Integrated Project on Interaction and Presence in Urban Environments

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First Prototype of Large-Scale Events Application

Deliverable D7.2

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Abstract

In this report we present the development of new prototypes and demonstrators of large-scale events application created in the Workpackage 7 of the IPCity showcase on “Large Scale Events”. Scenarios developed into demonstrators during year 1 have been developed further using different mixed reality tools and addressing different interaction and experience aspects.

In this second year M12-M24 WP7 had to re-design the demonstrators, create a new version of demonstrator and carry out a new round of field trials. The re-design has successfully moved forward the demonstrator with more articulated and substantially new mixed reality application in compare to year 1. The current demonstrators follow the plan of having a mobile, an installation and a pervasive component. In all components substantial advancement has been made. The mobile component has moved beyond CoMedia which was already field trialed in year 1 therefore WP7 has moved forward to investigate the augmented map lens as a new mobile component. The installation component has concretized in the CityWall a large multi-touch urban display, which was the object of extensive field trials. Finally, prototype development has commenced on Illuminate the pervasive technology component. The Illuminate component has a working prototype with the intention of developing an ambient guiding system. A new concept for navigating the urban space has been created: the idea of the mobile MapLens application is to augment real maps with location based and user created media.

The CityWall is a large public display, to which users can send their own media content using mobile phones. It has been created to support multi-touch interaction, thus enabling collaborative use of the display. This display called CityWall (formerly Contact Wall) was set up in a city center with the goal of showing information of events happening in the city. The installation has been successfully running from the beginning of May 2007 in the city center of Helsinki, Finland, and it has been part of multiple large-scale events. Several field trials of its use have been conducted resulting in two long papers accepted in CHI2008 and MUM2007 which received the conference’s Best Paper Award.

The showcase succeeded in carrying out field trials in three different large-scale events in Helsinki (Eurovision May 2007, Samba Carnival June 2007, Helsinki Festival August 2007). The multitouch display was the object of demonstration in a B2B event of the advertising sector in August 2007 in Germany.

In addition the CityWall has been turned into a permanent installation coming in contact with several thousands citizens and visitors. In particular in the Helsinki Festival the CityWall was part of the official program of the night of the Arts and appeared in the National News paper Heslingin Sanmat as well as in the program of the event. The CityWall appeared in several media internationally, Design Week UK, Casamica Italy(magazine of Coriere della Sera), Italian National Television Rai Tre in the news , Italian radio the first channel interview.

The CityWall attracted a lot of attention also in the web. Our site http://citywall.org received more than 40 000 contacts. A video was posted in youtube, CityWall was referenced in a variety of important websites, including slash.com and several blogs. We received requests from all over the world to create similar installations.

We also created a start-up to commercialise the technology www.multitouch.fi tThree of the researchers that worked in WP7 have founded the company. The company is seeking funding, has successfully negotiated IPR with the University and is negotiating sales with its first clients.

Intended Audience

The primary audience of this deliverable is the Project consortium and the EC.

1 Workpackage Objectives

Objectives Phase II	The objectives of this phase are to re-design the demonstrator, develop the second large-scale event prototypes and to conduct field trails exploring their impact to large-scale events experiences. The Demonstrator has three components that we all develop at a different pace.
Results Phase II	We have created and trialed successfully the public interactive display in large-scale events the CityWall a multi-touch large display also a permanent installation, we initiated development of a new mobile component the augmented map lens, we have a first prototype of the Illuminate the pervasive component. Two conference paper accepted, the CityWall received a lot of media attention internationally and based on this three members of the research group create a start up company. This technology was also part of a demonstration in Germany in a B2B event.
Evaluation Results Phase II	The evaluation of the prototype has been successful: two field trials were conducted in two different large-scale events happening in Helsinki resulting in new information about presence and social interaction in large-scale events situated in urban space. In addition the CityWall has been evaluated as a permanent installation.
Objectives Phase III	In the next phase we will re-define the WP7 and showcase given the large amount of results already achieved in Large-Scale Events. The WP7 will be re-directed to “Environmental Awareness” using the same demonstrator components.

2 State-of-the-Art

In this state of the art we write additional related work compared to D7.1 especially concentrating on public display as this is the component of the demonstrator that has been most significantly further developed in this period. Public outdoor spaces in urban environments are an interesting but under-researched setting for large multi-touch screens. Reported user studies have been carried out in laboratory settings or in semi-public indoors contexts such as offices and conferences. Social organization of the public space is however different from private settings (like companies) and semi-public settings like conferences. These three settings differ in a number of dimensions that may or may not affect interaction, such as number of potential users, social relationships between potential users, and knowledge about the display and its use.

2.1 Social uses of large displays

Although not that much research has been done regarding multi-touch large screens in public outdoor settings, a lot of research has already been carried out that is relevant for understanding interactions between people around large interactive displays. This field of research is vast and varied, ranging from indoor to outdoor settings and from office and work contexts to deployments for public spaces and communities. The following review focuses on studies on social uses of different large displays. We categorize public interactive displays according to the social configurations and interaction they afford: tabletops, ambient and wall displays.

Tabletop displays support a particular kind of bodily – configuration standing and sitting – and are used mainly in collaborative work spaces. Research has presented new kinds of collaborative touch-based interaction techniques that take into consideration multi-hand manipulations and touching possibilities (fingers, hand angles, user-user gestures etc.) (Rogers et al. 2004, Wu et al. 2003, Morris et al. 2006).

Ambient displays, on the other hand, do not usually involve direct interaction on their surface. They have been developed to investigate the ways how displays can be situated in physical settings, representing rhythms and movements of people in a space and increasing reflection and awareness of other users of space (Wisneski et al. 1998, Skog et al. 2003, Vogel et al. 2004). TexTales, a photograph installation in an area of buildings under a threat of being run down, attempted to develop practices of citizen journalism. An analysis of content showed eight different categories of texting, but did not address direct face-to-face citizen interaction facilitated by the display (Ananny et al. 2004).

Studies on *large multi-user wall displays* are the ones closest to the case we present. Research on these displays dates back to the 80ies but only recently studies focused particularly on interaction have been reported. The settings range from collaborative workspaces in office environments to more public settings such as schools.

The study on BlueBoard, a touch-screen display that can identify users with a RFID reader, focused on possibilities to use large displays for small group collaborative use such as sketching. This observation-based study highlighted benefits of visible physical actions (that facilitate learning from others), difficulties in developing clear turn-taking practices, and varying emerging ways to collaborate without anyone taking a leader role (Russel et al. 2002).

MERBoards were used in NASA's Mars Exploration Rover missions and studied in real collaborative settings. In longitudinal use the role and the function of the display changed as the use of other displays in the control room evolved (Huang et al. 2006). However, MERBoards' roles in team's activities were supplemental rather than central, and this posed challenges to their adoption, related to perceived ease of use, usefulness and availability at a right time (Huang et al. To appear).

The systems mentioned above are examples of *semi-public displays* – systems for "members of a small, co-located group within a confined physical space, and not general passersby" (Huang et al. 2003, 51). By being located in indoor spaces with limited access, the content and interaction with these displays has been fitted to suit the particular work practices in that space. In contrast, *public displays* are for anyone to interact in a walk-up-and use (Izadi et al. 2003) manner. In public displays, a large extent of users is passersby and thus first-time users. Most of the research on public displays has been carried out by running installations in local communities. In Opinionizer (Brignull et al. 2003), social interactions were studied in two social settings (a book launch party and a welcoming party for students). Two personal thresholds were found that potential users have to overcome before they can start interacting with the display. First, they have to withdraw from other activities (e.g., talking to other people). Second, once standing at the display, they still have to wait for their turn and feel willing to use the display in the presence of others. As an implication, the authors suggested positioning the display along the thoroughfares of traffic and improving the ways display's interaction principles are communicated implicitly to bystanders.

Campiello was a system installed in a local school in Venice, designed to support the local community that lives under a pressure of high level of tourism. In this task, it was found important to gather and share collective memories and provide it to all community members in a personalized manner (Agostini et al. 2002).

A third related study of a public display was about Dynamo, a multi-user system installed also in a school and designed to support multimedia content sharing. In addition to using public content, Dynamo supported the use of private content through "carving": reservation of a dedicated space on the screen for personal purposes. During the two weeks of a user study use patterns evolved, including ways to draw other people's attention through "upsizing" one's pictures, staging video performances in the display, and turn-taking in how much space collocated users could take from each other (Brignull et al. 2004).

The review shows how studies of large multi-touch displays mostly interested tabletops and controlled settings as office spaces. We contribute to this line of work with an ethnographic observation of social uses of a large public multi-touch display. We elaborate earlier observations on multiple user situations, including aspects of teamwork and parallel uses, as well as interactions between strangers.

Second, earlier research has indicated turn-taking as crucial for successful collaborative use. We take a detailed look at the practices and challenges related to turn-taking, e.g., conflicts that are due because of multiple users using the screen at once. We also look at how people recognize these conflicts and how they go about managing them.

Third, we want to extend current discussion from large display prototypes to their relationship with the urban environment. Interactive installations can potentially restructure the way people experience and use the space around them.

3 Overview

As in the year 1 the demonstrator is divided into three components each of which is based on its own platform. In each component there have been advancements leading to three separate applications with own developing and evaluation road map. The mobile component that was implemented in year one by CoMedia is this year continued with the Augmented Map Lens. The Contact Wall of year one is now continued as a multi-touch public display CityWall. The Pervasive component is being continued by creating the first prototype of Illuminate.

The aim of having three complementary components is to be able to address the user experience in a more comprehensive manner and to address most of the state of the art technologies for this showcase supporting the main aspects of visitors : group co-experience, engagement with an event, and navigation through space.

3.1 Applications and Mixed Reality

The three component elements described here are at various stages of development:

Component	Mobile	Public Display	Pervasive
Application	Augmented Map Lens	CityWall	Illuminate
Features	Digital overlays on physical map	Collaborative and tangible exploration and manipulation of media, contextualised display	Visualisation with lights of network flows and social interactions
Platform	Mobile phone, Symbian III edition	Installation, public touch screen, rear projection, PC	Pervasive sensing networked nodes (mini-computers)
Development	Mock-up	Field evaluated prototype	Prototype
Mixed Reality	Computer vision for map tracking and overlays on video feed of map.	Multi-hand and gesture tracking, virtual objects and simulated physical behaviour with tangible interface	Representing with pervasive audio-visual cues context sensing information

3.2 Presence and Experience

In this showcase we aim at supporting presence in urban environments focusing on events that are “large-scale”. This refers to the number of visitors and spectators (crowds), the duration that extends over days the spatial distribution. The urban perspective includes addressing flows of visitors their interaction with spaces, visibility of the mobility networks and spatial distribution of events

In particular mixed reality is seen as a way to support presence for active spectatorship improving three aspects of their experience (adapted and revised from D7.1):

- Co-experience in spectator groups –supporting awareness, coordination and expressions (verbal, mediated, embodied) in a groups in both distributed and collocated interaction.
- Engagement to the event – beyond passive witnessing deeper cognitive and social processing of the event.
- Ubiquity and distribution in space. The spectator experience has to be considered beyond the limited time and space of the core of the event. Spectators navigate through and spent time in a variety of spaces during the event period. Ubiquitous media for event should support this experience pervasively.

The research includes experimenting with interactive interface layers of awareness cues about fellow visitors, collective media, transport and mobility network, and event happenings. The three above objectives.

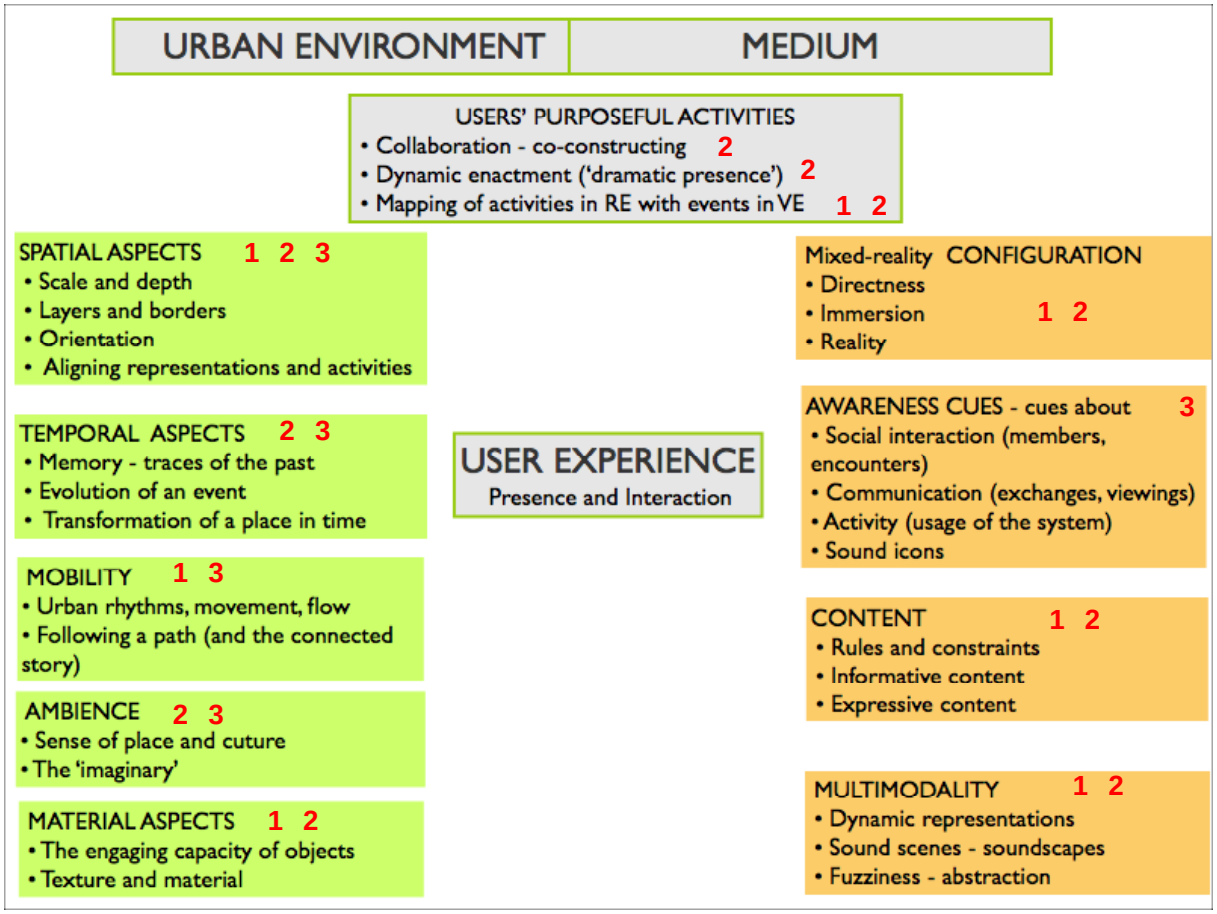

Figure 1: Relation to the concept map of components:1) mobile 2) public display and 3) pervasive

The following table summarizes how the components of the demonstrator relate to the Showcase objectives and to the revised concept map of D3.3. In both cases items are ordered by priority.

Component	Mobile	Public Display	Pervasive
Showcase objective	Engagement to the event coordination and Co-experience of spectator groups,	Engagement to the event, Co-experience of spectator groups	Navigating in the space
Urban Environment	SPATIAL, MATERIAL TEMPORAL ASPECTS	TEMPORAL, SOCIAL, MATERIAL ASPECTS	SPATIAL TEMPORAL MOBILITY, AMBIENCE
Activities	MAPPING of RE and VE	Collaboration, Dynamic Enactment,	
Medium	MR configuration , CONTENT, MULTIMODALITY	CONTENT, Multimodality, MR CONFIG	AWARENESS CUES

4 Year 2 Prototypes and Demonstrators

4.1 CityWall

The demonstrator of a large public display, to which users can send their own media content using mobile phones, was presented in the year one deliverable. During year 2 it was set up in a city center with the goal of showing information of events happening in the city. This display called CityWall (formerly Contact Wall) has now evolved to a fully functional prototype which has been set up in a city center with the goal of showing information of events

Figure 2. Screenshot of CityWall with Flickr content.

happening in the city. The installation has been successfully running from the beginning of May 2007 in the city center of Helsinki, Finland, and it has been part of several large-scale events and field-trials.

4.1.1 Description

The CityWall prototype was developed following the concept detailed in the D7.1 deliverable. The main features of the CityWall technology are 1) multiple hand tracking capable of identifying uniquely as many fingers and hands as can fit in the screen, 2) hand posture and gesture tracking, 3) high resolution and high frequency camera processing up to 60 frames per second, and 4) computer vision based tracking that works in changing light conditions. The main challenge was to support interactions for any user, from a child to a senior citizen, not requiring special skills or previous knowledge. The four technological features create the conditions for such a multi-user and multi-touch installation that is appropriate for public space. The set up is similar to HoloWall (Matshushita et al. 2003). This setup allows us to place all the equipment indoors out of the public space and use a normal safety glass as a screen.

CityWall is especially suitable for navigation of media, photos in particular. The current version gathers content that is tagged with certain keywords (“Helsinki” or a specific festival name in our case) in real time from Flickr. Figure 1 shows a screenshot from CityWall with Flickr content displayed in it, organized according to the overview + detail principle. The bottom part (B) of the screen has a timeline with pictures in a thumbnail size. It is navigated by scrubbing it left or right and it can also be compressed or expanded to show the contents retrieved during a full day or just during a couple of minutes. This has been found important as the frequency of media may vary greatly.

Interaction with the top part (A) of CityWall follows two interaction paradigms. Moving, scaling and rotation of content (C) follows direct manipulation principles: user can grab an image by putting a hand on it. The photo follows the hand movements when the user shifts her hand. Rotation and scaling are possible by grabbing the photo in more than two points (e.g., by two hands or two fingers of the same hand) and then either rotating the two points around each other or altering their distance.

The other interaction principle is non-modality. All the functionalities mentioned above are available for the user all the time. This is in contrast to modal user interfaces in which different modes of interaction are often chosen from palettes or menus. Non-modality is especially important for multi-user systems because confusions arise easily if the system needs to associate different touches with different interaction modes. With non-modal interaction this problem does not occur.

Figure 3. CityWall installation in Helsinki, Finland.

To study touch-screen interaction in a real setting, we had an opportunity to install CityWall in a central location in Helsinki, Finland for the summer 2007. The site was a 2.5 meter wide shop window next to a café located between the main bus and train stations (see Figure 2). The two stations are used by 400 000 passengers each day, and there is a lot of pedestrian traffic past the display around the clock.

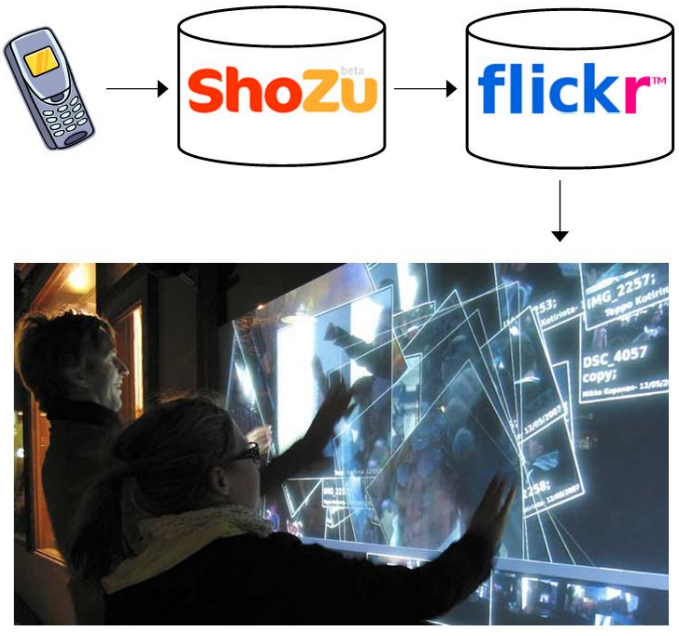

Figure 4. Information flow from the mobile to the CityWall.

To facilitate easy media capture and sharing, a mobile component was also designed. The mobile component includes a camera phone that includes software to upload pictures to the Flickr web site instantly after a photo has been taken (see Figure 3). For this purpose we used the publicly available ShoZu application. As soon as a user takes a picture, ShoZu offers to tag it with appropriate keywords and send it to Flickr with a simple button click on the phone. The CityWall computer in turn periodically checks Flickr for new content and downloads it to the wall. With this arrangement, users can take pictures easily with their camera phones during an event and later view them also on the CityWall. The pictures are also available for viewing on the Internet to anyone having access to Flickr, which gave the users more benefit (and motivation) for publishing photos.

4.1.2 Specification

Hardware and OS	• Data Projector, infrared filters • Camera and infrared lens • Infrared emittors • Multiple cameras and projectors are supported to handle larger screen (so far 2 FireWire cameras with 60fps and VGA resolution have been used with maximum of 4 projectors) • PC Hardware • OS: Linux
Software	The software uses the multi-touch display developed in WP4 and described in D4.2. Additionally the following components: • TimeLine application visualizing pictures on a timeline • Pictures can be scaled, moved, zoomed • Interface to Flickr • Email interface
Core Features	• Multiple point touch-screen supporting interaction with two hands and several people at once allowing for group interactions. • Browsing and organizing of media on a timeline • Media downloaded automatically from Internet media services like Flickr

Status	Technological prototype
Intended users	The number of simultaneous users at the screen is limited by the physical size of the screen and how many people can physically touch it at once. We have observed the groups of users to range from passers by wanting to simply look at media, to people interested in engaging in the various areas of activity over several days which the wall provides for such as sending your own media to the display and coming to see your own pictures at the wall from time to time.

4.1.3 Evaluation of CityWall usage in every-day use

Data collection. CityWall use was recorded in multiple ways during the installation. The system wrote continuously interaction log of the touches, updates of content etc. so as to timestamp the moments of interaction and see what photos were interacted with. A web camera was installed in the sunshade above the shop window, looking down to the street and the users. The recording was on continuously for one month (July 2007). Twelve short on-site interviews were carried out to collect immediate feedback from the users.

Data analysis. The video data was used as the primary content for analysis of interaction. It was first pre-processed with the help of interaction logs, to leave out the video clips containing no active use. The eight last days of July were chosen for a more detailed analysis, due to the possibility of seeing both first-time and returning users in the video. The video footage was partitioned into sessions of interaction, each session containing a full episode of uninterrupted use, either by one or more users. This partitioning preserved the possibility to analyze multi-user situations in which users may enter and leave the display at different times. If there was more than a ten second gap between user interaction with the display or with each other (nobody using the wall), then the usage was counted as a new session.

For each session, manual coding was carried out to find out, (1) its duration, (2) number of active users who touch the display, and (3) the number of passive bystanders who were using the active users. For determining the numbers of passive users, seeing their reflection in the window was helpful, as it allowed seeing a large part of the area behind the camera as well. The data from this stage of coding were used for statistical investigations of use. Upon noticing the prevalence of multi-user interactions (see below), this data was used for two types of further analysis. The multi-user instances were subjected to a second stage of coding to show what group sizes were present at the display in these sessions. Because of tediousness of analyzing whether users belonged to the same or different groups, only Monday, Tuesday and Saturday of the previously coded data were re-analyzed.

The outcome from the first coding was also used for identifying the most interesting multi-user sessions for a qualitative analysis. This analysis focused on unfolding of events and interactions at the wall and the ways in which users displayed their understanding to others in these events. Material for this analysis was selected by the following selection criteria: a) the five sessions having the most active users b) the five sessions having the most passive users c) the five sessions having the most people present in total. These sessions contained sessions from different days of the week and different hours of the day.

Figure 5. a) shows mulitple users and b) shows pairs in parallel use of the CityWall.

Findings. During the eight days of which all the interaction at the display was coded, the display was in use 8.8% of its uptime and 1199 persons stopped to interact with it in 516 sessions. They were accompanied with (at least) other 202 persons who only participated in viewing other people's interaction, without touching the display. The use was slightly more active during the weekend, and in general, took place during in the evenings after working hours. Thus, most interaction took place by freetime users, However, the increased evening and night-time use can also be partially explained by more favourable lighting conditions for the display's visibility.

Only 18% of the users were individuals. The more detailed coding of the three selected days revealed more about the social configurations in multi-user situations, two of which can be seen in Figure 5. In multi-user situations, pairs were most common: in 72% a pair was present. Individuals and groups of three were seen more rarely in these situations (18% and 23%, respectively). Groups larger than three very rarely stopped at the display at any time. Already such a short analysis of statistics points out the social nature of the large display use in an urban environment. In the following sub-sections we analyze this theme in more detail, drawing from statistics and analyses of episodes of interaction.

Deeper content analysis of the videos revelaed the following aspects regarding the social interaction that happened at the CityWall:

Dynamics of approach. Example users at the display attracted other users: in 19% of cases CityWall was already in use by someone else when a new user started using the display -- learning from other users was a key element in adapting this new technology.

Interacting at the display with others. Two baseline patterns of multi-user interaction were observed: 1) parallel use, where people use the screen without any cooperation 2) teamwork, where people use the screen collaboratively together, for e.g. to play pong like game with the pictures on the CityWall. Conflicts are unavoidable when multiple users are at the display together at the same time. Conflicts relate usually to the ownership of photos and their immediate surroundings, i.e. areas that may be needed for rotating, scaling and sorting the set of photos one is working on. But they are not always a problem, as resolving them might create new interaction between people who would not have otherwise contacted each others.

Transitions between activities and participants. By observing the actions of others, people can anticipate when it is appropriate to go and take the floor. Should one want to keep the floor, one is to take into account that any idle moment or transition relevant place, others may possibly jump in. Also, should one want to engage the other party in interaction, one may have to wait for a suitable moment to do so. Also, when people browse and play with photos together, they use verbal and physical means to communicate and ensure that they have a shared point of attention (e.g. a photo or set of photos), as well as a common understanding of the frame of activity, i.e. what to do with the object.. For example, one can establish a new point of attention pointing at an object saying "ooh" or "hey look!"

Roles and Social Configurations. When people team up at the screen, they in principle have equal rights to interact with it. However, we observed that individuals in groups orient to different and often complementary roles or social configurations. The most recurring social configuration is the teacher–apprentice setting, where one or more users take the role of an experienced user and goes on explaining the features of application and assisting the other members of the group when needed. Certain rights and constraints apply also to social configurations between strangers. Unacquainted persons need a reason to enter face encounters with each other in public places. Conflicts between parallel tasks of two or more users or teams were the main reason for interactions between strangers: The positive outcome is that the system can make strangers to interact with each other. However, we should also think of other means to support this, not rely on positive effects of accidental and unwanted system features.

These findings are discussed in more depth and with more examples in Appendix 2.

4.1.4 Evaluation of CityWall usage in large-scale events

To evaluate the system we recruited 12 users participating at two different large-scale events: a music festival and a samba carnival.

The Eurovision Song Contest is an annual competition held by member countries of the European Broadcasting Union (EBU). It is one of the most-watched non-sporting events in the world, with audience figures having been quoted in recent years as anything between 100 million and 600 million internationally. In 2007 it was held during 12–15 May in Helsinki, Finland, and attracted thousands of on-site spectators from all represented European countries. Eurovision spectators are usually organized into fan groups by nationality, supporting the performer representing their country. During a Eurovision opening party in the "fans center", a group of six female 18–22 years old supporters of Hanna Pakarinen, the Finnish competitor, were recruited. Most of them were students.

The annual Helsinki Samba Carnaval took place on June 8–9, 2007, in the streets of the city center. One part of the carnival is the national championships competition between Finnish samba schools. For the study, a group of four users (4 females) and a group of three users (2 females, 1 male) were recruited from spectators. All the users were students, aged 16–25. The users were recruited using convenience sampling at the beginning during the opening party of the carnival.

Procedure. For both events, a pre-installed Nokia N70 phone was given to each participant the day before the event. The users were instructed to enjoy the event, and to take pictures and publish them on Flickr when they felt like it. ShoZu tagged the pictures automatically with the keyword "Helsinki", helping the CityWall computer catch them. Users were not shadowed by a researcher, but we asked them to visit the CityWall a few times to allow the researcher to meet them and use a video camera to record their social interaction as they interacted with the pictures on the screen. The CityWall site was also a "help point", where the users could change their phone batteries and ask for help.

Data Collection. The following methods were used for data collection: 1) *Background questionnaires* were used to gather information on a) what kind of communication technology the users were already familiar with, and b) to inform the users how the media content they submitted was going to be used. 2) *Video observation* was used when the users visited the CityWall to get an understanding how social interaction formulated within the user group and with other random CityWall users present at that time 3) *Interviews*. Each user was interviewed privately after the event either face to face or via telephone. A semi-structured interview was used, which contained questions about CityWall usage, mobile camera phone usage and event participation in general. Each interview lasted approximately 15–20 minutes. 4) Finally *content analysis* was done to the data that had been gathered, which included both the videos and interviews recorded. A written transcription of both video and audio data was generated. Also pictures taken by users and submitted to the CityWall were

logged and categorized to get a general view of what things at the events were of most interest to the users.

Findings. All the user groups used the mobile phones to take photos in the events and came afterwards to look at their photos at the CityWall. All but one user took photos, the average number of photos per user being 69. Most photographed targets were the events that users participated in. This indicates that having a camera phone did not seem to disturb event participation. One's friends were the second most popular target.

In the interviews the users reported concentrating more on the events than they would have without the phone.

A user from Eurovision group commented that:

> "It was fun. It gave a different perspective. Otherwise I would have just watched. Since the images would go onto the CityWall and stay there for a while, they should be something not special but capture some point, so we started searching for these kinds of things. It was different".

It can be argued that the users were not just merely watching the events as passive spectators, but actively being part of it as creators of public media.

The users did not have technical problems using the camera phone as most of them were already familiar with using such devices. The only real limitation in the users' point of view was the duration of the batteries of the camera phones: all users had to take breaks from the events to replace or recharge batteries.

The Eurovision group visited the CityWall every time they passed by the CityWall, approximately five times a day. The two Helsinki Samba Carnaval groups did not go there as often, only "a few times a day". What all looked for on the CityWall were their own pictures, as "it's nicer to look at your own photos than photos of buildings" and because photos taken by others were felt to contain "nothing interesting".

From the videos could be seen that the users learned rather quickly how to use the CityWall display. The general expression of the users' attitude on the system was a positive one. One user ended the interview saying, "It's a fun system that the pictures stay there, so you can go and see what has happened at different events."

These findings are discussed in more depth and with more examples in Appendix 2.

4.1.5 Demonstration of CityWall with a portable installation

CityWall was also tested in 2007 with a portable system. The aim was to see how much time a portable setup and takedown would take. The demonstrators happened at the IPDeutschland tour as shown in Figure 6, with a “mobile” system that was set up in 4 locations. The system took one and a half days for setup for a one afternoon show. The take down took all the evening. The portable system consisted of a 2.8 x 1.8 x 1.5 meter box with 2.8 x 1.2 meter screen. This heavy and demanding project was implemented successfully, but the need for a lighter and more easily transportable installation package was recognized. Especially the frame and the surface where images are projected were found to be too heavy to be really portable.

Figure 6. Picture from the IPDeutchland tour.

4.2 Illuminate

Illuminate technology is currently a working beta demonstration. Trials on using the illuminate technology will be planned during January 2008 and will happen probably during Fall 2008. The trials of the Illuminate have been postponed because of other trials which have occurred within WP7. The technology (described in detail in D5.2) enables tracking the movement of people through distributed event spaces, the staging area for social interactions that occur outside a given users peer group. These interactions are composed of flowing movements resulting in moments where new, perhaps fleeting, connections are made. Rendering partially invisible flows and social interactions visible enriches a spectator’s presence at and awareness of an event.

As a means to visualize and support these flows and social interactions, people and spaces are illuminated with coloured lights. Physical spaces are illuminated with ambient lighting by Nodes (small PCs, connected together wirelessly), whilst people are provided with illuminated Badges. The color of ones badge or the color of a space is affected by physical interactions between spectators and spaces, events or other spectators. Also, as a new concept, yet to be fully implemented, the Illuminate allows users to set the lightning of a

place interactively, thus modifying also actively their immediate environment lightning, using their mobile phones.

4.2.1 Description

The Illuminate technology has been realized through the use of a network of Nodes each equipped with Bluetooth™ sensors and a wireless Internet connection. The nodes are communicating with each other using the Atelier Infrastructure, a Java and XML based distributed framework. The nodes also have the ability to control ambient lighting within the space they are installed, using the Arduino board. A wearable electronic badge, to be prototyped using mobile phones, will employ a Bluetooth™ sensor and a light source.

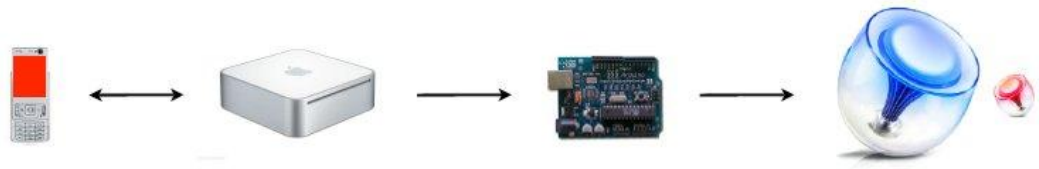

Figure 7. Information flow from mobile phone through a Node and an Arduino board to lights in Illuminate.

Since Bluetooth™ device discovery takes time, especially when many devices are nearby, the implementation caches the found badges (mobile phones) in the Nodes, thus minimizing the need for device discovery. This also enables the other Nodes further away to find the Badges quickly, since the Nodes share the cached, found devices over the Atelier Infrastructure. Nodes use the cached Bluetooth™ device addresses to attempt direct connections, eliminating the time consuming device discovery phase. A possible sequence is shown in Figure 7.

Bluetooth security requires that the devices have to be paired before data can be transferred between the devices (Nodes at the event site and the participants' mobile phones). Since pairing requires physical proximity, this makes this approach practically impossible. For this reason the Nodes and Badges must not be required to be paired. Thus, in the implementation, we use the Bluetooth Service IDs as the means to pass color information between the Nodes and the Badges. Devices can thus just by using the service discovery, querying the service attributes of the Badge service, get the color of the Badge.

4.2.2 Specification

Hardware and OS	PC hardware, Linux, MacOS X, Arduino board for controlling lightning. J2ME 2.0 enabled mobile phones (with necessary JSRs) as Badges.
Software	• Modified Avetana open source Bluetooth™ OBEX implementation • BlueZ Bluetooth™ stack • Component implemented in Java, using the Atelier Infrastructure as a platform for distribution.
Core Features	• Enables control of lightning in a space, as well as controlling the color of the Badges carried by the event participants,

	in a wireless environment. In new version, active control of the lightning in a space.
Status	• Beta prototype
Intended users	• Any number of users
Showcases	• WP7, others
Relevance beyond project	• Can be used outside the project in similar purposes; uses open source and freely available software and hardware.

4.2.3 Testing / Evaluation

The Illuminate has been tested in a laboratory environment using four nodes, one Arduino board (other nodes using flat displays to simulate lights) and eight mobile phones. The system performed well, considering the limitations of the Bluetooth™ discovery. In the implementation, the open source Bluetooth™ stack used had to be hacked in order to enable the usage of the service attributes in conveying the devices' colors between the Nodes and the Badges.

4.3 MapLens

This tool enables the user to view location based media on top of the map image projected on a smartphone camera screen. The map image is grabbed from the phone camera, as the user holds the camera on front of the map. The media overlay can be various things, e.g. photographs, locations of other uses, event locations or other information related to any event.

4.3.1 Description

MapLens application is developed with C++ on Symbian OS v9. The application acquires an image of a map with the phone camera, analyses the features of the image, and based on the features, identifies the GPS coordinates of the map area visible on the phone screen. Based on these coordinates, the tool fetches location based event data from a HyperMedia Database using the WLAN connection on the phone. User then is able to view the event data based on the location of the media and other event related data. For more in depth technical description, please see the D4.2.

As the user moves the camera over the map, the content thus changes, depending on the area visible on the phone screen.

The role of the HMDB is to act as a cache and a single source for the location based data displayed on the layers of the tool. Actual media and other data may either be directly stored by other applications to HMDB (like MMS Entrance, Bluetooth Media Dispatcher, eMailEntrace or other tools).

In some scenarios Flickr images are planned to be used in WP7. In these cases we strive to keep the simplicity of the media browser tool and still use only HMDB as the data source. For this purpose, we will build extension modules to HMDB which will prefetch the Flickr geotagged photographs for the geographical areas that are planned to be used with the tool (MapLens). The HMDB may either store the original photographs or just a link to the original photograph in Flickr, depending on the performance difference and the required performance.

4.3.2 Specification

Hardware and OS	Nokia N95, Symbian OS v 9, S60 UI 3rd Edition
Software	C++
Core Features	Grabs mobile phone camera image, extracts features from the image, showing a map. Defines the area of the map visible on screen, gets location based media from remote database and displays media, icons on top of map.
Status	Implementation ongoing, first prototype ready by March 2008.
Intended users	Users interested in location based media, events.
Showcases	WP7, others.
Relevance beyond project	Would be usable and extensible over many usage scenarios.

4.3.3 Testing / Evaluation

The first version of the tool with limited functionality and restricted performance will be available in March 2008. First field tests are initially planned to be held in Fall 2008. Details of these will be planned during Q1/2008.

A mockup picture of MapLens UI with an augmented map can be seen in Figure 8.

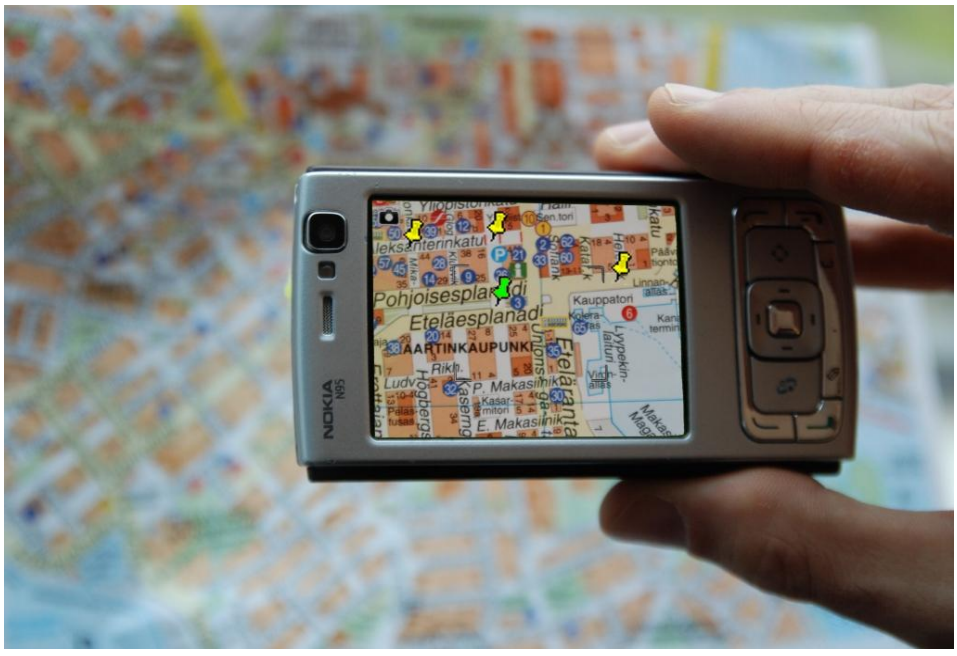

Figure 8. A mockup picture of MapLens user interface.

5 Dissemination

The CityWall has been turned into a permanent installation coming in contact with several thousands citizens and visitors. In particular in the Helsinki Festival the CityWall was part of the official program of the Night of the Arts and appeared in the National News paper Heslingin Sanomat as well as in the program of the event. The CityWall appeared in several media internationally: Design Week UK, Casamica Italy (magazine of Coriere della Sera), Italian National Television Rai Tre in the news and Italian radio, the first channel interview.

The CityWall attracted a lot of attention also in the web. Our site http://citywall.org received more than 40 000 contacts. A video of CityWall was posted in YouTube and CityWall was referenced in a variety of important websites including http://www.slashdot.org

The CityWall was reported in a large number of news sites and blog around the planet. See 5.4.

Below a summary table of field trials and users.

The showcase succeeded in carrying out field trials in three different large-scale events in Helsinki. In addition the showcase had and is having a permanent installation in Lasipalatsi, Helsinki.

Prototype	period	Event	url	Users
CityWall	May-July 07	City installation in cooperation with Cultural Office	http://citywall.org	Average 1000 per week
CityWall + mobile	May 2007	Eurovision, song competition	http://www.eurovision.tv/index.php	8 users
CityWall + mobile	June 2007	Samba Carnival	http://www.samba.fi/?lang=en	6 users
CityWalll	August 2007	Juhlaviikot, Helsinki festival, Night of the Arts	http://www.helsinginjuhlaviikot.fi/	General Public
CityWalll	Current	City installation in cooperation with Cultural Office	http://citywall.org	General Public

5.1 Commercial Exploitation in a start-up

We received requests from all over the world to create similar installations. We also created a start-up to commercialize the technology http://www.multitouch.fi: three of the researchers that worked in WP7 have founded the company. The company is seeking funding, has successfully negotiated IPR with the University and is negotiating sales with its first clients.

5.2 Publications and presentations

Peltonen, P., Kurvinen, E., Salovaara, A., Jacucci, G.,, Ilmonen, T., Evans, J, Salovaara, A, Oulasvirta, A. '"It's Mine, Don't Touch!": Interactions at a Large Multi-Touch Display in a City Center' to appear in CHI2008, ACM press.

Peltonen, P., Salovaara, A., Jacucci, G., Ilmonen, T., Ardito, C., Saarikko, P., Batra, V. Semi-public displays for small, co-located groups. In Proc MUM 2007, ACM Press (2007), New York, 131–138.

Peltonen, P. CityWall. A presentation at the annual Conference of Finnish Social Psychologists in Tampere, 2007.

5.3 Sites and Blogs reporting on CityWall

From the city of Helsinki:

http://www.helsinki.fi/en/index/matkailu/uutiset/2d69988a9c720d6937cd28e1b817db1d.html

CityWall also appeared in several blogs and news sites:

http://www.gearfuse.com/citywall-built-this-city-on-social-media/

http://votwfrench.wordpress.com/ 2007/12/05/le-city-wall-a-helsinki/

http://www.gwix.net/blog/fr/interface-human-computer/citywall-mobilier-urbain-ecran-multitouch.asp

http://digitalexperience.dk/index.php?s=multi-touch

http://meneame.net/story/citywall-ejemplo-tecnologia-multi-toque-gran-escala-video

http://digg.com/design/A_large_multi_touch_display_and_playful_human_engagement

http://cooing.kr/tag/multi-touch

http://mjulia.org.ua/index.php?newsid=1857

http://cooing.kr/577

http://www.blogarts.net/?2007/08/30/ 286-city-wall-un-ecran-tactile-pas-comme-les-autres

http://blog.jvm-neckar.de/2007/05/29/citywall/

http://tw.youtube.com/watch?v=FZ9JvzYec4U

http://eliax.com/index.php?/archives/ 4136-CityWall,-ejemplo-de-tecnologia-multi-toque-a-gran-escala.html

http://www.limk.com/yorumlar.php?cid=112514

http://emeshing.blogspot.com/2007/08/citywall.htm

http://favoritos.kazulo.com/bookmark/ detailfo/cat_id/1/rec/77/citywall.htm

http://www.bold.cl/blog/?p=620

http://www.gearfuse.com/citywall-built-this-city-on-social-media/

http://people.clarkson.edu/~johndan/workspace/2007/05/citywall_public_collaborative.html

http://finnmetal.com/blog/?p=146

http://www.designerblog.it/post/ 1395/un-citywall-nel-cuore-di-helsinki

http://olkas.blogspot.com/2007/07/citywall.html

http://www.xinoxano.com/2007/05/28/citywall-helsinki/

http://www.medienschmerz.com/2007/05/citywall_helsinki.html

http://www.flytip.com/blog/?p=1424

http://e-spacy.com/blog/citywall-multitouch-technology/

http://bumped-heads.blogspot.com/2007/06/citywall.html

http://www.dailygalaxy.com/my_weblog/ 2007/05/city_wall_colla.html

http://www.youtube.com/watch?v=MSC6mPbuQg8

http://www.polaine.com/playpen/ 2007/05/25/multitouch-city-wall/

http://ebuzzblog.blogspot.com/2007/10/citywall.html

http://www.dirtymouse.co.uk/web/city-wall-helsinki/

http://geeksugar.com/472558

www.digitalexperience.dk/?p=289
http://sweb.cityu.edu.hk/nmi/2007/07/citywall-multitouch-again.htm
http://www.facade.fi/?p=27
http://people.clarkson.edu/~johndan/workspace/ 2007/05/citywall_public_collaborative.html
http://www.stylecrux.com/city-wall-helsinki/
http://www.tranism.com/weblog/2007/05/the_citywall.html

6 Appendix 1: Production factors of a large-scale event in the context of IPCity

Transferring a research laboratory projects into real world case prototypes requires many things in addition to technology development and user research. Experience in event production and networking with people having appropriate relation to the events and people organizing them is needed. Convincing cultural producers can be critical when trying to apply technical innovations such as multi-touch technology to support large-scale event based activities: without the support of the producers and event organizers integrating the technology to the event will become most likely impossible. Potential extra work regarding guidance, maintenance and misuse issues must be taken in consideration. Successful results are based on seamless collaboration with resources and professionals in relation to real world events and their production requirements. Well designed project can help to open a dialog between multidisciplinary professionals and establish new practices as happened with CityWall.

6.1 The Lasipalatsi Film and Media Centre

CityWall is a large public display to which users can send their own media content using mobile phones. The display is set up in the Lasipalatsi building in the Helsinki city center with the goal of showing information of events happening in the city. Lasipalatsi building is owned by the city of Helsinki and maintained by the Lasipalatsi Media Centre Ltd. The building is located in the center of Helsinki, presenting the spirit of accessibility and modernity that its creators strove for already in the 1930's. The event driven collaboration between city officials, Lasipalatsi and HIIT established a premise where a suitable shop window space for testing the CityWall multi-touch interface was found. Dedicated space allowed developers to work flexible times with the installation in the middle of the city, where potentials users can come to use the display at any time of the day. Most of the construction work occurred on site and required flexibility from the researchers, as the research institute is located outside the city center. Benefits of working closely to the installation site provided again ground for instant feedback from the users, critical to technologies dealing with crowds and social activity. Also, working around people in the public space made the research work more enjoyable and inspiring.

As our installation was to be used and easily adapted by the public without prior knowledge of how to use the technology, user interface design and usage instructions played a critical role in the setup. The CityWall display is used for public photo sharing via appropriated media content sites and their functionalities such as Flickr and YouTube. The ubiquitous functionality of media sites and their original usability was supported with window vinyl stickers presenting the contribution guidelines and gestures used to manipulate visual content. Use guidelines were designed collaboratively by the usability expert and interface designer while event organizers gave editorial feedback which helped to limit technical jargon in the final communications and to match the visual identity of the event.

6.2 Branding design

Visual identity was created to be used in the electronic and printed communications as a base for disseminating HIIT UIx research objectives and contextualize the project in media. Multidisciplinary R&D visibility was implemented as part of the window design, and partners from EU research context such as HIIT and IPCity were made visible with logotypes; as were local partners such as Helsinki City Cultural Office, Helsinki Festival. The branding of the window and its accessibility were not specifically tested or inquired by the users, which could be done in the future.

6.3 Local partners in 2007-2008

Experienced designer with appropriate networks helped to establish a relationship in between Helsinki Festival and HIIT UIx research group. Also partners and event organizers from the Helsinki Design Week, Museum of Contemporary Art, Kiasma and Helsinki Samba Carnaval were contacted. A stable working relationship between Helsinki Festival and Helsinki Design Week was established. This collaboration is planned to continue in 2008 on the basis of existing plans and evolving relationships within UIx group

7 Appendix 2: Field Evaluation of CityWall Prototype

7.1 CityWall Every-day Use

In this presentation of findings of CityWall every-day use we focus on how people used the CityWall installation, and how they collaborated and interact with each other at the screen. The presentation draws from the statistics distilled from the coded episodes of interactions on the videotape, on-site interviews, and interaction analyses on selected multi-user episodes.

During the eight days of which all the interaction at the display was coded, the display was in use 8.8% of its uptime and 1199 persons stopped to interact with it in 516 sessions. They were accompanied with (at least) other 202 persons who only participated in viewing other people's interaction, without touching the display. CityWall use was slightly more active during the weekend, and in general, took place during in the evenings after working hours. Thus, most interaction took place by free time users. However, the increased evening and night-time use can also be partially explained by more favorable lighting conditions for the display's visibility.

Only 18% of the users were individuals. The more detailed coding of the three selected days revealed more about the social configurations in multi-user situations. In multi-user situations, pairs were most common: in 72% a pair was present. Individuals and groups of three were seen more rarely in these situations (18% and 23%, respectively). Groups larger than three very rarely stopped at the display at any time.

Already such a short analysis of statistics points out the social nature of the large display use in an urban environment. In the following sub-sections we analyze this theme in more detail, drawing from statistics and analyses of episodes of interaction.

7.1.1 Dynamics of Approach

The CityWall installation was set up along a busy public street. Logically, the first question is how people who pass by or go about their business there notice that there is an installation – or that the installation is interactive.

Noticing the Display

The presence of other users is important already in the way how new users arrive at the display. In 19% of the cases CityWall was already in use by someone else when a new user entered the display and started using it. Given that the display was in use 8.8% of its total uptime, this indicates very simply that seeing people using the display served as an attractor for more users.

In Figure 9, people are gathering under the sunshade to shelter from the rain that has just started. Despite of the objects on the screen constantly moving, they are not paying attention to the screen, and stand their back towards it just waiting for the rain to end. After ~20 seconds, a boy that arrived there with his friends, notices the instructions reacts. He utters "oooh", getting the attention of his friends, and the older man standing next to him.

Figure 9. Shelter from the rain

Figure 10. Stepwise approach to the wall

The example illustrate a typical pattern related to entries; *people most often notice the wall when someone is using it*. Visibility of the screen is not merely a sum of its physical properties. As the urban landscape is already full of visual clutter, people appear to be more attentive to other people's doings there. The user interviews conducted supported this: users commented, that the system was hard to notice if nobody was using it and one did not know what it was beforehand. They also stated that when they started using the installation it attracted a lot of attention from passers by.

Stepwise Approach

After noticing the screen, people need to decide what to do about it. If there is nobody using it, or if there is room at the display, one can just step in and start exploring. From the reflection on the display, however, we observed that people often approached it in a stepwise manner (Brignull et al. 2003).

In Figure 10a, the reflection shows the feet of two men observing it from several meters away. They wait for the couple in front to leave before approaching the screen. In Figure 10b, the reflection shows two women waiting for their turn just behind the person(s) using the screen. The latter layout is akin to queuing, but more about making one's presence visible to the one(s) using the screen than explicitly stating who is to take the floor next.

7.1.2 Interacting at the Display with Others

Multi-user interaction was the primary type of interaction observed at the display. In the most extreme case observed, there were even seven users touching the wall and browsing content with both hands at the same time! Because browsing content in the wall often had implications to other users' possibilities to use the wall, many turn-taking mechanisms were taking place.

Two baseline patterns of multi-user interaction were observed. Firstly, in *parallel use*, people can occupy an area of the screen and focus on their own task irrespectively of the activities on their left or right. Alternatively, they can engage in *teamwork:* grouping with other users

and focusing on the same object or set of objects. Failing to maintain the current organization, or to provide a smooth transition from one mode to another, leads to conflicts that then need to be handled separately.

Parallel Use

The CityWall screen is 2.5 meters wide, which means that it can accommodate several users at the same time. All users interviewed commented that the installation is most fun to use together and with one's friends. We observed that there are several ways people can organize parallel and joint activities at the screen.

Example above displays two instances of parallel uses. In Figure 11a, a group of more than ten young users has just gathered in front of the display, and at the moment seven of them are trying to use it simultaneously using their both hands. Instead of coordinating their action, each of them tries to use the screen as an individual, not paying attention to what the others do. The end result is that nobody gets anything done as the screen receives too many inputs.

In Figure 11b, a pair of young males have both picked their own photos rotating and scaling them irrespectively of the doings of the other. In this respect, their use also can be characterized as parallel. However, at some point the two friends notice a similarity between their interaction, and start making fun of it. They start scaling up and scaling down the photos in a synchronized and pulsating fashion. This turns into a kind of dance, as the person on the left starts bending his knees and nodding his head according to the rhythm of the photos. This *dance between boys* lasts a brief moment only, as the man on the left breaks it short by

Figure 11. Parallel use

taking a bunch photos and throwing them on the one his friend is holding. The example shows how small the difference between doing things alone vs. doing things together can be.

Teamwork and playful activities

As in Figure 11b, it often happened that people who came to the screen with their friends, did not just step in as individuals, but clearly teamed up in joint activities or started working on the same object.

In Figure 12a we see a large group of older tourists that have gathered in front of the display. Although the outset is similar to the one in Figure 6a, the social organization is different. In this case, not everyone goes to the display at once, but most of the group gathers behind the users, commenting and giving advice.

Teamwork is sometimes also a way of dealing with physical obstacles, or it can be done because it is more fun that way, or both. In Figure 12b, the two men are both holding a can of beer in their hand, and because of that reason – or inspired by it – start scaling up the photo each grabbing one corner. Although CityWall was designed to enable two-hand usage, we observed many people using it with one hand only. As two-hand usage was not enforced (all moving, zooming and panning activities could also be done one handed), this may have something to do with personal preferences, but not always. Not rarely was one-handedness due to a similar physical obstacle as in the example above; it appears that people downtown Helsinki are carrying all sorts of bags, skateboards, cameras, mobile phones or other items.

Figure 12. Teamwork

The photos displayed on CityWall were downloaded from public forums in the web. This resulted that an average user had no personal relationship with the content of the photos that happened to be on the screen when she appeared on site. Browsing to one's own photos, should one have any online, or to more interesting photos was possible but not well supported. This turned the user's attention from content to aspect of the interface. There were also users that seemed to take the content of the photos seriously, but a vast majority seemed to focus on playing with the interface. This was visible in invention of *games* and different kinds of *nonsense activities* at the display. For example, people were playing *Pong*, throwing photos at each other, and *soccer*, building a goal out of two photos and trying to throw a third one in. There were also occasions when several people went to the screen bellowing and waving their hands irrationally.

Conflict management

Regardless of the type of activity individuals or teams are involved in, occasions where activities of different groups collide are likely to happen at some point.

In Figure 13a, the activities of the two groups conflict when the man on the left accidentally blows up a photo so that it goes on top of the photos that the group on the right was working on. They both turn their gaze towards the other group, and pull their hands out from the screen. In addition, the woman places her hands in front of her chest making her withdrawal clearly visible to the other team.

Figure 13. Conflict management by withdrawal

In Figure 13b, an older woman has spent quite some time at the screen browsing the photos, and carefully scaling up and assembling some selected ones on the center of the screen. At some point, two men start using the screen on the left, which soon leads into similar blow up and overlap problem, preventing her to continue. She turns to her husband (who has been watching the episode from behind) with a frustrated comment and bodily gesture, lifting her eyebrows and placing her arms on her hips. Instead of displaying her frustration to the other team, she seeks the support of the audience to make a moral statement about the situation. Similar observations have been made about responses to butting in a queue; the party feeling violated brings the attention of others to the observable problem, as if making the members speak in unison (Livingston 1987, 13–14).

Conflicts relate to the ownership of photos and their immediate surroundings, i.e. areas that may be needed for rotating, scaling and sorting the set of photos one is working on. The problem is that the UI causes people to unintentionally break these territorial borders, for example when photos are accidentally blown up or when using the timeline irrespectively of the doings of the other participants, , which was found most disturbing conflict by the users interviewed. This is not to say that conflicts are always a problem – in the user interview one user stated that one's friends helped out when something unexpected happened and it was actually fun when photos got accidentally and unexpectedly too big.

Figure 14. Social interaction inspired by conflicts

Although conflicts take place, they can also have positive consequences to the social organization at the display. In Figure 14a, the boy has just jumped to try to take over the photo on the top left corner of the screen. The man in white shirt steps in claiming: "It is mine, don't touch". The participants take this as joking and laugh together. In Figure 14b, the man on the left has accidentally thrown a photo on top of the one the couple on the right is working on. After a joint recognition of the conflict, he and his friend start throwing more photos at the other group. The man on the left responses "bravo bravo", all four laugh together, and the group on the left withdraws handing over the floor to the couple.

7.2 Transitions between activities and participants

Above we have presented that CityWall supports various joint activities, such as *browsing* and *scaling* of photos, playing *Pong* or *soccer*, or even *dancing with photos*. Similarly, we have shown how people use the screen together with others in various combinations, and how they negotiate who gets to, or should use the screen, and when.

The possible activities or possible combinations of people are as infinite as the imaginable contents of photos displayed on the screen. Rather than telling what all the possible activities supported by CityWall are, we show how the management of transitions of different kind is intertwined with the physical interaction with the display and with the other users, as well as sense-making of photos.

Floor and Turn-Taking

Research on ordinary conversation has shown how the participants monitor the current speaker and orient to transition relevant places (TRPs), i.e. moments when it is possible to take the floor (Sacks et al. 1974). Also the speaker recognizes these windows of opportunity, and has means to select the next speaker slot or ways to continue keeping the floor across a TRP (Sacks et al. 1974). In a similar manner the CityWall users, when giving the floor to others, could provide for fluent transition by making their withdrawal noticeable. For example they could leave the screen throwing a photo or fast-forwarding the timeline. Another example of *terminal activity* was when people, just before their exit, slowly but steadily move towards the side of the screen haphazardly poking at the elements of the UI. The conclusive nature of the activity is visible in how they play with whatever happens to be visible on the screen, with no attempts to bring in any new items (Schegloff & Sacks 1973).

By observing the actions of others, people can anticipate when it is appropriate to go and take the floor (Sacks et al. 1974). In one occasion, a boy who came to the installation with his mother, made a move towards the screen when there was only one person using it and there was plenty of room. His mother however prevented this, ordering "*noo-no no, wait it's their turn now.*" The example shows that appropriate moment for entry or transition between users is not a matter of available space at the display, but a result of a more complex reasoning and negotiation between the participants.

Expressive and Pondering Gestures

Should one want to keep the floor, one is to take into account that any *idle moment* or *transition relevant place*, others may possibly jump in. Also, should one want to engage the other party in interaction, one may have to wait for a suitable moment to do so.

We observed that people can use *distinct ways to touch or hold photos* in ways that serve the management of transitions between users or activities. Furthermore, transition management of this kind is not a separate activity, but intertwined with cognitive and physical aspects of use.

In Figure 15a, the woman on the left is carefully moving objects around the left side of the wall. In contrast, the couple on his right is exercising scaling up with grandiose gestures, at verge of entering her personal space. In Figure 15b the man on the left is holding a photo in his hand, keeping it in constant small movement, waiting for the right moment to interfere with his friend's intense interaction with the photo on the right. When the right moment comes, he proposes "catch", after which the two start throwing his photo back and forth (see Pong playing above).

When it comes to holding and manipulating photos, the *intensity of touch* can vary a lot. *Grandiose gestures* provide for an intensively tangible interaction experience that also communicates to the other participants. On the other hand, we recorded many events where people were holding photos with a *pondering grip*, as if thinking of what to do with the photo or waiting for an inspiration or action of a co-participants that would open an opportunity of some kind.

Figure 15. . Pondering grip vs. grandiose gestures

Concluding Actions

When people browse and play with photos together, they use verbal and physical means to communicate and ensure that they have a shared point of attention (e.g. a photo or set of photos), as well as a common understanding of the frame of activity, i.e. what to do with the object.

Before changing to a new object or frame of activity, it is natural to summarize the earlier ones, for example saying that something was *fun* or *cool* or *boring* etc. Assessments can also look forward in time. For example, one can establish a new point of attention pointing at an object saying "*ooh*" or "*hey look!*"

Although possible in theory, it would be difficult, i.e. socially obscure to go to the screen and use it with someone without presenting opinions or assessments at some point. For example, when leaving the site, people sometimes leave their fingerprint or make a mark of some kind.

Figure 16. . Leaving a mark

In Figure 16a, just before leaving the screen, the man scales down and arranges all visible photos in a gallery-like layout, wasting no space. In Figure 16b, the man entertains his audience by blowing up one photo to fill the whole screen and announcing in a loud voice "the world is MINE!"

There are several means to leave a mark. At exit, people, for instance, can give momentum to the timeline or desktop so that photos fly there for a moment, or select a funny or embarrassing photo to leave on top.

7.3 Roles and Social Configurations

As also said, 18% of the use episodes contained only one person interacting with the display. Of the complementary 82%, 20% of the time there was more than one group present at the wall. Thus, in total 0.82 * 020 = 16% of the use situations at the display took place when the display was interacted with by people who were strangers to each other. The introductory chapter already stated that the most common group sizes were two, three and one (in this order).

When people team up at the screen, they in principle have equal rights to interact with it. However, we observed that instead of uniform orientation, individuals in groups orient to different and often complementary roles or social configurations. The most recurring social configuration is the *teacher–apprentice* setting, where one or more users take the role of an experienced user or technologically savvy, and goes on explaining the features of application and assisting the other members of the group when needed.

Figure 17. Teacher-apprentice setting

In Figure 17a, the man shows and tells to his girlfriend how the touchscreen works. The posture of his girlfriend clearly tells she does not intend to touch the screen yet. In Figure

17b, the man in front of the display gives an overview of various parts of the UI. For that purpose he has positioned himself between the screen and audience. In the user interviews it also came up that it was easy to learn to use the touchscreen just by following the example of others, and nobody actually needed to read the instructions printed next to the installation.

Another role is that of a *comedian*. For example the man appearing in Figures 14a and 16b looked actively for opportunities to entertain his audience. Role taking is also an essential part of gaming; when playing *pong*, we are tied to the fuzzy set of rules that relate to the game, and do not for example interact with the timeline. Although we did not find instances of authorship in the sample, it is easy to imagine roles that relate to the content of the photos, for example the photographer or subject of a photo is likely to highlight a different aspect of it than an average passer-by.

Role-taking can also be seen a way to deal with the complexity of the social setting and usability problems it causes. When several people gather at the display it is unfeasible to assume that all could step in as the main operator of the system. As there was no concrete support for queuing or turn-taking, people often filled in any space that opened in front of the screen. Different types of social configurations at the display make *it possible for multiple people to participate* at once. For example, when a person is interacting with the wall, her friend can adopt the role of an assistant or a commentator, affecting the course of events without having to touch the display. Casting was not done only at the outset, but people were changing places on the fly. Supported by verbal reports, people were also able to align their parallel and joint activities (Kurvinen et al. 2007).

Certain rights and constraints apply also to social configurations between strangers. Unacquainted persons *need a reason* to enter face encounters with each other in public places (Goffman 1963., 124). In case of CityWall, conflicts between parallel tasks of two or more users or teams were the main reason for interactions between strangers. Users did try to avoid interfering with parallel activities, but the system did not support *the norm of social segregation* between the unacquainted, but made photos accidentally inflate or fly across the screen. This then forced the users to engage in conflict management with each other. The positive outcome is that the system can make strangers to interact with each other. However, we should also think of other means to support this, not rely on positive effects of accidental and unwanted system features.

7.4 CityWall Usage in Large-scale Events

In presenting our findings we will first look at statistics gathered of the camera phone use. Then we will discuss the results of the content analysis of the user interviews and video recordings, first turning our eye on the camera phone use and last on what could be observed from the activities at the CityWall.

7.4.1 Events most Often Captured with Phones

The users used their mobile camera phones extensively. All but one user (who participated in the Helsinki Samba Carnaval only for a short while and was not interviewed and was therefore excluded from the primary analysis) took photos, the minimum number of photos being 12 and the maximum 199. The average number of photos per user was 69.

The events that users participated in were their most photographed targets. This indicates that having a camera phone did not seem to disturb event participation. One's friends were the second most popular target. The rest of the pictures consisted of urban scenery. Example photos taken by users can be seen in Figure 13.

7.4.2 More than just Watching

In the interviews the users reported that taking pictures with their mobile camera phones knowing that they would go look at the pictures on the CityWall later on, they ended up concentrating more on the events than they would have without the phone. One user from the Samba Carnival group commented that

> "I probably would've watched the event from a different location, from further away, but now we were in the front line. And I think we also watched more closely how the parade goes."

The same user also said that

> "We were participating in the event more actively than we would have otherwise, and probably would have watched only half of the event without the phones and the wall."

A member of the Eurovision group commented that they

> "started taking pictures mostly when something was happening and not when we went to sit in McDonald's or anything. Mostly things related to the Eurovision as the whole week was filled with things related to it".

Another user from Eurovision group commented that

> "It was fun. It gave a different perspective. Otherwise I would have just watched. Since the images would go onto the CityWall and stay there for a while, they should be something not special but capture some point, so we started searching for these kinds of things. It was different".

So, from the end-user viewpoint it could be argued that the users were not just merely watching the events as passive spectators, but actively being part of it as creators of public media.

The users did not have technical problems using the camera phone as most of them were already familiar with using such devices: as one of the users commented: "It was easy. And fun too... I have the same kind of phone myself, so it wasn't that hard." The phone was not

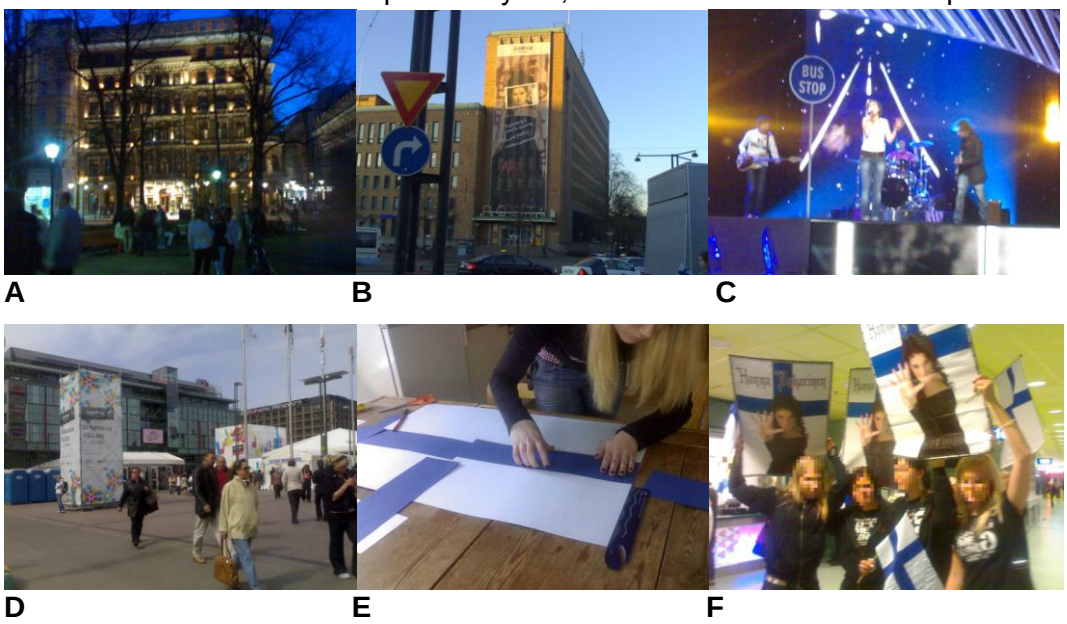

Figure 18. Example photos of urban scenery (A, B), event (C, D) and group (E, F) taken by users with their camera phones.

considered as a burden to carry as the users were used to carrying their own mobile phones anyway.

What some of the users missed were features of good quality cameras, namely having a good optical zoom. But the only real limitation in the users' point of view was the duration of the batteries of the camera phones: even with ShoZu transferring the photos via GPRS and not the more power consuming 3G data transfer mode, all users had to take breaks from the events to replace or recharge batteries.

7.4.3 Having Fun Together at the Wall

The Eurovision group visited the CityWall frequently, in their own words “every time we passed by the CityWall, about five times a day”. The two Helsinki Samba Carnaval groups did not go there as often, only “a few times a day”. What all looked for on the CityWall were their own pictures, as “it's nicer to look at your own photos than photos of buildings” and because photos taken by others were felt to contain “nothing interesting”.

From the videos could be seen that the users learned rather quickly how to use the CityWall display. The only male user explained:

> “It comes very naturally how it works, so you stop focusing on the technology. We were interested especially in the photos, and liked zooming and moving [them]. You don't have to think how to do it”

The general concept was seen as fun, like one of the Eurovision users commented:

> “It was kinda nice to see that one's pictures ended up on the wall. And that one could add text to them. It was fun to see your own photos there“.

However, one of the first Helsinki Samba Carnaval user group reported that:

> “The touchwall was a bit hard to use, to get the idea how it works, and the photos did not stay straight and they got really big. At some point it started go more easily, but it’s a bit hard system to understand right away.”

From the video could be observed that sometimes the user interface of the display seemed to be unresponsive when they used it, and it was rather a technical problem (touch recognition not working properly in specific light conditions) than a usability issue, as at other times they had no problems using it.

Every user interviewed felt that the CityWall was more fun to use together than alone. A user from the second Samba carnival group commented that:

> “I can't see that one would go there alone to look [at pictures], unless you know that there is a specific photo or something. It works better with a group. It's also more fun maybe that way, as many people can see what [pictures] have been taken.”

All groups used the CityWall also with strangers, people not belonging to their group. From the video could be seen that the Samba user groups used the photos in parallel with other users (mostly tourists). The Eurovision user group reported that:

> “At those moments we usually moved away from the screen. Because we had already seen the pictures and wanted to be polite, as we would be coming there again.”

Also one user commented that:

> “It was a bit annoying trying to use the wall with too many people using the screen, when someone else started to pulling the screen in another direction than you.“

One of the users reported watching strangers from far away to check out how they reacted when seeing the pictures taken by the users. Noticing the CityWall seemed to be hard for regular passers by, as they mostly got interested in the display only after someone went to use it first, showing by example that the window was interactive.

The biggest problem reported by the users and also clearly seen from the video was daylight reflecting from the screen affecting the visibility of the pictures on the display.

> “You can’t see that much on the display during daytime, you can't be bothered to look at the photos because you can't see clearly”,

reported one of the users. All groups had difficulties with visibility and the sunshade on top of the screen did not help.

The users were also asked about the publicity of photos: did they mind that a picture of themselves ended up at the wall? The users did not seem to mind, one of them responding:

> “It doesn’t matter. It isn't so public that it would matter that you have a photo of yourself there. But if it were a bigger screen, then it could be a little more uncomfortable. Of course depending on the fact whether one wants her own picture to be there or not. But it did not matter as it was fun to test how it works”

Another user commented that as “most of the pics were okay, so they were positive things."

The general expression of the users’ attitude on the system was a positive one. One user ended the interview saying, “It's a fun system that the pictures stay there, so you can go and see what has happened at different events.”

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