real-world before the system is rolled-out (or after every iteration). Simple examples would include checking the Internet connection "in the wild" (as in case of Wray Photo Display) or checking the hardware and user experience it creates (as in cases of FunSquare and Digifieds). This requirement for checking the changes "in the wild" goes for each iteration of the system and is usually not a one-off thing. In order to manage resources in the best way a remote monitoring system can be installed that would allow seeing the changes from the lab. Complementary, a designated "community worker" or "Human Access Point" [47] could also check how the changes affect the system and the experience it creates.

Using Shape as an Indicator of Effort

The framework can also "shaped" in different ways in order to indicate the amount of effort a researcher or research team wants to put into each layer. For example, the pyramid shown in the left part of Figure 7.4 shows an example where most of the effort is put into the hardware and least into the community interaction design, while the pyramid on the right shows an example where most of the resources goes into system interaction. Effort can be seen as putting resource associated with a certain cost and time. Resources can be various, e.g, hardware, people, or software. They carry a certain cost that can be, e.g., monetary (for the hardware or payment for professional support); or numerical, e.g., the number of people or different third party licenses; or it can include logistics, .e.g., the overall cost for moving from one hardware or software platform to another, or for moving an entire display network from one location to another. Resources also carry a certain amount of time necessary for their use, e.g., how much time is necessary to developed a certain layer (e.g., system interaction), or how much time is necessary to integrate different pieces of software developed for each layer. In an iterative design process different shapes would indicate effort for each layer; and also could be used to track the overall effort used across all the iterations.

7.3 Generalizing Coordination and Engagement Around Public Displays – The ELSI Model

The PACD model presented in Section 4.4 is not the only model that describes how users coordinate and engage around public displays. In this section I will present how a meta model called Elastic Space-Interaction (ELSI) model was derived by analyzing existing models and finding commonalities between them. The model was originally derived to point out similarities between existing models that portray user engagement around smaller public displays and bigger media façades. However, it also generalizes the behavior that leads to 'social triangulation' processes.

Every coordination and engagement model can be seen as describing one very specific aspect of passers-by behavior. These models describe:

1. Coarse [6] and fine grained interactions [70] with a public display, focusing primarily on activities a user or a group of users can have within a certain proximity to a display, i.e., within a certain zone;

2. Multi-user interactions [66] that connects user coordination and engagement between the zones;

3. User behavior and interactions around large-scale displays, i.e., media façades [21]; and

4. Classification of users' roles depending on their activities in front of a display [19].

Complementary to these models researchers have also looked into how displays should adapt their content depending on the user's proximity [96]. Similar proximity based models are described here [40] and here [97] and are based on the work of Vogel and Balakrishnan [96]. More broad discussion on the design space for proxemic interactions can be found here [14].

In the following sections I will summarize key properties of coordination and engagement models for public displays. I want to note that the analysis of existing models does not cover flat displays and did not consider how people behave around grouped displays (as in [93]) or displays of different shapes, e.g., cylindrical [4]. Additionally, the analysis focuses on situated or tethered interaction [57] and does not cover remote interaction, i.e., interaction that is not requiring collocation with a display (for example through Twitter [27].

7.3.1 Models on User Activities around Public Displays

Brignull and Rogers [6] provide a model that describes coordination and engagement around public displays with respect to the flow of public interaction around it (around
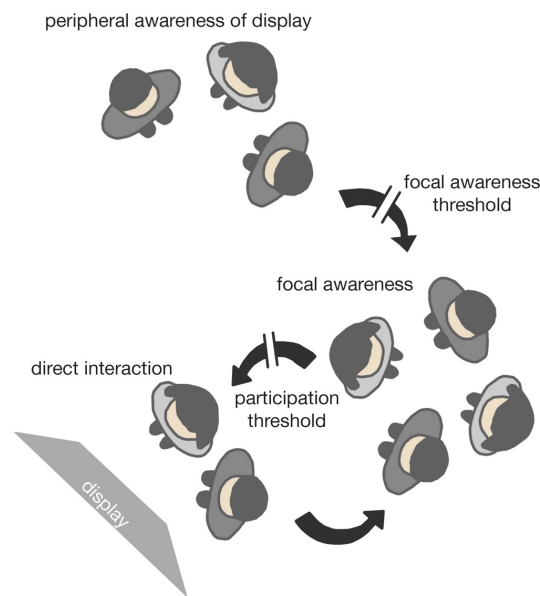
Figure 7.5. Brignull and Roger's engagement and coordination model. Image
courtesy of Sven Gehring.

the display). Their model was derived from observations of people interacting with
the "Opinionizer" application that allowed people to post personalized comments on a
topic shown on a public display. Users were able to write comments using a keyboard
located near the display.

Their model groups people's activities within three zones or phases as they describe
it: (1) The Peripheral Awareness Activity Phase, where people are somewhere else
in the space and are not aware of display content; (2) the Focal Awareness Activity
Phase, in which people are closer to the display and are engaged in other activities
like eating, drinking, or talking next to a display; and finally (3) the Direct Interaction
Activity Phase, in which a person is interacting with a display ly. User coordination and
engagement according to this model is shown in 7.5.

Similar model is offered by the "Audience Funnel" of [70]. Their model comes from
observations of people interacting with "Magical Mirrors an interactive multi-display
installation that showed live video feed of the passers-by and reacted to their gestures
by adding an optical effect to the live video feed (e.g., showing a white "aura" around
a user). The "Audience Funnel" model describes the interaction flow in front of one or
several consecutive displays in six phases and zones: 1) passing by, i.e., simply passing
by a display and not recognizing it (not recognizing the display), 2) viewing and
reacting, i.e., very short glancing at a display 3) subtle interaction, i.e., user movement
with an intention to trigger display reaction 4) direct interaction, i.e., interacting with
a display directly through gestures, 5) multiple interaction, i.e., moving and interacting
with more than one display, and 6) follow-up action, i.e., actions that followed after
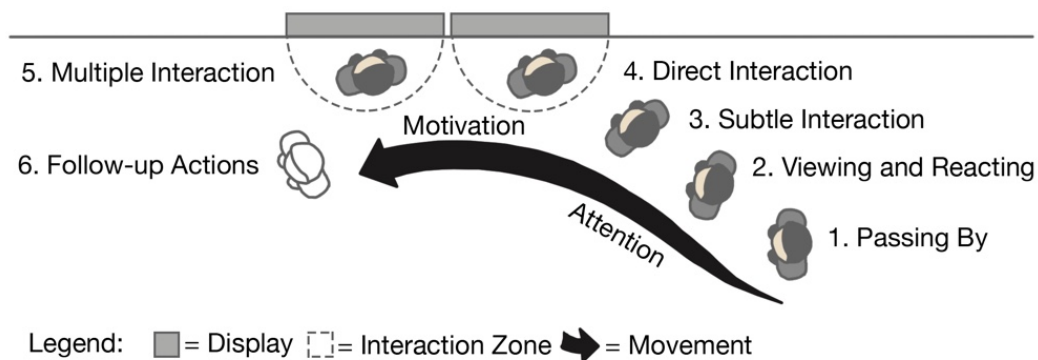
Figure 7.6. "Audience Funnel" engagement and coordination model. Image
courtesy of Sven Gehring.

the interaction was done, e.g., taking photos of a display. The "Audience Funnel" model
is show in Figure 7.6.

Both models focus on how users and group of users behave with respect to the
proximity to a display, i.e., within a certain zone. The two models have different levels
of details with respect to describing how people coordinate and behave, i.e., Brignull
and Roger's model is a bit coarser when compared to the "Audience Funnel" model.

7.3.2   Model on Multi-User Coordination and Engagement

The PACD model [66] describes multi-user coordination and engagement around the
display. The model was described in details in Section 4.4 and the model is presented
in figures 4.10 and 4.11.

7.3.3   Model on User Behavior and Interaction around Media Media Façades

While Brignull and Roger's, "Audience Funnel" and PACD model describe user behavior
and interactions around (small) public displays, the Urban HCI model [21] describes
user engagement and coordination around large public screens, i.e., media façades.
The model is mainly derived from observations on a media façade installation called
SMSlingshot that allowed users to shoot virtual paint balls and "paint" the media façade
using a slingshot like device.

Figure 7.7 summarizes and illustrates different types of spaces identified by the
Urban HCI space model where a city-plaza is used to illustrate passers-by coordination
and engagement. However, similar spaces are also applicable in walkway situations,
independent of permanent or temporary installations.

Activation spaces are spaces from where a display is visible, but a full
comprehension of what is happening/how users are interacting is not possible. These
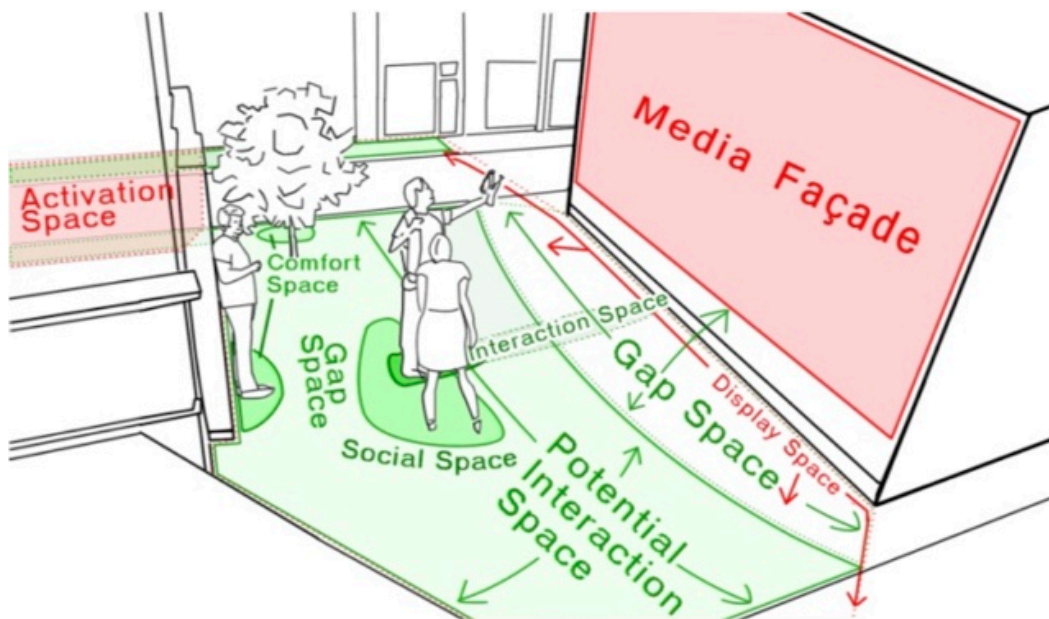
Figure 7.7. Urban HCI engagement and coordination model. Image courtesy of
Patrick Tobias Fischer. Source [21].

spaces are on the edge of Display spaces – areas from which a display and other
elements/props that comprise the display installation are visible.

Interaction Space is the space from where interaction with a display is possible
and is happening. This encompasses also the Potential interaction spaces (PIS), spaces
where the interaction between the system and the user can occur. The difference
between the two is made by the actual interaction, i.e., potential interaction space
becomes interaction space once the interaction happens.

Gap spaces are spaces that create distances/gaps between people or between the
people and the system. These spaces might come from the environment where the
media façade is located, e.g., a street creating the gap between the media façade and
interaction/ potential interaction space; or it can be introduced by cultural norms
between the people.

Social interaction spaces (SIS) are space where people group and socialize/have
social interaction.

Comfort spaces are spaces where people can relax and observe what others are
doing, e.g., around pillars, walls, benches, big public stairways.

As mentioned in the beginning of this section, Urban HCI model complements the
Brignull and Roger's mode, "Audience Funnel" and PACD model by describing user
interactions and behavior around interactive media façades.
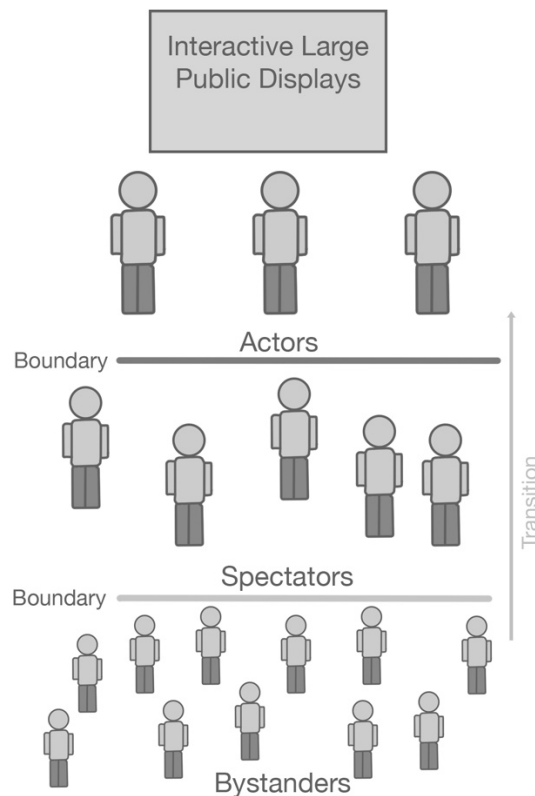
Figure 7.8. Classification of user roles. Image courtesy of Sven Gehring.

7.3.4   Classification of User Roles

Finke et al. [19] group user behavior and assign roles to passers-by depending on
their activities. Their model is not empirical, it rather describes ideal user behavior
leading to active engagement with a display. They differentiate between three types
of users: (1) actors – people who are engaged with a display, (2) spectators – people
who observe what actors are doing, and (3) bystanders – people who are aware of
the display installation. Their terminology avoids the term user and introduces a
role-based view at the people that are more or less engaged with the public display
application. Reeves et al. [84] and Sheridna et al. [87] use a similar role-based
view to distinguish the people present in front of the display. They prefer to call
them performer, observer and participant. While the first two are similar to Finke's
definition, the participant here is not only a bystander, but a person that has already
used the application or provides information about it to the performer. The term
performer also emphasizes the fact that in public space interaction (especially large
gestures) has show aspects, naturally drawing gazes from others.

7.3.5   Model Describing Content Adaptation According to User Proximity

While all the above-mentioned models describe how passers-by coordinate and engage around public displays and media façades Vogel and Balakrishnan [96] describe information appropriation zones. Within these zones, a display should react to people's presence and change and appropriate its content. Their model consists of four such zones: (1) The Ambient Display Zone, in which a display should show a range of categorized content that would signal available information on it, (2) the Implicit Interaction Zone, where a display should notice user's presence and should signal that it knows a user is in the vicinity, (3) the Subtle Interaction Zone, where user-relevant information should be displayed, and finally (4) the Personal Interaction Zone, where users can interact and manipulate with the information.

7.3.6   Elastic Space-Interaction Model

With the Elastic Space-Interaction model – the ELSI model [60] – we describe a spatial model that connects similarities between existing models that describe user engagement behavior around public displays and media façades. The ELSI model was created together with Sven Gehring and Patrick Tobias Fischer. We jointly discussed commonalities of all the models in order to create a theoretical meta model that unifies all the similarities between different models. This process is illustrated in Figure 7.9 and Table 7.2.

Role	Zone	Interactions
Passer-by	Display awareness space • display awareness space [Urban HCI model] • passing by [Audience Funnel]	None
Bystander	Display awareness space • passive engagement zone [PACD] • activation space [Urban HCI model] • viewing and reacting zone [Audience Funnel] • peripheral awareness activity zone [Brignull and Rogers] • ambient display zone [Vogel and Balakrishnan]	• glimpse interaction [PACD] • viewing and reacting [Audience Funnel] • peripheral awareness of the display [Vogel and Balakrishnan]

Role	Zone	Interactions
Spectator	Passive engagement space • passive engagement zone [PACD] • activation space [Urban HCI model] • subtle interaction zone [Audience Funnel] • focal awareness activity zone [Brignull and Rogers] • subtle interaction zone [Vogel and Balakrishnan]	• immersive interaction, social triangulation [PACD] • social interaction [Urban HCI model] • subtle interaction [Audience Funnel] • social activities provoked by the display [Brignull and Rogers]
Actor	Active engagement space • active engagement zone [PACD] • potential interaction space and interaction space [Urban HCI model] • direct interaction zone [Audience Funnel] • direct interaction zone [Brignull and Rogers] • personal interaction zone [Vogel and Balakrishnan]	• active reading, read'n'interact, direct interaction, social interaction [PACD] • interaction with the installation, social interaction [Urban HCI model] • interacting with a display [Audience Funnel, Brignull and Rogers]
Retired Actor	Potential active engagement space • passive engagement zone [PACD] • subtle interaction zone [Audience Funnel]	• social interaction [PACD] • interacting with a display [Audience Funnel]

Table 7.2. Deriving the ELSI model by identifying commonalities between existing models.

By leveraging the models that categorize user behavior [19, 84, 87] we can infer the following five user roles:

1. Passer-by is a person located in the display's vicinity and that sees the display or its parts, but does not interact with a display (at least at first).

2. Bystander is a person that has glimpse interactions with a display or is peripherally aware of it.

3. Spectators are people that are actively engaged in the setting, either through immerse or subtle interactions, or by interacting with other people in it. While engaged in these activities they spectators could be preparing to interact with a dispplay.

4. Actors are people that actively interact with a display. After they finish interacting with a display they become

5. Retired Actors. Retired Actors are people who have just finished interacting with a display and are potentially interacting with others in the setting or are just observing it.

By mapping interaction zones and user roles as described in Figure 7.9 and Table 7.2 we derive the ELSI model shown in Figure 7.10 – an elastic space interaction model that connects observed user behavior around public displays and media façades. By finding similarities between these models, the ELSI model describes a geneal spatial setting for interaction with digital public displays.
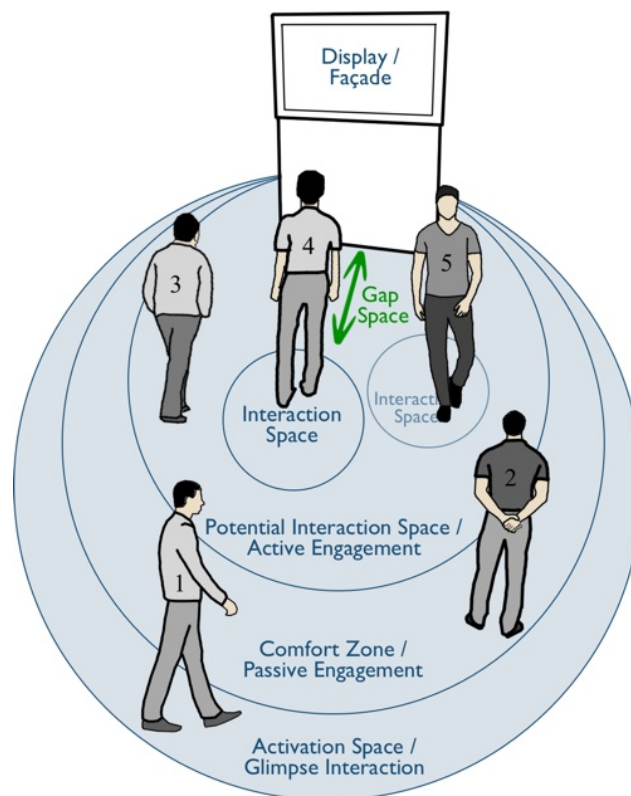
Figure 7.9. Mapping of the zones and roles of existing models. The roles of the people depicted are (1) Passer-by, (2) Bystander, (3) Spectator, (4) Actor and (5) Retired Actor. Image courtesy of Sven Gehring.
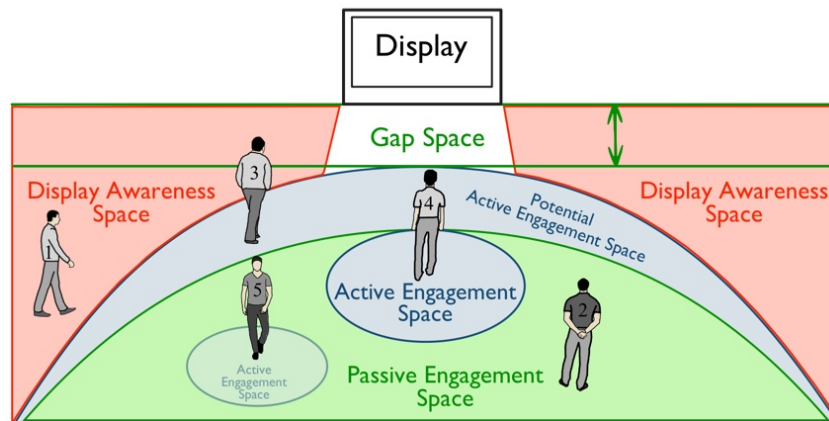
Figure 7.10. The ELSI model – Elastic space-interaction model for user
engagement around public displays of different sizes: (1) A passer-by in the
Display Awareness Space, (2) a Bystander in the Passive Engagement Space, (3) a
Spectator in the Potential Active Engagement Space, (4) an Actor in the Active
Engagement Space and (5) a Retired Actor leaving the Active Engagement Space.
Image courtesy of Sven Gehring.

We can describe the ELSI model with the following dynamic zones:

Gap Space is the minimal space required to see the whole display content and
to interact with it. There are three factors that influence the size of the Gap Space.
i.e., display size, interaction technique, and physical barriers in the environment (e.g.,
streets).

Active Engagement Space is the space from which interaction with a display
is possible – the size and distance of the space depend on the display's interaction
technique. For example, in case of a touch display (as in FunSquare) the Active
Engagement Space is quite small as users need to be in front of a display. On the
other hand, interaction techniques that use the whole body and/or gestures create a
larger space as users need to move around in order to interact.

Potential Active Engagement Space includes the Active Engagement Space and
marks the space from which interaction can happen. The size of the space depends on
the size of a display and its interaction technique.

Passive Engagement Space is the space from which people have glimpse
interactions and also observe others interacting. The size of the space depends on
the setting and its arrangement, as well as the display size.

Display Awareness Space is the space from which a display is visible, but
interaction with it is not possible (unlike in the Gap Space). The size of the space
depends on the display size, the setting where the display is located, and display's
interaction technique.

At the moment, the ELSI model is purely a theoretical model and represents an
effort towards bridging and unifying different models that describe user engagement
and coordination around public displays and media façades. Hence, as mentioned in
the beginning of this subsection, the ELSI model comes with certain limitations. In the
following, I describe instantiations of the ELSI model for a small-scale, situated public
display, as well as for a large-scale media façade.

Instantiation Of the ELSI Model For Small Public Displays

In Figure 7.11 we can see how the ELSI model looks when instantiated for a small
public display that uses touch interaction.   In this particular case, Gap Space is
eliminated as users need to be in an arms-length distance in order to interact with
it. Potential Active Engagement Space depends on the actual size of the display and
marks all the space from where user interactions can happen.   Once a user starts
interacting with a display he turns part of the Potential Active Engagement Space
into Active Engagement Space. As users shield their interactions with their body they
create Passive Engagement Space close behind them, right after the Potential Active
Engagement Space, from where people can have glimpse interactions. Further away
from the Potential Active Engagement Space we can have Display Awareness Space,
from where display or its parts are visible, but interaction is not possible.

Instantiation Of the ELSI Model For Media façades

In Figure 7.12 we can see an instantiation of the ELSI model for a media façade that
uses mediated interaction via a device (as in SMSlingshot). As there is a certain range
from which interaction is possible – introduced by the display size and interaction
technique – Gap Space is created. After the Gap Space comes the Potential Active
Engagement Space, from which interaction is possible – as in the case of public displays
when a user starts interacting he turns part of the Potential Active Engagement Space
into Active Engagement Space. As users (potentially) move while interacting with
a media façade they also move their Active Engagement Space with them. Because
of this Passive Engagement Space is also moving and can potentially be also within
the Potential Active Engagement Space. Thus, the size and position of the Passive
Engagement Space depend on the setting and the position of a user interacting.
Although there is "free" space in front of a user that could potentially be turned into
Passive Engagement Space, this usually does not happen as this space is necessary for
a user to interact with a media façade. Also, within this space users cannot see the
whole scene and cannot have glimpse interactions without actively taking part in the
setting.
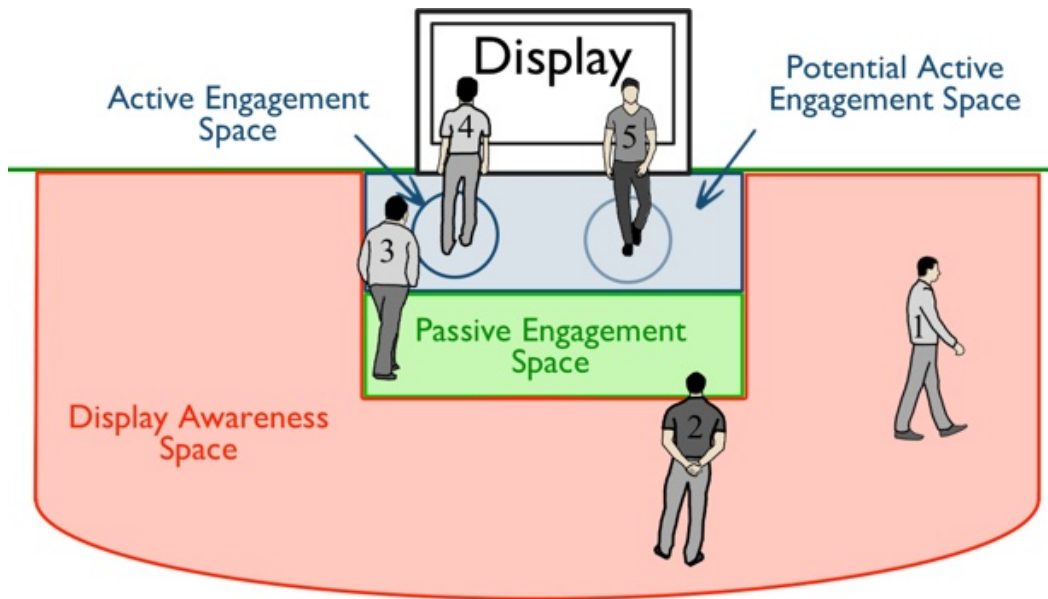
Figure 7.11. Instantiation of the ELSI model for small, situated public displays
requiring direct touch interaction. Due to the small size of a display and input by
direct touch, there is no Gap Space between Actor (4) and the display. Also, the
Active Engagement Space and Potential Active Engagement Space are small and
in the immediate proximity of the display. The Active Engagement Space is
created around the particular Actor. The Passive Engagement Space is adjacent to
the Potential Active Engagement Space. The Display Awareness Space takes up
the remaining space in which the display is visible. The roles are: (1) Passer-by,
(2) Bystander, (3) Spectator, (4) Actor and (5) Retired Actor. Image courtesy of
Sven Gehring.
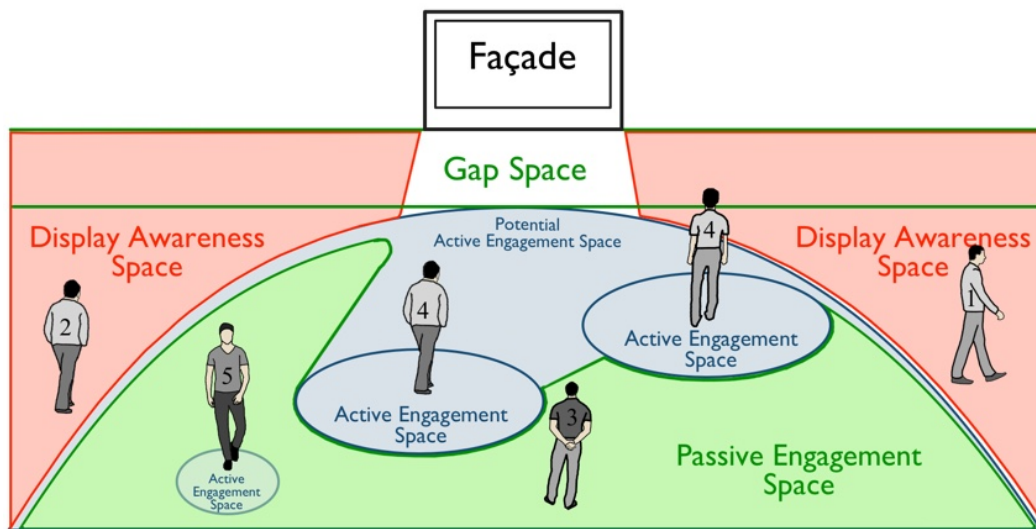
Figure 7.12. Instantiation of the ELSI model for media façades. Due to the size of
the façade and the required minimal viewing distance, there is a Gap Space
between Actor (4) and façade. Actors can distribute across the Potential Active
Engagement Space, creating Active Engagement Spaces around them. The Passive
Engagement Space is located within the Potential Active Engagement Space,
leaving out the parts in the direct line between Actor and façade. The Display
Awareness Space takes up the remaining space from which the façade is visible.
The roles are: (1) Passer-by, (2) Bystander, (3) Spectator, (4) Actor and (5)
Retired Actor. Image courtesy of Sven Gehring.

7.3.7   Discussion of the ELSI Model

The ELSI model unifies existing models in order to show similarities in the observed behavior across display installations. Some of the differences that impact how users coordinate and behave comes from the (1) size of the screen and (2) proximity of the interaction technique (to the screen). Both have an impact on the size of the spaces in which people coordinate and engage with the display. Different screen sizes of public displays and media façades and proximity of interaction technique can be used to classify interaction with public displays as illustrated in Table 7.3.

Size/Proximity	Close	Far
Media façade		"Point and Shoot" with a custom input device [21]
Public display	Touch based [58]	

Table 7.3. Classification cluster based on (1) screen size and (2) interaction technique.

For example, FunSquare and Urban HCI's SMSlingshot are in the opposite corners of the cluster. FunSquare was deployed on small public displays and used touch interaction that requires close proximity to the screen. On the other hand SMSlingshot was deployed on a large media façade and employed a "point and shoot" interaction technique that required interaction from a far. It remains to be seen how the ELSI model would transform for the other types of interaction and screen sizes, i.e., media façades that require close proximity to the installation and public displays that require interaction from a far.

Further, the ELSI model can be used to describe the impact of different interaction techniques on a more fine-grained level within the same setting. This can be done using the vocabulary and spatial configurations of the ELSI model and the knowledge that (1) people create certain types of spaces, i.e., active engagement space, potential active engagement space, and passive engagement space, as well as knowing (2) the types of spaces created by the display and used interaction technique, i.e., gap and display awareness spaces.

Also, the elastic nature of the model allows resize of the ELSI model's spaces and reconfiguration of peoples' behavior in created spaces. For example, the behavior of people could be modeled for touch interaction with public displays and afterwards, the interaction technique could be changed, e.g., to gesture embodied, or mobile phone. By doing so within the same setting, we could determine the impact of the newly introduced interaction technique. Similarly, ELSI model could be used to describe how

different screen sizes influence people's coordination and engagement or even how people transition between screens of different sizes.

Complementary to describing differences introduced by the interaction technique and display size, the ELSI model can also be used for comparison of peoples' behavior around public displays in different settings. For example, the two instantiations represented in sections, i.e., instantiation of the model for small public displays and instantiation of the model for media façades, can represent indoor and outdoor settings respectively.

7.4 Commonalities in Using Situated Snapshots for Community Interaction

Both Moment Machine and Moment Machine 2.0 used situated snapshots as a way to allow people to leave their mark in the setting. In this section I will summarize some of the general uses and effects of situated snapshots captured through networked public displays based on the analysis of the use at the Mill and at USI.

7.4.1 User Engagement and Frequency of Interactions

As shown in section 5.6.2 engagement around applications that support situated snapshots captured through networked public displays is short in nature – average engagement for exact photo sessions ranged from 44 seconds (Leytonstone, STD 60 seconds) to 63 seconds (the Mill, STD 91 seconds); while median ranged from 80 seconds (NAE) to 140 seconds (Broadway). This type of application has stable use as shown by engagement in Figure 5.5 and Figure 5.6 on daily and weekly basis for one of the locations (the Mill) respectively. To a certain extent, stable engagement is also shown with the percentage of returning users across all four locations for the deployment in the UK, ranging from 18.27% for the Mill to 6.17% for NAE – these percentages directly influence the overall contribution of returning users to the use of the medium.

Another thing to note is the behavior of returning users, i.e., regulars, burst returners, and occasional users, that seem to be able to show the overall dynamics of a place. For example, the three groups had somewhat similar distribution for three of the locations – the Mill, Leytonstone, and NAE – while for the fourth location – Broadway – distribution was more in favor of occasional users, potentially showing higher turnover of different people that pass-by that location. The three user groups also show the sporadic engagement with displays (cf. see figures 5.15, 5.16, 5.17, and 5.18) – engagement ranged from a monthly level for occasional users who returned to interact with a display after 12.25 to 32.57 days (NAE and Broadway). Similar behavior is shown by burst returners who interacted withe a display in a single "burst", returning to interact after 2.01 (Leytonstone) to 3.36 (the Mill) days coming back 1 or

2.04 times (Broadway and the Mill). The most "stable" group of returning users – the regulars – return to interact on a regular basis where they come back to interact on a weekly level, but also have a break in between.

Similar frequency of interaction is reported by USI community. As shown in Figure 6.7 for the deployment at USI most of the users engaged on a monthly level (76.47% and 42.86% for the display in front of the Mensa and in Red building) while a smaller percentage engaged on a weekly level (11.76% for the display in front of the Mensa and and 7.56% for the display in the Red building).

Another difference between the sites in the UK is the standard deviation of the "standard" return time for returning users: for the Mill and Leytonstone the standard deviation of up to 25 minutes covers for 55.91% and 50.00% users respectively, while for Broadway and NAE standard deviation was not that "stable" – it varied much more. In general, different communities express themselves differently through this medium as shown in Figure 5.12 and Table 5.4 where we can see the difference in categories. So far, the three parameters – distribution of the three groups of returning users, standard return time, and most importantly how the community express itself through the photos – look like solid parameters for describing a community in a unique way through the use of situated snapshots captured through networked public displays.

7.4.2 Motivation at Install Locations

One of the reasons for taking the photos was that the application was integrated in the passers-by schedule/routine. Both, at the Mill and at USI participants mentioned this: for example, the group of school boys (R1 in Table 5.3) at the Mill would take the photos on their way back from school, while 04 from USI (Table 6.1) reported on taking the photos every day when they go to get their coffee.

Another reason that was noticed for both deployments was that taking photos was seen as part of a group activity. While at the Mill these groups were somewhat standard, i.e., they comprised from the same people (R1, R2, R3, B1, O1, O2, U1), at USI groups were diverse and capturing oneself within a group was also a motivation, e.g., as stated by 08. In general, the main motivation for taking situated snapshots is to capture everyday, but also special moments within the locality – whether it is taking coffee (04), or being with different people (08), or taking a photo to capture oneself in a costume (B2), or celebrating an end of a class project (18). In this way people keep their memories attached (14) and leaving a mark in the setting. People tooks photos "out of community spirit" (U1, 19) and taking photos was connected to being part of a community. However, to a certain extent "vanity" seems to play a role when it comes to taking situated snapshots, as stated by B1 from the Mill "I'm looking at you, well take a look at me and I want to look my best and that's the vanity thing." This can be connected to seeing others from the same age group interacting, as this was also another incentive to interact.

7.4.3   Stimulating Social Interaction

For both deployments the Moment Machine application stimulated social interaction between people that knew each other, but also between strangers. For people who knew each other interactions were mainly short and situated, and in the case of Moment Machine 2.0 they also went onto Facebook. When it comes to interactions between strangers they revolved mainly about explaining what the application does or how to use it, or in the case of USI "photo bombing" someone's photo. At the moment there is still a lot of excitement coming from the Moment Machine's novelty, as participants mentioned talking to their family and friends about it. It may be that this depends on the number of one's friends/peers that are using the application: as stated by R5 she did not talk about the application to people that were not part of the Mill's community "because none of my friends live in the area." This can be somewhat connected with seeing people from the same age group interacting with the application, as most of the users at USI are close to each others age, while age groups of users at the Mill varied.

7.4.4   Community Interaction and Awareness

Through the situated snapshots captured via networked pubic displays place-based communities get a chance to express themselves – we can see how the four communities in the UK have done so in Table 5.4 and in Figure 5.12. This ability to express oneself in a public space is most evident in the case of USI where students reported on Moment Machine being the only outlet (e.g., 17) where they get a chance to create their own space, ultimately creating a fun space within a serious place. As reported in the USI's survey (cf. Figure 6.11), posted photos reflect the community, posting photos is seen as an act of expressing membership to the community, and looking at the photos of others stimulates sense of community – the last statement was also reported by the interviewees at the Mill. Within the USI community the Moment Machine application stimulated sense of awareness between the students and its use evolved into fun people directory that served as a reference point where the community would check out its members. Similar use was reported at the Mill where sense of awareness emerged on different levels, from recognizing the "stars" of the community (R1) – the group of school boys that took the photos jumping in the air – or having general awareness of the different groups that use the application.

7.4.5   Situated Snapshots as a Communication Medium

One of the aspects of situated snapshots as a communication medium is that it allows people to take unconventional/unusual photos that they normally would not take. For example, as stated by USI participant 10 "Nice unconventional pics that you would never do with your phone." or 04 "if there was not the [Moment] machine I would

never take the photos in the morning". However, at this moment the possibility to take situated snapshots depends highly if a person knows that s/he can take it, as stated by participant O2 from the Mill: "This is a media without me having any sort of like interface, this is a media as in... percentages luck, that I'm passing the screen, percentage is luck that I know that's it taking photographs".

Taking photos through the Moment Machine application is seen as a more social/group way of taking selfies, almost like anti-selfie, e.g., as stated by 02: "This is much more fun because you don't take a photo by yourself, you take a photo with your friends, you have fun and you laugh about the photo, then you share the photo, then you post comments about the photos, or it... it encourages social interaction between people that took the photo and it's fun for them. With my phone I just take a photo and post it on Instagram and over there it's finished." The social nature of taking the photos seems to be depending on the community and its members: if we look at Figure 5.12 we can see that the more we move into areas that are residential the more equal ratio of group and single portrait photos becomes; or if we look at Broadway, the most urban and outgoing location, the more group photos we get.

Chapter 8

Conclusions And Future Work

This thesis showed how a novel communication medium – networked public displays – can be used in public spaces to stimulate community interaction in public spaces, thus creating what I call Interacting Places. The basic premise of this thesis relies on a small part of McLuhan's media theory that shows the connection between the Figure – the medium, networked public displays – and the ground – the context in which it operates, public space – and how the Figure amplifies otherwise invisible processes in the ground. By examining (some of the) effects of the ground, i.e., public spaces, this thesis identified four opportunities for networked public displays to be used as a communication medium, i.e., connecting local communities and its members, promoting the diversity of different communities that thrive in the space, stimulating greater connections within geographically distributed communities, and enriching local life by connecting it with diverse (enough) communities. These four opportunities can be grouped into the community space cluster shown in Table 1.1 that represents a research agenda for Interacting Places. In this thesis I have focused on the first item in the agenda, i.e., connecting local communities.

By using the rear-view mirror tool and further examining the ground and processes and interactions that occur in it I have identified three processes[1] that stimulate community interaction that leads to the sense of community, namely, social triangulation, leaving a mark in the setting, and joining in a competition. These processes have been embedded into the three Interacting Places applications described throughout in this thesis, i.e., the FunSquare application (described in Chapter 4), Moment Machine application (described in Chapter 5), and Moment Machine 2.0 and Moments Gallery applications (described in Chapter 6). As according to McLuhan every medium is an extension of a previous one these applications also build upon previous media, i.e., traditional notice boards and currently used ICTs (described in Chapter 3).

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[1]These are not the only processes as there are many more happening in public spaces. The three are the ones that I found to be good cases to examine.

The core of the thesis are five studies, i.e., two broad user requirements studies – the PNA study and USI students' communicative ecology study described in Chapter 3 – and three "in the wild" deployments described in Chapter 4, Chapter 5, and Chapter 6. Studies' timeline and connection between the broad user requirements studies and "in the wild" deployments is shown in Figure 8.1.

The PNA study provided input for all three deployments. In general, this study helped focus the thesis on two of the three stakeholders – content providers and content viewers. This was done in order to focus research efforts, but also in order to split the workload and interests between the PD-NET team members in Lugano – while my work focused on the community in the form of content providers and viewers, Ivan Elhart's work focused on display providers and managers. The study alos informed FunSquare and Moment Machine 2.0 on supporting takeaway information where the former relied on QR codes and the latter on posting the images to Facebook. Also, both versions of the Moment Machine application supported on the spot content creation, something that was also observed in the PNA study.

Study on USI students' communicative ecology provided mainly initial input for the broader set of applications that were developed for the USI community by Ivan Elhart. The study also provided important insight that students see USI as purely academic institution and that more social aspects in communication would be preferred. Also, this study revealed that students spend most of their leisure time on Facebook where they socialize; that one of their main activities is posting photos, liking, and commenting on them; and that they would like to see photos that are associated with USI and its events. This prompted the decision to create a second version of the Moment Machine application that would support new features such as posting photos to Facebook and seeing comments and likes form Facebook in the Moments Gallery application.

There were several constraints when it comes to "in the wild" deployments. For example, for the FunSquare evaluation in ambient mode we got only two days for deploying and evaluating the application on UBI-Hotspots, where it would be the only application running on the screens. This was mainly due requirements of UBI-Hotspots to run paid content that creates revenue necessary for their maintenance. Similarly, in the case of Moment Machine deployment decision when the application would be running on the Screens In The Wild network were made mainly by the research team in London. Lastly, deployment of applications on networked displays at USI was postponed several times due changes in USI's personnel that was in charge of making the necessary decisions to start the project.

Despite these constraints these deployments form the majority of findings that influenced the outcomes of this thesis, which are lessons learned in the form of conceptual models, frameworks, and generalizations that were extracted across the carried out studies. The Interacting Places Framework maps the overall design space for networked public displays that stimulate community interaction. In the initial
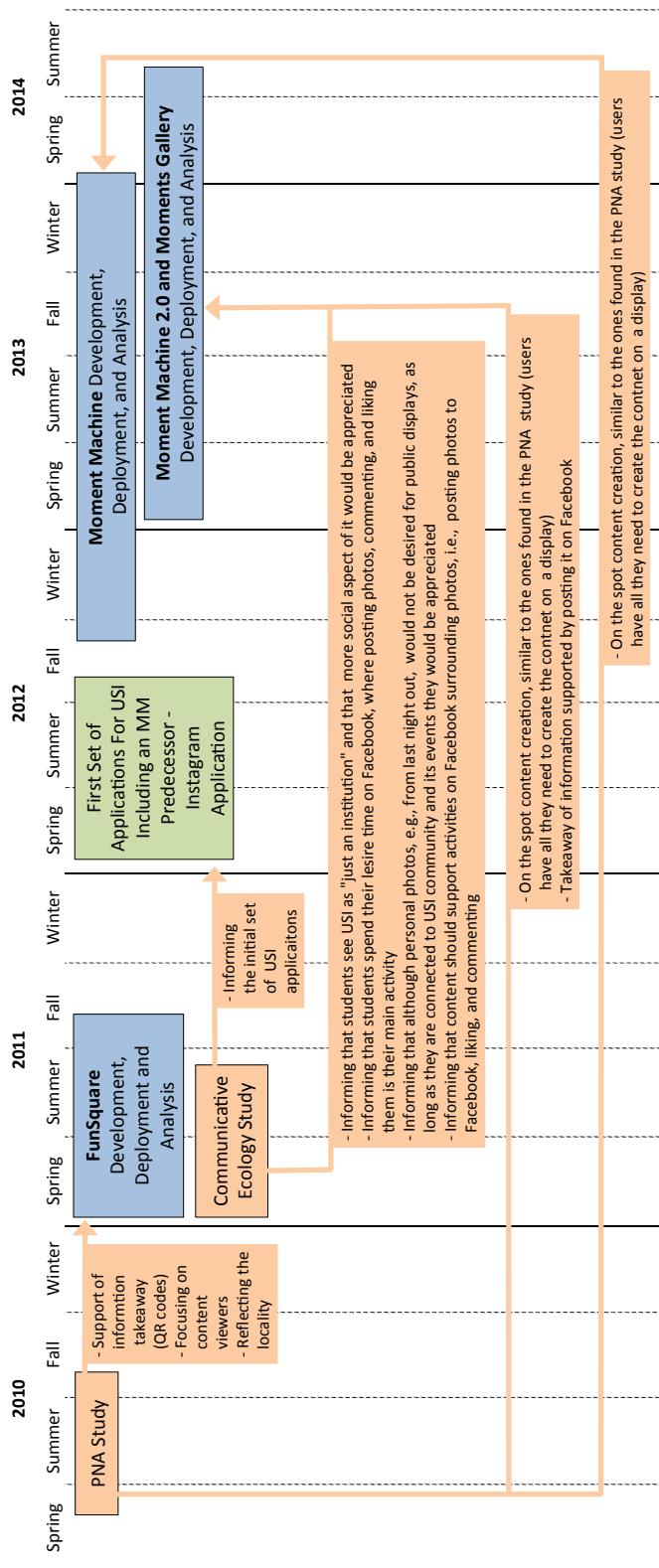
Figure 8.1. Studies' timeline and connection between the user requirements studies and "in the wild" deployments. Light orange boxes are user requirement studies and their inputs into different applications and their respective deployments. Light blue boxes represent deployments. Light green box are applications that leveraged form the USI communicative ecology study, but are not part of this thesis's work.

stages of the research future researchers and developers can leverage on the IPF by examining their goals and understanding concepts they want to use and effects they want to produce that are described through the IPF components. For example the *content providers* component can be used to determine whether an application will be a service or it will allow user generated content. The *communication channel* component can be used to examine will an application target inclusive use and communication open for everyone who passes by a display and the whole community around it or will it target exclusive and directed communication for a particular recipient. Also, through this component researchers and developers can think if an application will be scoped through people or places, i.e., will it transmit content and messages for certain group of people or certain places. The *awareness diffusion layer* shows how a service stimulates community interaction *implicitly* by stimulating the effect of social triangulation – social interaction between community members mediated by an unusual feature in a public space. The effect of social triangulation is also stimulated by applications that support user-generated content, which also stimulate community interaction *explicitly* by allowing individual community members to express their values, interests, ethos, and believes directly. This type of application also supports legitimate peripheral participation – an effects where new members and outsiders can learn about the community from a distance by observing the display's content and how people engage around a display. The *content viewers* component describes how communication channels map to unknown groups, known groups, and individuals that pass-by a display.

Once researchers and developers make conceptual decisions about their application they can proceed to more concrete steps, i.e., development, deployment, and evaluation of their application. In these steps they can leverage on the P-LAYERS framework that describes challenges in developing, deploying, and evaluating networked public display applications that aim at stimulating community interaction "in the wild". These challenges are described around five layers – hardware, system architecture, content, system interaction, and community interaction design. The P-LAYERS framework shows not only challenges on the individual layers, but also how issues on one of the layers propagates and impacts the other. It can be used as a Table to write down the issues emerging in the process and brainstorm about the issue's impact on the other layers. The shape of the framework can be used to indicate resource distribution, teams awareness of the challenges, or simply their interests.

Evaluation of the impact of the developed application "in the wild" typically implies situated observations. Researchers and developers can leverage here on the ELSI model that describes a generalized coordination and engagement model around public displays and user roles in this process. The ELSI model shows how different engagement spaces transform according to display size and how users transition between these zones. This allows future researchers and developers to understand user behavior prior to actual field observations and helps them prepare for it. It can

also help them to capture unusual or unreported behavior that differs from the one described by ELSI.

Also, the thesis provided a good baseline for the research on situated snapshots captured via networked public displays. Researchers and developers interested in this particular application of Interacting Places can benefit from it as the two studies provide commonalities in their use.

The thesis also showed high-level findings that generalize for networked public displays:

- *Repeated experiences are necessary for connections to develop and thus longer deployments.* Throughout the course of the thesis the amount of time for each "in the wild" deployment was increased, starting from 2 days for FunSquare, 12 weeks for the Moment Machine, and 15 weeks for the Moment Machine 2.0 deployment. When reflecting back on the overall impact each deployment had it became clear that the more people were exposed to the application, the more chances they got for repeated interactions with it. In turn, the impact of the application would be stronger. This shows that in order for Interacting Places to have a good quality impact on the community longer deployments are necessary

- *Regular users have breaks, so don't expect to see them every day* The first Moment Machine deployment showed the behavior for the three types of returning users across the four deployment locations. Occasional users return on almost monthly period, burst returners return couple of times in a single week, and regulars who return the most also may have a longer break (cf. Figure 5.15, 5.16, 5.17, and 5.18). The high-level finding here is that Interacting Places and networked public displays can attract regular users, however they will not come back every day to interact.

- *Deployment setting has a clear impact on the distribution of returning users as well as the number of times they come back to interact* The four settings in the Moment Machine deployment can be classified as residential area (the Mill), local neighborhood center (Leytonstone), cultural exchange center (NAE), and a third place (Broadway). For the three of the places, i.e., the Mill, Leytonstone, and NAE, the distribution of the different types of returning users was similar while it was different for Broadway that had a higher number of occasional users (cf. Figure 5.14). This can be interpreted as that in third places frequency of different people is much higher and therefore there are more occasional users than in the other three settings. Also, the setting had a clear impact on the number of times returning users would come back to interact – the more we moved into a typical residential area the more users cam back to interact (cf. Figure 5.13).

- *The fear of inappropriate user generated content might not be justified when input*

is tethered to a display One of the most common fears when it comes to public displays and user generated content is that inappropriate content would be posted. However, if we look at Table 5.4 that shows percentage of inappropriate photos that were posted at each location in the Moment Machine deployment, we can see that there were not that many – the highest percentage of inappropriate photos was 6.18% at NAE and the lowest was at the Mill, 1.51%. This shows that at least in the case of situated input inappropriate content does not show up in large amount.

- *Interacting Places and networked public displays need to be considered as part of bigger media ecology and appropriate for communities ICT practices* While moving across differnt settings it became evident that not all of them have the same ICT use-practices. For example, the first version of the Moment Machine application was built without the possibility to publish the photos to Facebook – this was a deliberate design decision as the community around the Mill was quite "novice" when it comes to existing ICTs. In contrast to that this option was a must-have for the Moment Machine 2.0 as the student community in Lugano is quite tech-savvy and they spend their leisure time on Facebook. The two examples show how Interacting Places and networked public displays in general have to be seen as part of a bigger media ecology scoped through local place-based communities ICT use-practices.

- *Further investigation of the networked public displays medium through Marshal McLuhan's media theory is needed* This thesis examined the networked public displays medium through only a small portion of Marshall McLuhan's media theory, i.e., the notion of figure-ground and the rear-view mirror. By no means is this including the full spectrum of his work that covers much more, e.g., the hot-cool properties of a medium or the acoustic and visual spaces or most importantly the four laws of media: 1) what does a media amplify, 2) what does it bring back from the past, 3) what does it obsolete, and 4) what does it flip into when pushed to the extreme. To a certain extent this thesis does touch upon parts of the tetrad as it make a case that Interacting Places amplify community oriented processes and that it brings back the notion of (today somewhat forgotten) belonging to a community. Nevertheless, further investigation is needed in order to better understand the networked public displays medium and the way it operates.

Future work should build upon the work carried out in this thesis and should explore other areas of the research agenda more explicitly. This can be as simple as using currently developed applications to examine other aspects of the research agenda, e.g., to understand how autopoiesic content or situated snapshots can promote community diversity, how they can stimulate greater connections within geographically distributed communities, or how they can be used enrich local life[2]. For example,

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[2]There is already some evidence coming from Moment Machine deployment that situated snapshots

autopoiesic content could be explicitly constructed to convey information about different communities that thrive in a single public space by sensing the information around the display and connecting it with information about different communities in it (e.g., "The population of India (1.237 billion) is around 10M times more than the number of people in this space (100)" or "Current temperature in Zurich is 10 degrees less than the temperature in Beijing"), or similarly different stamps could be used for the Moment Machine to further explicitly portray community membership[3]. Also, other applications and concepts that "emerge" from the ground can be explored (e.g., some are summarized here [56]), and more than a single application could be deployed in order to understand how different applications can complete each other or which one works the bes and under what circumstances.

Another strand of research lies also in carrying out more of similar deployments in different setting in order to further validate current results. By doing so and by iterating on currently developed interview scheme and survey presented in Appendix C, D, and E, better evaluation tools would be developed. Further development could lead to better crafted questions that pin point particular aspects of the applications that effect community interaction and sense of community the most, or they could lead to a more comprehensive evaluation techniques and strategies.

When it comes to particularly future work on situated snapshots the first step would be to there were already suggestions on how to improve the experience when taking the photos, e.g., adding tagging feature directly from a display, adding the capability to insert comments/captions onto photos, or adding the possibility to search through the photo archive form a display. Also further deployments and evaluations could show how well the three parameters, i.e., how a community expresses itself through situated snapshots, how much the standard return time of returning users varies, and what is the distribution of different types of returning users, perform for describing different communities. As a first step in that direction an analysis of user behavior at USI can be conducted. Also further deployments would uncover more parameters as well. Similarly when it comes to autopiesic content simple improvements would include visualizing the existing categories, showing the facts a bit longer, or better balancing the local and global content.

Overall, by conducting more deployments the IPF, P-LAYERS, and ELSI models will be populated, thus providing a better picture of the challenges in building and deploying Interacting Places as well as how the new communication medium – networked public displays – can stimulate community interaction in general.

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are a good way of enriching local life as well as other areas.

[3]There were already reports form the Moment Machine 2.0 deployment how the application supports diversity and internationalization as it allows different groups to take photos.

Appendix A

Semi-structured Interview on Students' Communicative Ecology at USI

I'd like to ask you some questions on the way you communicate to your friends and acquaintances within the university in order to have an overview of the current communication practices within the university. This research will have as a final purpose the deployment of a Public Display Network within the university that will try to facilitate communication between yourself and fellow schoolmates and friends. This should take around **30** minutes

Demographics:

Age:
Occupation:
Faculty:

1. **Artifact tour**
    a. **What kind of Software or web services do you use to stay in touch?** list of tools

    b. **How often do you use these tools and how (do you keep it always open in background)?**

    c. **Tool**
        i. **what was the last thing you used it for? (status update, profile update, pic sharing, chat, poke?, events, fan, like)**

        ii. **could you give me a tour of the features that you use (status update, profile update, pic sharing, chat, poke?, events, fan, like)**

    iii. **how do you use it (status update, profile update, pic sharing, chat, poke?, events, fan, like) (how do you upload videos? your own or from youtube?)**

    iv. **how often? (status update, profile update, pic sharing, chat, poke?, events, fan, like) how many contacts do you have?**

    v. **what for?**

    vi. **with whom rather than with others? (what audience?) - how many are colleagues, how many friends?**

    vii. **how do you choose one tool over the other?**

  d. **How do you use it for communication with people within USI? Do you think you use it differently than when you use it with outside people?**

  e. **where do you usually meet with people from the university? (for projects, for entertainment)**

2. **Scenarios**

Can you remember when you last shared last minute news with friends? How did you do that?
Eg. You want to share with your friends the news that you passed the hardest exam.

Can you remember when was the last time you organized an event with friends and colleagues? How did you do that?
Eg. Imagine you want to organize going out on a friday night with faculty friends and colleagues to celebrate the end of school.

Can you recollect the most recent time you shared or distributed media (pictures or video). How did you do that?
Eg. You took many pictures at the party last friday and want to distribute/share them with the others.

Eg. You want to share with your friend this song you really are crazy about and you think they would enjoy as well.

Picture a public display, what would you imagine posting on it?

From your point of view, what are the interests of your collegues, what would they like to see on that display?

Can you remember the last time you wanted to get informed on some university events? How did you do that?
 Eg. You are interested in some sport events that are organized by the university.

So, to summarize you mostly use _____ and the features _____ in the applications _____. You use these as often as _____, with _____.

I appreciate the time you took for the interview. I should have all the information i need. Thanks again.

Appendix B

Survey on Public Display Content Prefernces at USI

Upgrade   nipponlugano

Home   My Surveys   Survey Services   Plans & Pricing

+ Create Survey

You have a **BASIC account** | To remove the limits of a BASIC account and get unlimited questions, **upgrade now!**

Content sharing and consumption

Summary | **Design Survey** | Collect Responses   Analyze Results

Edit Survey

[Preview Survey]   [**Send Survey »**]

To change the **look** of your survey, select a theme below.

[Aqua ▲▼]   [Create Custom Theme]

TITLE & LOGO   [Edit Title]   [**Upgrade to Add Logo »**]

Università della Svizzera italiana   **Faculty of Informatics**
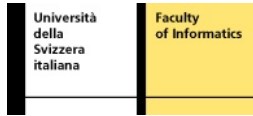
Content sharing and consumption

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1.

[**Upgrade to Add More Questions**]

[Edit Question] [▼] [Move] [Delete]

Dear Student,

We are planning to deploy a number of large public displays around campus that will be able to show a variety of content from both University administration (e.g., upcoming events, exam schedules) and the student community (e.g., party announcements, photo sharing). In order to understand what kind of content you would be interested in (a) seeing on these displays, but also interested in (b) posting to them, we would like you to fill out a couple of questions about different pieces of content, and their suitability for seeing them on and posting them to those public displays on campus. As some of this information is already available (or can already be posted) via other sources (e.g., Facebook, Email), we also would like to know your preferences regarding these existing applications.

[**Upgrade to Add More Questions**]

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2. Scenario

[**Upgrade to Add More Questions**]

Edit Question ▼ Move   Delete

So, anyway, here's a brief illustration on how these displays would work:

Display screen at the main entrance in the white building is showing USI campus map, current weather information, faculty schedule, and an upcoming seminar.
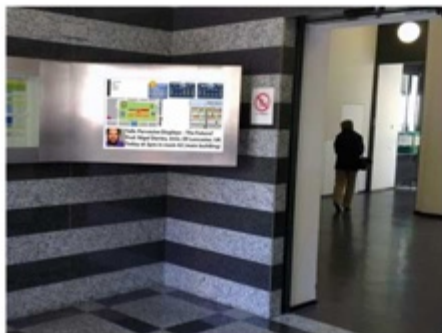
Alice and Bob are about to pass it. Since both Alice and Bob have public display applications on their mobile phones the display notices that they are near it.

Display notices that Bob has "My Schedule" application installed. The application filters faculty schedule and points out Bob's classes in it.

Upgrade to Add More Questions   Split Page Here

Edit Question ▼ Move   Delete

Bob sees that Professor Muller's lecture will start 10 minutes late. He also notices that he has a "Corporate communication" midterm in room 351 today.
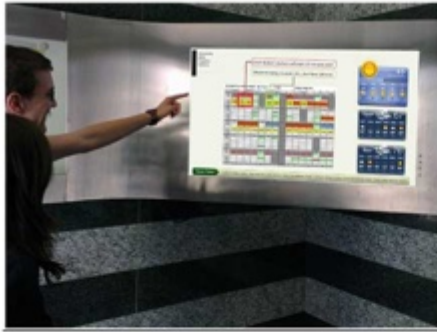
Alice comes closer to the display. The display notices that Alice has "My Photo Stream" application installed. Just before coming to USI Alice uploaded to "My Photo Stream" application images from her latest design project – custom made ambient lamp. The screen changes and starts displaying series of images from Alice's stream. Alice and Bob can see how design changed from the initial concept to final product.

Since Alice and Bob are not near the display it returns back to showing USI campus map, current weather information, faculty schedule, and upcoming seminar.

Upgrade to Add More Questions | Split Page Here

Edit Question ▼ | Move | Delete

On the next 2 pages you will find a list of content items and possible ways of sharing and reading about them. These questions should take no longer than 7 minutes. We would be really grateful for your help in our project.

Upgrade to Add More Questions

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3.

Upgrade to Add More Questions

Q1   Edit Question ▼   Add Question Logic   Move   Delete

✱1. How old are you?

Under 20

20-25

26-30

31-35

36-40

Over 40

Upgrade to Add More Questions   Split Page Here

Q2   Edit Question ▼   Add Question Logic   Move   Delete

✱2. From which faculty do you come from?

Architecture

Communication

Economics

Informatics

Upgrade to Add More Questions   Split Page Here

Q3   Edit Question ▼   Add Question Logic   Move   Delete

✱3. Which Programm?

Bachelor

Master

PhD

Upgrade to Add More Questions

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4.
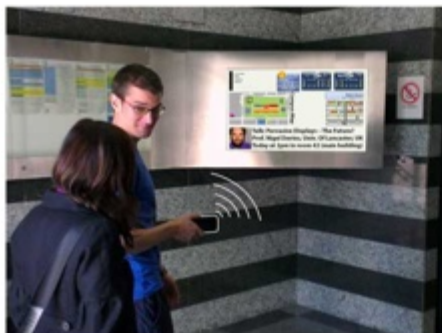
Upgrade to Add More Questions

Edit Question   ▼   Move   Delete

Part 1: Sharing preferences

Upgrade to Add More Questions   Split Page Here

Q4   Edit Question   ▼   Move   Delete

✱ 4. Plaese, select ways to share particular content item: for each of them please mark all columns that you think would be a suitable way for you to share this information with others.

	Screen in places where you relax or meet (e.g. mensa)	Screen in places where you attend classes and study (e.g. red, white and black buildings)	All screens on campus	I would be concerned about sharing this on a public screen	Social Networking website (e.g.FB/ Google+)	Email	Instant Messenger (Skype, iChat, MSN etc.)	Other - if a tool/system that you would use is not listed, check this column
1. A personal ad (e.g., used books, shared housing, furniture)								
2. Advertising a personal (i.e., non USI) event you are organizing (e.g., concert/party)								
3. Advertising an extra-curricular USI event you are participating in (e.g., USI Coro, debate club)								
4. Posting your class project (pics, description)								
5. Posting class-relevant material (e.g., link to videos, books, news)								
6. Link to / news about upcoming cultural events (e.g., concert)								
7. Link to / news about upcoming scientific event (e.g., talk)								
8. Scientific news								
9. World affairs news								
10. Recreational news (e.g., gadgets, music fashion, sports)								

If you have selected "other" for any of the above options please write here which tool/system you would use.

Upgrade to Add More Questions

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PAGE 5 Edit Page Options ▼ | Add Page Logic | Move | Delete   Show this page only

5.

Upgrade to Add More Questions

Edit Question | ▼ | Move | Delete

Part 1: Sharing preferences

Upgrade to Add More Questions | Split Page Here

Q5   Edit Question | ▼ | Move | Delete

＊5. Plaese, select ways to share particular content item: for each of them please mark all columns that you think would be a suitable way for you to share this information with others.

	Screen in places where you relax or meet (e.g. mensa)	Screen in places where you attend classes and study (e.g. red, white and black buildings)	All screens on campus	I would be concerned about sharing this on a public screen	Social Networking website (e.g.FB/ Google+)	Email	Instant Messenger (Skype, iChat, MSN etc.)	Other - if a tool/system that you would use is not listed, check this column
11. Pictures from your last night's clubbing								
12. Pictures from art exhibition or concert you visited								
13. Trip/Hike/Holiday pictures you took								
14. Pictures from an official USI event (e.g., talk) you attended								
15. Pictures from a recreational USI event you took (e.g., USI sports, debate team, USI Coro)								
16. Your comments on someone's personal pictures / announcements								
17. Your comments on official USI news / event / pictures								
18. Your comments on re-posted news (scientific,								

	Screen in places where you relax or meet (e.g. mensa)	Screen in places where you attend classes and study (e.g. red, white and black buildings)	All screens on campus	I would be concerned about sharing this on a public screen	Social Networking website (e.g.FB/ Google+)	Email	Instant Messenger (Skype, iChat, MSN etc.)	Other - if a tool/system that you would use is not listed, check this column
cultural, world)								
19. Your comments on a USI course / teacher								
20. Your "status update"								

If you have selected "other" for any of the above options please write here which tool/system you would use.

[text box]

Upgrade to Add More Questions

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6.

Upgrade to Add More Questions

Edit Question ▼ | Move | Delete

Part 2: Viewing preferences

Upgrade to Add More Questions | Split Page Here

Q6   Edit Question ▼ | Move | Delete

✱ **6. Please, for each content item check all the ways in which you would like to hear/find out/receive information about this.**

	Screen in places where you relax or meet (e.g. mensa)	Screen in places where you attend classes and study (e.g. red, white and black buildings)	All screens on campus	I would feel annoyed by seeing this on a public screen	Social Networking website (e.g.FB/ Google+)	Email	Instant Messenger (Skype, iChat, MSN etc.)	Other - if a tool/system that you would use is not listed, check this column
1. A personal ad (e.g., used books, shared housing, furniture) from your friend/colleague								
2. A personal (i.e., non USI) event your friend/colleague is organizing (e.g., concert/party)								

	Screen in places where you relax or meet (e.g. mensa)	Screen in places where you attend classes and study (e.g. red, white and black buildings)	All screens on campus	I would feel annoyed by seeing this on a public screen	Social Networking website (e.g.FB/ Google+)	Email	Instant Messenger (Skype, iChat, MSN etc.)	Other - if a tool/system that you would use is not listed, check this column
3. Advertising an extra-curricular USI event your friend/colleague participating in (e.g., USI Coro, debate club)								
4. Your classmates project (pics, description)								
5. Class-relevant material (e.g., link to videos, books, news)								
6. Someone posting/linking to news about upcoming cultural events (e.g., concert)								
7. Someone posting/linking to news about upcoming scientific event (e.g., talk)								
8. Someone posting/linking to scientific news								
9. Someone posting/linking to world affairs news								
10. Recreational news (e.g., gadgets, music fashion, sports)								

If you have selected "other" for any of the above options please write here which tool/system you would use.

Upgrade to Add More Questions

+ Add Page

PAGE 7   Edit Page Options ▼   Add Page Logic   Move   Delete   Show this page only

7.

Upgrade to Add More Questions

Edit Question   ▼   Move   Delete
Part 2: Viewing preferences

Upgrade to Add More Questions   Split Page Here

Q7   Edit Question   ▼   Move   Delete

✱7. Almost done! Please, for each content item check all the ways in which you would like to hear/find out/receive information about this.

	Screen in places where you relax or meet (e.g. mensa)	Screen in places where you attend classes and study (e.g. red, white and black buildings)	All screens on campus	I would feel annoyed by seeing this on a public screen	Social Networking website (e.g.FB/Google+)	Email	Instant Messenger (Skype, iChat, MSN etc.)	Other - if a tool/system that you would use is not listed, check this column
11. Pictures from your friend/colleague last night's clubbing								
12. Pictures from art exhibition or concert your friend/colleague visited								
13. Trip/Hike/Holiday pictures you friend/colleague took								
14. Pictures from an official USI event (e.g., talk) your friend/colleague attended								
15. Pictures from a recreational USI event your friend/colleague took (e.g., USI sports, debate team, USI Coro)								
16. Your friend/colleague comments on someone's personal pictures / announcements								
17. Your friend/colleague comments on official USI news / event / pictures								
18. Your friend/colleague comments on re-posted news (scientific, cultural, world)								
19. Your friend/colleague comments on a USI course / teacher								
20. Your friend/colleague "status update"								

If you have selected "other" for any of the above options please write here which tool/system you would use.

Upgrade to Add More Questions

+ Add Page

PAGE 8 Edit Page Options ▼ Move Delete Show this page only

8.

Upgrade to Add More Questions

Edit Question | ▼ | Move | Delete

We successfully received your answers. Many thanks for your support of this study.
With best regards,
UbiComp group, Faculty of Informatics (Università della Svizzera Italiana)

Upgrade to Add More Questions

+ Add Page

Back to My Surveys

Preview Survey | **Send Survey »**

Community: Developers • Facebook • Twitter • LinkedIn • Our Blog • Google+ • YouTube

About Us: Management Team • Board of Directors • Partners • Newsroom • Contact Us • Jobs • Sitemap • Help

Policies: Terms of Use • Privacy Policy • Anti-Spam Policy • Security Statement

Language: English • Español • Português • Deutsch • Nederlands • Français • Русский • Italiano • Dansk • Svenska • 日本語 • 한국어 • 中文(繁體) • Türkçe • Norsk • Suomi

Appendix C

Moment Machine Semi-Structured Interview at the Mill

Interview with well known community members

Introduce myself. Hi, my name is Nemanja. I'm form Switzerland. I work with Ava on the screens in the wild project. I'm interested in understanding how we can build public display applications for communities.

Date: __17_____ Time: _____ Location:_____

Age Group:

	F No.	M No.	41 – 45	F No.	M No.
5 – 10			41 – 45		
11 – 15			46 – 50		
16 – 20			51– 55		
21 – 25			56 – 60		
26 – 30			61 - 65		
31 – 35x	x		Over 65		
36 - 40					

A bit about yourself, your background, how are you related to the Mill

1 Daily routine/encounter with the Moment Machine

1. Are you local to the area? How often do you visit the Mill?
2. Do you pass by frequently?

2 Moment Machine's user interface

3. How do you find the user interface?
        Follow up: Is it easy to understand the interface? Is it easy to take the photos? What would you like to change about it?

3 Interactions With the Moment Machine

4. How do you find the photo taking experience? (if they don't answer ask. Is it exciting boring…)

5. What photos do you usually take? What photos would you like to take?

6. Can you remember what you did before and after you took the photo? Do you remember what was before and after you stopped here, were you on your way to do something?

7. Do you do this on your own or only with friends family. Did you come with someone else or have you thought of bringing someone else? Do you talk with your friends or family about the photos? Do you know if any of them came to take a photo?

8. What would you like to do with the photos taken with the Moment Machine?

4   Effects on community/community awareness

9. Browse the photos and ask which are the regulars and which the locals, or unknown

10. Tell me a bit about the people in the photos. For example, do you recognize people in the photos? Did you maybe notice any new faces?

11. Tell me a bit about the photos in the MM, for example, were there any interesting ones?

12. Were there any memorable events around the Moment Machine application or the photos? For example some funny, exciting, or even negative situation in front of the MM application? Something that you talked about with the rest of the community or people in the locality?

13. Did you talk to some people that you did not know before because of the images in the MM or MM application?

5   Finding returning users

14. Have you seen anyone who is commenting on the photos, who is enthusiastic, or who comes over and over again?

6 Online Social Media and Moment Machine

15. Do you maybe use online social media and upload the photos?

16. For the online social ones what kind of photos do you take? For example do you take personal pictures of you or pictures of others?

17. How do you find this experience? Is it different? How different?

7 Interest in the images from the other sites

18. Tell me a bit about the locations in the photos. For example, do you know where are the pictures coming from, i.e., from which locations? Do you know more about the locations?

Appendix D

Moment Machine Semi-Structured Interview at USI

Date: Location: Mensa

Start Time: End Time:

Number of people:

Faculty:

[   ] Communications   [ ] Economics   □ Informatics   □ USI Staff

Year:

□ Bachelor   X Master   □ Faculty Staff

Age Group:

	F No.	M No.		F No.	M No.
5 – 10			41 – 45		
11 – 15			46 – 50		
16 – 20			51– 55		
21 – 25			56 – 60		
26 – 30			61 - 65		
31 – 35			Over 65		
36 - 40					

Where are you from?

1. How often do you come to USI on average?
   a. Once a day
   b. A few times a week
   c. About once a week
   d. A couple of times a month
   e. Less than once a month

2. How long do you stay at USI on average?
   f. More than 8 hours
   g. Between 8 and 6 hours
   h. Between 6 and 4 hours
   i. Between 4 and 2 hours
   j. Between 2 and 1 hour

3. How often have you interacted with the USI Display?

[ ] Regularly - weekly [ ] Sometimes - monthly   Very Seldom - yearly

Moment machine: situated snapshots and situated/community interaction

15. How often have you interacted with the Moment Machine?

[ ] Regularly - weekly [ ] Sometimes - monthly   Very Seldom – yearly [ ] Never

16. Tell me a bit about the last time you took the photo. What did you do?

17. Did you post the photo to Facebook or just display? Can you tell me a bit more about that? E.g., why display or why Facebook?

18. What was your interaction like with the Moment Machine in front of a display? **Did you use filters and stickers? Did you notice the Hot4 photos?**

19. How do you find the photo taking experience, for example, in comparison to taking a photo with your phone or Instgram or some other? Is it different? How different?

20. Do you remember any interesting photo?

21. Did you like someone's photo on the display?

22. Have you interacted with friends or people in general in front of the display?

23. Have you seen others interacting with the Moment Machine application? What were they doing?

24. Would you come again to take another photo? With whom?

25. Would you tell your friends about the application?

Moment machine: community awareness
(20-21 in front of a display, 22 -23 on FB)

26. What do you think about the people in the photos? How does the Moment Machine connect to USI?

27. Ask them if they browse the photos on Facebook.

28. Did you notice people liking or commenting on your photos on Facebook? Did you like or comment other people photos?

29. Attitudes and usage: Overall, do you agree with the statement that having a Moment Machine application makes your time at this location more social?

□ Completely disagree □ Somewhat disagree □ Neutral [ ] Somewhat Agree [ ] Completely Agree

30. Now that you've seen all the applications do you know which ones have the official information and which ones have user generated content?

31. How often do you use social media:

Facebook
[ ] Regularly - weekly   Sometimes - monthly   Very Seldom - yearly [ ] Not at all

Twitter
    Regularly - weekly [] Sometimes - monthly   Very Seldom - yearly [ ] Not at all

Instagram
[ ] Regularly - weekly [] Sometimes - monthly   Very Seldom - yearly [ ] Not at all

Additional comments:

Being students at USI

32. Do you have interaction with other students (students of other Bachelors/Masters)? If yes, when, how and where (sport, associations, mensa, …)?

33. Do you feel the need to have more opportunities to interact with other students (e.g. official parties theme day) / To what extent do you want to interact with other USI students of your Bachelor/Master?

Available for follow up interviews? [ ] Yes   No email:_____

Appendix E

Moment Machine Survey at USI

Moment Machine Survey

Howdy,

Thanks for participating in a user study about the Moment Machine application that is running on the displays placed around USI. In this survey we would really like to get your feedback on your experience with the Moment Machine application.

Your feedback means a lot to us and will help us further refine and improve the app and overall experience with it.

Thanks for your help!

Nemanja, Ivan, Elisa, and Marc
UbiComp Research Group
Faculty of Informatics

* Required

General information

1. **How old are you?** *

   ....

2. **I am** *
   Mark only one oval.

   ◯ Male

   ◯ Female

3. **What faculty do you come from/are attending?** *
   If you are a student please choose the faculty you are currently enrolled in. If you are a staff member/professor please choose your employer/where you work
   Mark only one oval.

   ◯ Informatics

   ◯ Economics

   ◯ Comunications

   ◯ USI

4. **How would you describe your involvement/status with USI?** *
   Mark only one oval.

   ◯ I'm a Bachelor student

   ◯ I'm a Master student

   ◯ I'm a PhD student

   ◯ I'm a Postdoc

   ◯ I'm a Professor

   ◯ I'm part of the staff

5. **On average how often do you come to USI?** *

   Mark only one oval.

   ◯ About once a day

   ◯ A few times a week

   ◯ About once a week

   ◯ A couple of times a month

   ◯ Less than once a month

6. **On average how long do you stay at USI?** *

   Mark only one oval.

   ◯ More than 8 hours

   ◯ Between 8 and 6 hours

   ◯ Between 6 and 4 hours

   ◯ Between 4 and 2 hours

   ◯ Between 2 and 1 hours

General experience with the Moment Machine application

Please tell us what are the things that you like or dislike about the Moment Machine application. Be as expressive as you like.

Frequency of interactions with the Moment Machine

Remember the last couple of times you interacted with the Moment Machine. How often were they? Interactions can also be simple as looking at the display's content, or more engaging as browsing the bus schedule or taking a photo.

7. **To what extent have you interacted with the Moment Machine at these locations** *

   Mark only one oval per row.

	Never	Rarely, about once a month	Occasionally, couple of times a month	Sometimes, every week	Frequently, couple of times a week	Usually, about once a day	Every time when I passed by the display
Display in the main building in front of the Mensa	◯	◯	◯	◯	◯	◯	◯
Display in the Red building	◯	◯	◯	◯	◯	◯	◯
Display in the Black building, 1st floor	◯	◯	◯	◯	◯	◯	◯
Display in the Black building, 2nd floor	◯	◯	◯	◯	◯	◯	◯

8. **How often do you typically visit the Moment Machine Facebook page?** *
Mark only one oval per row.

	Never	Rarely, about once a month	Occasionally, couple of times a month	Sometimes, every week	Frequently, couple of times a week	Usually, about once a day	Every time when I'm on Facebook
	◯	◯	◯	◯	◯	◯	◯

9. **Overall how many times have you interacted with the Moment Machine?** *
Mark only one oval per row.

	Between 1 and 5 times	Between 6 and 10 times	Between 11 and 15 times	Between 16 and 20 times	More than 20 times
	◯	◯	◯	◯	◯

To what extent have you perfromed the following actions

10. **When you interacted with the Moment Machine how often have you taken the photos...** *
Mark only one oval per row.

	Never	Rarely, 1 out of 10 times when I interacted	Occasionally, 3 out of 10 times when I interacted	Sometimes, 5 out of 10 times when I interacted	Frequently, 7 out of 10 times when I interacted	Usually, 9 out of 10 times when I interacted	Every time when I interacted
Alone	◯	◯	◯	◯	◯	◯	◯
With friends/classmates	◯	◯	◯	◯	◯	◯	◯
With acquaintances	◯	◯	◯	◯	◯	◯	◯
With anyone that was around the display	◯	◯	◯	◯	◯	◯	◯

11. **When you took the photos you posted them** *
Mark only one oval per row.

	Never	Rarely, 1 out of 10 times when I interacted	Occasionally, 3 out of 10 times when I interacted	Sometimes, 5 out of 10 times when I interacted	Frequently, 7 out of 10 times when I interacted	Usually, 9 out of 10 times when I interacted	Every time when I interacted
To display	◯	◯	◯	◯	◯	◯	◯
To display and Moment Machine Facebook page	◯	◯	◯	◯	◯	◯	◯

12. **How important was it for you that photos could be posted to Facebook** *
Mark only one oval per row.

	Not at all important	Low importance	Slightly important	Neutral	Moderately important	Very important	Extremely important
	◯	◯	◯	◯	◯	◯	◯

13. **You used the stickers on the photos** *
Mark only one oval per row.

	Never	Rarely, 1 out of 10 times when I interacted	Occasionally, 3 out of 10 times when I interacted	Sometimes, 5 out of 10 times when I interacted	Frequently, 7 out of 10 times when I interacted	Usually, 9 out of 10 times when I interacted	Every time when I interacted
To represent the faculty you are attending, e.g., ECO, INF, COM	◯	◯	◯	◯	◯	◯	◯
To represent the university, USI	◯	◯	◯	◯	◯	◯	◯
Any sticker that was already on when you took the photo	◯	◯	◯	◯	◯	◯	◯

To what extent have you perfromed the following actions

14. **Overall, you looked at the Moment Machine's photos on** *
Mark only one oval per row.

	Never	Rarely	Sometimes	Often	Always
The display	◯	◯	◯	◯	◯
Moment Machine Facebook page	◯	◯	◯	◯	◯

15. **When you were looking at the photos on the display you mainly looked at:** *
Mark only one oval per row.

	Never	Rarely, 1 out of 10 times when I interacted	Occasionally, 3 out of 10 times when I interacted	Sometimes, 5 out of 10 times when I interacted	Frequently, 7 out of 10 times when I interacted	Usually, 9 out of 10 times when I interacted	Every time when I interacted
Photos you are in, alone or with friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Photos of your friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Any photo on the the display	◯	◯	◯	◯	◯	◯	◯

16. **When you were liking the photos on the display you mainly liked:** *

Mark only one oval per row.

	Never	Rarely, 1 out of 10 times when I interacted	Occasionally, 3 out of 10 times when I interacted	Sometimes, 5 out of 10 times when I interacted	Frequently, 7 out of 10 times when I interacted	Usually, 9 out of 10 times when I interacted	Every time when I interacted
Photos you are in, alone or with friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Photos of your friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Any photo on the display	◯	◯	◯	◯	◯	◯	◯

17. **When you were liking the photos on the display to get it into Hot4! you mainly liked:** *

Mark only one oval per row.

	Never	Rarely, 1 out of 10 times when I interacted	Occasionally, 3 out of 10 times when I interacted	Sometimes, 5 out of 10 times when I interacted	Frequently, 7 out of 10 times when I interacted	Usually, 9 out of 10 times when I interacted	Every time when I interacted
Photos you are in, alone or with friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Photos of your friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Any photo on the display	◯	◯	◯	◯	◯	◯	◯

To what extent have you perfromed the following actions

18. **When you looked at the photos on the Moment Machine's Facebook page you mainly looked at: ***

Mark only one oval per row.

	Never	Rarely, 1 out of 10 times when I visited the page	Occasionally, 3 out of 10 times when I visited the page	Sometimes, 5 out of 10 times when I visited the page	Frequently, 7 out of 10 times when I visited the page	Usually, 9 out of 10 times when I visited the page	Every time when I visited the page
Photos you are in, alone or with friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Photos of your friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Any photo on the page	◯	◯	◯	◯	◯	◯	◯

19. **When you were liking the photos on the Moment Machine's Facebook page you mainly liked: ***

Mark only one oval per row.

	Never	Rarely, 1 out of 10 times when I visited the page	Occasionally, 3 out of 10 times when I visited the page	Sometimes, 5 out of 10 times when I visited the page	Frequently, 7 out of 10 times when I visited the page	Usually, 9 out of 10 times when I visited the page	Every time when I visited the page
Photos you are in, alone or with friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Photos of your friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Any photo on the page	◯	◯	◯	◯	◯	◯	◯

20. **When you were commenting the photos on the Moment Machine's Facebook page you mainly commented on: ***

Mark only one oval per row.

	Never	Rarely, 1 out of 10 times when I visited the page	Occasionally, 3 out of 10 times when I visited the page	Sometimes, 5 out of 10 times when I visited the page	Frequently, 7 out of 10 times when I visited the page	Usually, 9 out of 10 times when I visited the page	Every time when I visited the page
Photos you are in, alone or with friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Photos of your friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Any photo on the page	◯	◯	◯	◯	◯	◯	◯

To what extent have you perfromed the following actions

21. **When you were tagging the photos on the Moment Machine's Facebook page you mainly tagged: ***

Mark only one oval per row.

	Never	Rarely, 1 out of 10 times when I visited the page	Occasionally, 3 out of 10 times when I visited the page	Sometimes, 5 out of 10 times when I visited the page	Frequently, 7 out of 10 times when I visited the page	Usually, 9 out of 10 times when I visited the page	Every time when I visited the page
Photos you are in, alone or with friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Photos of your friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Any photo on the page	◯	◯	◯	◯	◯	◯	◯

22. **When you shared the photos on the Moment Machine's Facebook page you mainly shared:** *

Mark only one oval per row.

	Never	Rarely, 1 out of 10 times when I visited the page	Occasionally, 3 out of 10 times when I visited the page	Sometimes, 5 out of 10 times when I visited the page	Frequently, 7 out of 10 times when I visited the page	Usually, 9 out of 10 times when I visited the page	Every time when I visited the page
Photos you are in, alone or with friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Photos of your friends/ classmates	◯	◯	◯	◯	◯	◯	◯
Any photo on the page	◯	◯	◯	◯	◯	◯	◯

Impact of the Moment Machine application

23. **To what extent have the following actions influenced the sense of belonging to USI?** *

Mark only one oval per row.

	No affect	Minor affect	Neutral	Moderate affect	Major affect
Taking photos	◯	◯	◯	◯	◯
Looking at the photos on the USI Displays	◯	◯	◯	◯	◯
Using stickers to express community membership	◯	◯	◯	◯	◯
Liking the photos on the display	◯	◯	◯	◯	◯
Competing with others to get into Hot4!	◯	◯	◯	◯	◯
Getting your photo to Hot4!	◯	◯	◯	◯	◯
Looking at the photos on Facebook	◯	◯	◯	◯	◯
Liking the photos on Facebook	◯	◯	◯	◯	◯
Commenting the photos on Facebook	◯	◯	◯	◯	◯
Tagging the photos on Facebook	◯	◯	◯	◯	◯
Sharing the photos on Facebook	◯	◯	◯	◯	◯

Impact of the Moment Machine Application

24. **How would you rate the overall impact of the Moment Machine application on... ***
Mark only one oval per row.

	No affect	Minor affect	Neutral	Moderate affect	Major affect
My awareness of friends and colleagues at USI	◯	◯	◯	◯	◯
My awareness of acquaintances, other students, staff members, or employees that I do not know at USI	◯	◯	◯	◯	◯
My social interactions with friends and colleagues	◯	◯	◯	◯	◯
My social interactions with acquaintances, other students, staff members, or employees that I do not know	◯	◯	◯	◯	◯
My relationships with friends and colleagues	◯	◯	◯	◯	◯
My relationships with other acquaintances, students, staff members, or employees that I do not know	◯	◯	◯	◯	◯
The sense of belonging to USI	◯	◯	◯	◯	◯
USI's image as an institution	◯	◯	◯	◯	◯

Impact of the Moment Machine application

25. **To what extent do you agree with the statement that photos on the Moment Machine reflects USI as a community ***
Mark only one oval per row.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly agree
	◯	◯	◯	◯	◯	◯	◯

26. **To what extent do you agree with the statement that posting photos on the Moment Machine is a common activity for people at USI ***
Mark only one oval per row.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly agree
	◯	◯	◯	◯	◯	◯	◯

27. **To what extent do you agree with the statement that by posting a photo on the Moment Machine you express your membership to USI ***
Mark only one oval per row.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly agree
	◯	◯	◯	◯	◯	◯	◯

28. **To what extent do you agree with the statement that by posting a photo on the Moment Machine you contribute to USI's image as an institution** *

Mark only one oval per row.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly agree
	◯	◯	◯	◯	◯	◯	◯

29. **To what extent do you agree with the statement that by posting a photo on the Moment Machine you influence USI's image as an institution** *

Mark only one oval per row.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly agree
	◯	◯	◯	◯	◯	◯	◯

30. **To what extent do you agree with the statement that looking at the Moment Machine photos evokes an emotional connection with USI** *

Mark only one oval per row.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly agree
	◯	◯	◯	◯	◯	◯	◯

General experience with the Moment Machine application

Please tell us what are the things that you like or dislike about the Moment Machine application. Be as expressive as you like.

31. **What things do you LIKE the most about the Moment Machine application?**

....
....
....
....
....

32. **What things do you DISLIKE the most about the Moment Machine application?**

....
....
....
....
....

33. **How would you recommend that we improve the Moment Machine application?**

....

....

....

....

....

34. **Please share any interesting experiences you've had with the Moment Machine application - good and/or bad**

....

....

....

....

....

35. **Overall, how much do you like the Moment Machine application?** *
   Mark only one oval per row.

	Not much	It's OK	Like it	Love it	It's my favourite
	◯	◯	◯	◯	◯

If you would like to enter the raffle please leave your contact info here

36. **If you would like to enter the raffle and win one of the 20 CHF Manor voucher please leave your name below**

....

37. **If you would like to enter the raffle and win one of the 20 CHF Manor voucher please leave your email below**

....

38. **If you would be so kind we would really appreciate if you could copy and paste below the URL/link to your Facebook profile. We would just use it in our study to connect your answers with the use of the Moment Machine's Facebook page**

....

Thank you for completing the USI DIsplay questionnaire!

We sincerely appreciate you took time to complete this questionnaire: it will definitely help us in our research and in improving the Moment Machine!

Nemanja, Ivan, Elisa, and Marc
UbiComp Research Group
Faculty of Informatics

39. **If you have any more comments please write them here**

....

....

....

....

....

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Google Forms

Appendix F

CoCollage Questionnaire

This questionnaire is here with permission of Shelly Farnham and Joe McCarthy.

CoCollage Questionnaire

Strands Labs Seattle has installed a system called CoCollage for members of this café community. The system consists of a large display that shows photos and quotes uploaded to a special web site (*<café_name>*.cocollage.com) by customers and staff in the café.

Your answers to the following questions will help us better understand how CoCollage is currently being used, and how we might improve it. *Thanks for your help!*

1. How **often** do you typically visit this café? ____ times per week

2. What **time(s) of day** do you typically come to the café?
   ___ Early morning   ___ Mid morning   ___ Late morning   ___ Lunchtime
   ___ Early afternoon   ___ Mid afternoon   ___ Late afternoon   ___ Evening

3. How often do you typically **stay** in the café to drink your coffee/tea? ____ % of the time

4. How often do you typically use a **laptop** in the café? ____ % of the time

5. How often do you typically bring a **mobile phone** with you to the café? ____ % of the time

6. Which of the following **mobile phone capabilities** do you use (anywhere)?
   ☐ SMS (text messaging)
   ☐ Email
   ☐ Web browsing

7. Are you a member of this café's **loyalty program**? ___ Yes ___ No ___ N/A

8. How much do you **like** this café? [*Please circle one*]

   Not much   It's OK   Like it   Love it   A favorite

9. What do you **like best** about this café?

10. Have you created a **CoCollage account**? ___ Yes ___ No

    a. If so, approximately **when** did you create the account?

    b. If you have not created an account, **why not**?

[Feel free to use the back side of this sheet to elaborate on any response]

11. How often do you typically **visit the CoCollage web site**? ___ times per week

12. Which of the following **types of actions *on the CoCollage web site*** have you taken?
    [*Please check all boxes that apply*]:
    - ☐ I have viewed **another person's profile**
    - ☐ I have viewed **the Stream** of photos and quotes
    - ☐ I have viewed an **individual photo or quote page**
    - ☐ I have **voted** on someone's photo or quote
    - ☐ I have posted a **comment** on someone's photo, quote or profile
    - ☐ I have sent a **direct message *to the screen***
    - ☐ I have sent a **private message** to another CoCollage user
    - ☐ I have sent **feedback on CoCollage** through the website or email

13. Which of the following **types of actions *on the CoCollage web site*** have you observed?
    [*Please check all boxes that apply*]:
    - ☐ Someone else has **voted** on my photo or quote
    - ☐ Someone else has posted a **comment** on my photo, quote or profile
    - ☐ Someone else has sent me a **private message**

14. To what extent have you noticed and watched **the CoCollage display** in the café?
    [*Please circle one*]

    | Never | Rarely | Sometimes | Usually | Every visit |

15. What things do you **like** most about CoCollage?

16. What things do **dislike** or find **confusing** about CoCollage?

17. How would you recommend that we **improve** CoCollage?

18. Please share any **interesting experiences** you've had with CoCollage – good and/or bad.

[Feel free to use the back side of this sheet to elaborate on any response]

19. How would you rate the overall impact of CoCollage on **your connection with *other people*** at the café in each of the following dimensions? [*Please circle one item in each row*]

	Strong negative impact	Moderate negative impact	Slight negative impact	No impact	Slight positive impact	Moderate positive impact	Strong positive impact
My *awareness* of other people & their interests	-3	-2	-1	0	+1	+2	+3
My *interactions* with other people	-3	-2	-1	0	+1	+2	+3
My *relationships* with other people	-3	-2	-1	0	+1	+2	+3

20. How would you rate the overall impact of CoCollage on **your connection to *the café*** in each of the following dimensions? [*Please circle one item in each row*]

	Large decrease	Moderate decrease	Slight decrease	No change	Slight increase	Moderate increase	Large increase
The *frequency* with which I visit this café	-3	-2	-1	0	+1	+2	+3
The *amount of time* I spend at this café	-3	-2	-1	0	+1	+2	+3
The *sense of community* I feel at this café	-3	-2	-1	0	+1	+2	+3
The *loyalty* I feel toward this café	-3	-2	-1	0	+1	+2	+3

21. Overall, how much do you **like** CoCollage? [*Please circle one*]

Not much   It's OK   Like it   Love it   A favorite

22. Please feel free to share **any other thoughts or feelings** you have about CoCollage:

Thank you for helping us better understand and improve the CoCollage experience!

[Feel free to use the back side of this sheet to elaborate on any response]

CoCollage Questionnaire $20 Gift Certificate Drawing

If you would like to participate in a random drawing for a $20 gift certificate for this café, please clearly write your name, email address and phone number below. The drawing will take place within one week of today, and the winner will be notified shortly thereafter.

Please note that this information is being collected on a separate page so that your responses to the survey on the previous two pages will remain anonymous. We will not use this information for any purpose other than to contact you in the event that you win the drawing.

Thanks again for your help!

Name:

Email address:

Phone number:

[Feel free to use the back side of this sheet to elaborate on any response]

Appendix G

CoCollage Online Survey

This questionnaire is here with permission of Shelly Farnham and Joe McCarthy.

Coffee Shop Survey

At the Seattle Strands Lab we have been exploring ways to improve your social experiences in public spaces. One such project is "Wally", a large community display that shows information about customers in coffee shops to help then get to know each other. In order to improve our understanding of social experiences in coffee shops, we would like to ask some questions about your recent experiences at Allegra.

Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable, you can withdraw from the project at any point.

Please note your responses are entirely confidential. You should be able to complete this questionnaire in 10 minutes. If you have questions at any time about the survey or the procedures, you may contact Shelly Farnham at shelly@strands.com.

Thank you very much for your time and support.

Please start with the survey now by clicking on the Continue button below.

Page 2

Coffee Shop Survey

The following questions ask for basic demographic information.

What is your age?_____

What is your gender?

- Male
- Female

What is the highest level of education you have achieved?

- Some high school
- High school graduate
- Some college
- College graduate
- Some graduate school
- Master's or doctoral level degree

Which of the following best describes your employment level?

- Unemployed
- Home maker
- Blue collar
- White collar
- Service
- Student
- Management
- Professional
- Retired
- Other

If you were trying to explain your lifestyle to someone with just a few words, how would you describe yourself? (e.g. yuppie, hippie, preppie, hipster, redneck, punk, goth, partier, domestic, slacker, rocker, nerd, geek, skater, townie, hip hop....).

_____

What is your current living situation? Please check ALL that apply.

- Live alone
- Live with parents
- Live with housemates
- Live in dormitory
- Live with partner/spouse
- Live with kids
- Other

Please contact shelly@wagglelabs.com if you have any questions regarding this survey.

Page 3

Coffee Shop Survey

The following questions ask about your involvement with Allegra.

How would you describe your involvement with Allegra?

- Owner
- Employee/Barista
- Vendor
- Customer
- Other

How often do you come into Allegra? Please check the answer the best represents your frequency.

- More than once a day
- About once a day
- A few times a week
- About once a week
- A couple of times a month
- Less than once a month

What time of the day do you typically come into Allegra?

_____

When you purchase a drink or a snack, how often do you typically consume it within Allegra?

- Never
- Rarely
- Sometimes
- Often
- All the time

When you stay to consume your drinks or eat your snacks, how long do you typically spend in Allegra? In other words, how much time is your typical "session"? Please specify in minutes your typical stay.

_____

When you do stay in the coffee shop to consume your drinks or eat your snaks, what else are typically doing?

_____

What is usually your primary goal in coming to Allegra? Please explain in one or two sentences.

_____

Please contact shelly@wagglelabs.com if you have any questions regarding this survey.

Page 4

How often do you use the coffee shop's wireless service (wi-fi) to connect to the Internet with a computer?

- Never
- Rarely
- Sometimes
- Often
- All the time

Do you have a coffee shop loyalty card for Allegra -- that is, a card for regular users to get a special deal when they buy many cups of coffee?

- Yes, the one given to my for the Wally project
- Yes, some other loyalty card
- No

Please answer the questions below using the following scale:

1 = Not at all
7 = Extremely so

	1	2	3	4	5	6	7
To what extent are you satisfied with the quality of service at Allegra?	○	○	○	○	○	○	○
To what extent are you satisfied with the ambience of Allegra?	○	○	○	○	○	○	○
To what extent are you satisfied with your social experiences at Allegra?	○	○	○	○	○	○	○
To what extent do you believe Allegra is interested in building a sense of community?	○	○	○	○	○	○	○
To what extent do you want to connect with others while at Allegra?	○	○	○	○	○	○	○

The following questions ask you to estimate your connections to people you meet at or through Allegra, which includes both their employees and their customers.

How many people (employees AND customers) would you estimate are regularly at Allegra? By "regularly at" we mean they are in the coffee shop

once a week or more.

 _____

How many people that you meet at or through Allegra do you interact with outside of the Allegra shop?

 _____

How many people who frequent Allegra would you classify as an*online* acquaintance? By "online acquaintance" we mean that you recognize the person's name, email, or online profiles, that you have spoken to each other online at least once, and that the other person probably regards you as an online acquaintance as well. However you have not really met face-to-face.

 _____

How many people who frequent Allegra would regard as a professional friend or colleague (and whom you would expect to see you the same way).

 _____

How many people who frequent Allegra would you talk to about things that are very personal and private, such as problems as work or difficulties with family.

 _____

How many people at SeattleBarCamp would you call on to help with a large favor.

 _____

Please contact shelly@wagglelabs.com if you have any questions regarding this survey.

Page 5

Coffee Shop Survey

Please indicate for each of the following statements the extent to which you agree using the following scale.

1 = Not at all
7 = Extremely So

	1	2	3	4	5	6	7
I enjoy Allegra more than other coffee shops.	○	○	○	○	○	○	○
I get more satisfaction out of Allegra than other coffee shops.	○	○	○	○	○	○	○
Allegra is the best kind of coffee shop for someone like me.	○	○	○	○	○	○	○
Coming to Allegra is more important to me than going to other coffee shops.	○	○	○	○	○	○	○
I really care about the fate of Allegra.	○	○	○	○	○	○	○
I have talked up Allegra to my friends as a great coffee shop to go to.	○	○	○	○	○	○	○
I would go out of my way in order to keep coming to Allegra in the future.	○	○	○	○	○	○	○
I am glad that I chose to come to Allegra rather than other coffee shops.	○	○	○	○	○	○	○
I find my values are very similar to other people at Allegra.	○	○	○	○	○	○	○
I am very interested in what others think about Allegra.	○	○	○	○	○	○	○
When someone criticizes Allegra, it feels like a personal insult.	○	○	○	○	○	○	○
The success of Allegra is my success.	○	○	○	○	○	○	○
I like to think of myself as similar to the people at Allegra.	○	○	○	○	○	○	○
I have a feeling of fellowship between me and others at Allegra.	○	○	○	○	○	○	○
I feel loyal to the people at Allegra.	○	○	○	○	○	○	○
I agree with most people at Allegra about what is	○	○	○	○	○	○	○

important in life.

If I needed advice about something I could go to someone at Allegra.	○	○	○	○	○	○	○
My friendships and associations with others at Allegra mean a lot.	○	○	○	○	○	○	○
I would work together with others on something to improve Allegra.	○	○	○	○	○	○	○
If I can I will continue coming to Allegra for a number of years.	○	○	○	○	○	○	○
I feel like I belong at Allegra.	○	○	○	○	○	○	○
I borrow things and exchange favors with people at Allegra.	○	○	○	○	○	○	○
I have visited with others from Allegra at their work or in their homes.	○	○	○	○	○	○	○
I have had others from Allegra over to visit my work or home.	○	○	○	○	○	○	○

Continue

Please contact shelly@wagglelabs.com if you have any questions regarding this survey.

Page 6

The following questions ask about your usage of "Wally".

Did you complete a profile for the Allegra community display in Wally?
- Yes
- No

Answer the questions below using the following scale:

1 = Not at all

7 = Extremely so

	1	2	3	4	5	6	7
To what extent did you browse the list of Wally display items?	○	○	○	○	○	○	○
To what extent did you browse the list of Wally members?	○	○	○	○	○	○	○
To what extent did you browse the comments or messages from other Wally members?	○	○	○	○	○	○	○
To what extent did you use Wally to share information or images with other people who frequent Allegra?	○	○	○	○	○	○	○
To what extent did communicate with other Wally members within the Wally system?	○	○	○	○	○	○	○
To what extent were you aware of the Wally community display in Allegra each time you entered the coffee shop?	○	○	○	○	○	○	○
On the whole, to what extent did Wally help you become aware of other people who frequent Allegra?	○	○	○	○	○	○	○
On the whole, to what extent did Wally help you actually meet people at Allegra?	○	○	○	○	○	○	○
In the future, to what extent do you believe you will use Wally to communicate with others who frequent Allegra?	○	○	○	○	○	○	○

How many people did you meet for the first time through the Wally community display?

☐

Generally speaking, please describe in one to three sentences the impact the Wally web site and community display had on your experience of Allegra.

☐☐

What did you DISLIKE or find confusing about Wally? In other words, how would you recommend improving the Wally system?

☐

Continue

Please contact shelly@wagglelabs.com if you have any questions regarding this survey.

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