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Report on WP7 Environmental Awareness application re-design

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Table of Content

Abstract

In this report we discuss the re-design of a Large Scale Events of Workpackage 7 that has evolved to address a new theme of Environmental Awareness. In the third and fourth years M25-42 we look at working with the successful applications and adding new content. We aim to address issues relevant to the contemporary urban environment, namely problems of pollution and the degrees of awareness people have of these within their own environment. In order to do this we have discussed many ideas, which were mapped out and evaluated against the two successful applications: MapLens and CityWall. A third demonstrator Illuminate, which worked with lighting has been more difficult to implement within the confines of this brief. This application may be further developed in the final year. Feasibility and currency were major issues under consideration—in technical, conceptual and pragmatic terms, as were longevity and relevance to the citizens using the environment. The re-design has successfully moved forward the demonstrator with more articulated and substantially new mixed reality applications that address urban environments and environmental awareness through use of a multi-touch environment and an augmented digital-physical map environment.

1 Introduction

In this report we will discuss the two demonstrators MapLens and CityWall and their re-design to address the environmental awareness brief separately. One set of field trials has been undertaken with MapLens addressing this brief, the results have been reviewed and another trial is in planning stages. Four applications are in planning and development phase for CityWall. User trials planned for August, 2008 for the first two of the simpler applications and then again in November, 2008 for those two again, as well as for one or two of the more complex applications detailed in this report. The later two applications are a follow-on of the first two applications so feedback will be incorporated into the second set of user trials, as has been the approach with MapLens re-development.

Included in this report are the theoretical considerations under-pinning the re-design. Based on the structured attention resource model [4], we have developed an approach in which presence and workload are linked together [8]. The model is based on the fact that stimuli are presented both in the real and computer-mediated world. Some of the stimuli are relevant for the task at hand, some of them are irrelevant. Presence is interpreted as a state arising from allocating attentional resources to the computer-mediated world, and mental workload is the total amount of attentional resources expended. Our aim is to engage and activate our participants with mixed reality applications for sustained periods of time that demand their attentional resources with technological works implemented in an urban environment.

2 First Demonstrator: CityWall Current Status

Many displays in urban settings are developed to add life to a space and to allow reflection and serendipitous interaction between people. However, often interactions are short—too short to evoke reflection, and it is still to be shown if strangers really engage in interaction with each other.

Figure 1. CityWall user interface: the content area (A), scrollable timeline (B) and picture content (C).

CityWall is a multi-touch public display on permanent installation in the Helsinki city centre since May 2007 (see Figure 1). According to our research the kinds of activities common at public displays are [1, 10, 11, 12]:

- *Trying the basic interaction techniques.* Using the timeline in the bottom of the screen and rotating, enlarging, shrinking, sliding, and throwing the images between individuals and groups.
- *Performative environment.* In a group of people, users often adopt different roles, and take turns at being in one or even all of these roles—depending on circumstances. Roles include apprentices, clowns, spectators and teachers. Teachers show others how to use CityWall and may bring their friends to the wall at a later time.

In our study [11, 12] which included manual coding of 8 days of authentic interaction, as many as 82% of use episodes (sequences of uninterrupted use) had more than one user. The display then served as a site for social interaction, however mostly among the people of the same group rather than strangers, only 4.8% of all episodes having people from different groups engaged in conversation. Interpreting interaction as purely conversation is naturally a simplification. However, this was a means for gauging a conservative estimate of actual interaction from the footage.

For durations of interaction, the median lengths of episodes having 1, 2 or 3 users were 39, 60, and 63 seconds, respectively. Average lengths (61, 101 and 95 seconds) were a bit higher, and therefore there were some people who spent a longer time at the display. The general lengths however are not high as could be wished.

Therefore, the problem is that the initial design goals – evoking reflection and supporting interaction between people – are not fully met. Our approach in this paper is to devise ways to understand and address this problem.

3 Designing Ever-Increasing Challenges

We look to the work of Csikszentmihalyi [3] on flow and optimal engagement to continue this discussion and develop the work. In the flow model, the requirements identified for tasks and achieving optimal engagement are that 1) the task can be completed, 2) the person is able to concentrate on the task, 3) that concentration is possible because the task has clear goals; 4) that concentration is possible because the task provides immediate feedback; 5) that the person is able to exercise a sense of control over actions; 6) the task provides a deep but effortless involvement that removes awareness of the frustrations of everyday life; 7) that the concern for self disappears, but sense of self emerges stronger afterwards; and 8) that the sense of the duration of time is altered. The combination of these elements causes a sense of deep enjoyment so rewarding that people feel that expending a great deal of energy is worthwhile simply to be able to feel it [2].

The original eight requirements have lately been adapted to understanding flow in gaming [6]. In our work, we are using a similar approach to improve user experience on large touch displays. Our aim is to ensure that the same requirements are included as core values in our design considerations, and design increasing challenges as an integral part of the interaction and content of CityWall.

4 What Might These Challenges Be?

We look for a way to achieve these eight requirements, and this is currently part of the re-design—we plan to extend the current interaction paradigm. For now, gesture—a bodily action—meets with a flat 2D screen. The interaction is flattened: limited, as is access to and navigation through in-depth levels of information. As a response, we are designing a 3D navigation for content structure and system. In order to access the information, participants will also need to learn how to navigate the system—as well as being able to learn through interacting with the content itself. Over time with continuing use participants can increase their skill levels. Their interaction can be scaffolded so that small but incremental learning steps are supported. This will allow increasingly more sophisticated interactions with ever-more complex information. The content will deal with global issues around environmental awareness and the navigational interface will mimic the interlinked global nature of these issues. The information—in the form of text, images and videos from World Wildlife Foundation (WWF), includes a space-time dimension and reveals changes in local rainforests and habitats over time. In addition, with an attempt to provide more personal content, we plan to include a WWF measurement system for analyzing one's ecological footprint. With this interface, multiple groups can access multiple 'worlds of linked information' at the wall at the same time.

We are working to meet the eight requirements of flow. We believe that goals related to concentration, challenge, skills, control, clear goals, feedback, immersion and social interaction can be met. Successful interaction will require mental energy and appropriate skills. We believe that by addressing not only how the participants can interact with the content, but also by adding in-depth content (task not too simple, nor too difficult), we can extend the experience for our participants and engage them in a more meaningful and sustained manner for longer periods of time. We wish that the enticing interface not only entices but also prolongs and sustains engagement so that our 'players' lose their sense of time while playing and learning at CityWall.

5 Re-design Of CityWall

5.1 First Comparative Field Trial:

We are running an 8-day video data collection of users at CityWall at its changed location—internal in the square of Lasipalatsi. We do this to demonstrate any difference in interactions since the same time-period in the old location over the same time period from last year. We will then alter the applications and take field trials again in the hope of finding that our participants engage for more sustained periods with the content and applications at CityWall.

6 Four Applications:

1) Helsinki Flickr content
2) World Wild Life Foundation application
3) Community Chat
4) Music Machine

6.1 Helsinki Flickr content

6.1.1 Limitations of the current Interface and application:

Here we discuss some of the limitations of a multi-touch environment with the aim of highlighting areas that need improvement. We address these areas in the re-design.

Figure 2: CityWall user interface: the content area (A), scrollable timeline (B) and picture content (C).

Ease of use from the very start is an essential requisite for public displays, as the display must be understandable from the first moments. According to our evaluation on CityWall, this goal has been achieved well, but with a cost to the following issues:

- Treating the whole display as a single interaction space means that one user's actions sometimes have effects on the actions of another user. For example, resizing an image to a very large size might overlap another user's focus of interaction, and moving the timeline (see Figure 2) means disruptions for others because all the photos in the content then start moving left or right accordingly.

- There is no memory of past interactions, no functionality to comment images on screen and no means to identify a returning user. Because of this, all the conversations and stories evoked at the wall are lost. Neither is there a way to link related ‘photographic conversations’, i.e. photos that are posted as a response to photos already there. These factors in turn decrease interest to return later to the wall.
- Images taken by other people have limited relevance to a user unless there is a personal connection to the places or activities depicted. We also found that the participants were mainly passing tourists, and not local residents.
- Passers-by only interact if they see other people using it and watch how to use the interface. We have designed a default setting with a video that shows others how to use the display, which is triggered after a time-out period of non-use (see figure 3).

Figure 3. A shadow figure shows passers by how to use the screen after a set period of inactivity

These limitations arise from having designed an intuitive interface where novice users can easily approach and ‘master’ the interaction techniques. We hypothesize that there are not enough opportunities for learning in the current version of CityWall. There is a need to extend the scope of the interactions beyond this early learning curve.

6.1.2 Redesign of interface with same content but timeline accessible from multiple view points:

The redesign assigns time to the z-axis (or depth dimension), with the most recent content at the front. As in the original CityWall implementation, a Flickr photo retrieval engine periodically fetches content that has been tagged with specific keywords and stores the metadata in a database. In addition to the still content, the browser is able to display also video content that can be retrieved for example from YouTube.

The interface arranges photos into planes (one plane per date, stacked along z-axis—see figure 4 and 5), so that users are able to navigate back and forth in time by zooming gestures. The planes are transparent in order to show the temporal flow of the content (see figure 6). Although there is still only one timeline, it is possible to access the content simultaneously from different points of time, and manipulate individual media items by moving, stretching and rotating gestures. Items can also be annotated to the backside of the item using an onscreen keyboard. Annotations can form threads of discussion, and previously entered material can be scrolled up and down with flicking and dragging gestures. These kinds of interactions will add to the cognitive load of users, as part of a series of incremental steps to increase ‘challenges’ at CityWall interface.

Figure 4. The timeline stretches along the z axis

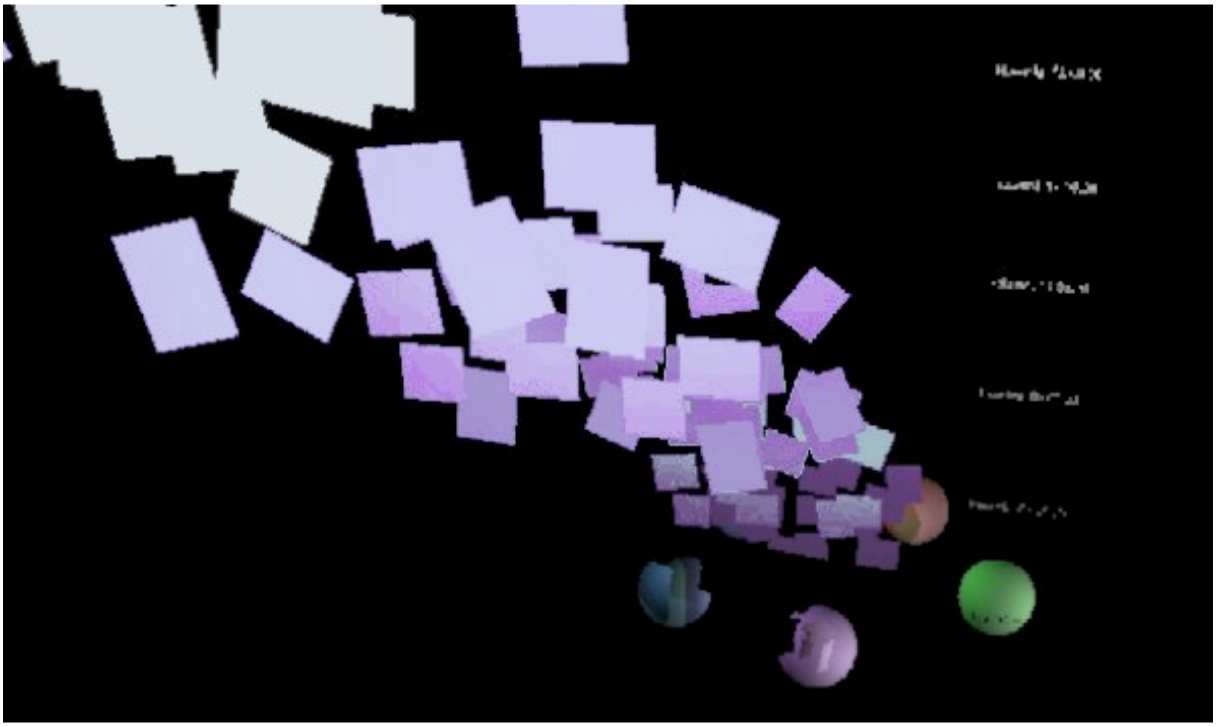

Figure 5.Side view to see how the navigable content can be approached and stretched and manoeuvred in space.

The icon is the last picture in use.

The last used view is displayed when the globe is selected.

The front layer may be manipulated at will.

Figure 6. The images can be grabbed from within the timeline and manipulated in the same way

6.2 World Wild Life Foundation 3D interface to reveal and make available more content

Addressing content that has relevance to the life of the citizens and in-depth information. Information has been designed in the form of text, images and videos from World Wild Life Foundation (WWF). This content includes a space-time dimension and reveals changes in e.g. local rainforests and habitats over time (see figure 7). Also, addressing more personal content, we plan to include a WWF measurement system for analyzing one's ecological footprint. With this interface, multiple groups can access multiple 'worlds of linked information' at the wall at the same time.

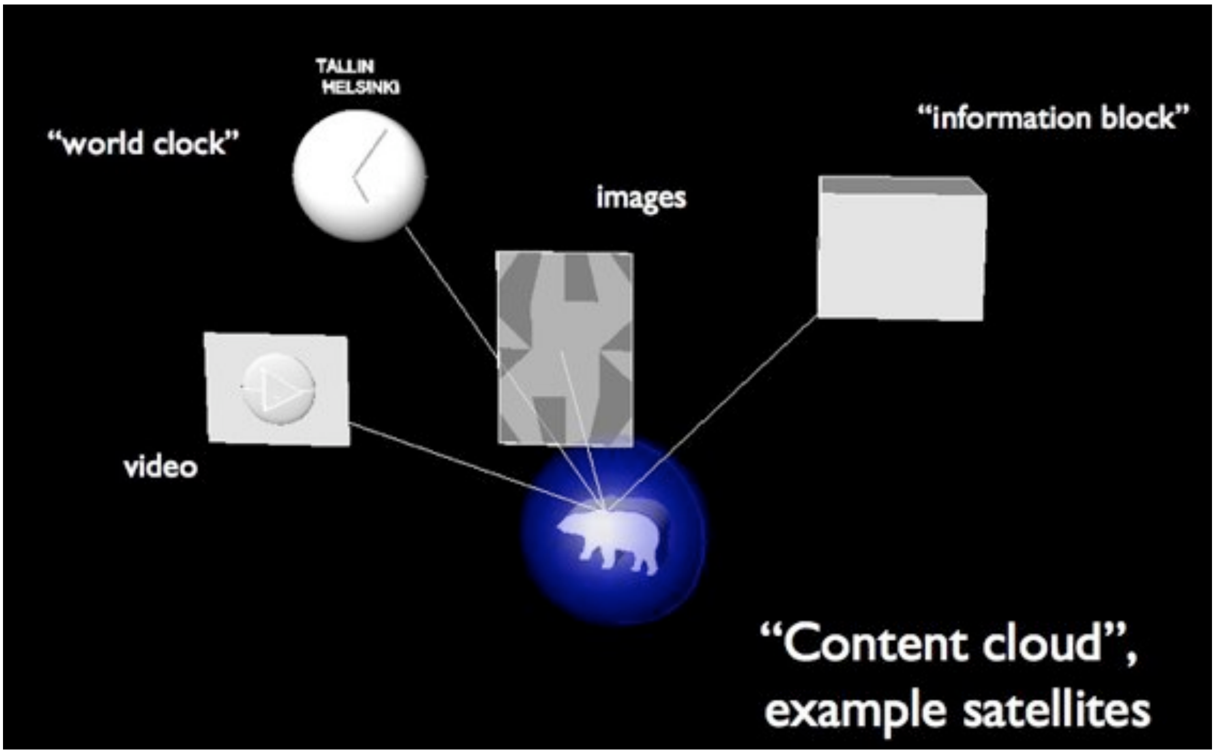

Figure 7. Example of a linked interface

We aim to initially focus on three- four topics, knowing we can add as we go and later on. To date we have identified the following topics with World Wild Life Foundation:

1) Rainforests and local habitats

2) Baltic Sea,

3) Climate change

With a potential for:

4) Ecological footprint as being another arm

Negotiations are currently underway for material. Once these are settled and the application is implemented, we will run field trials on how groups interact with this type of interface for our research purposes and whether we have improved sustainable engagement with the content--i.e. are people now aware of what they are looking at/ playing with, what parts did they spend more time/ less time with and why and so on.

A time zone concept is used to interlink the WWF content browser's globe object (sphere) with an interactive clock face. Rotating the clock hands spins the globe so that it shows the relevant time zone. Vice versa, rotating the globe changes the time zone so that the two are kept properly in sync. Thus, the clock is not tied to real time, but rather into a preset time zone-orientation linkage of the globe.

The globe has several hotspots that are linked to the WWF content relevant to the geographical location of the spot. The user can single-tap one of these hotspots to open its content as a satellite cloud. Spinning the globe translates the attached satellites, and it is possible to have several content clouds visible at a single instant. The user is also able to manipulate the position, size and rotation of the content cloud items, and annotate them using the same mechanism as is used for the photos. Tapping the source spot hides the cloud.

6.3 Community Chat (includes images MMS entrance to CityWall from users phone) for EU City Of Sciences week

An application that allows users to input with text and drawing at CityWall (see figure 8). This application will also retrieve images and videos via MMS Entrance and BlueTooth Media Dispatcher.

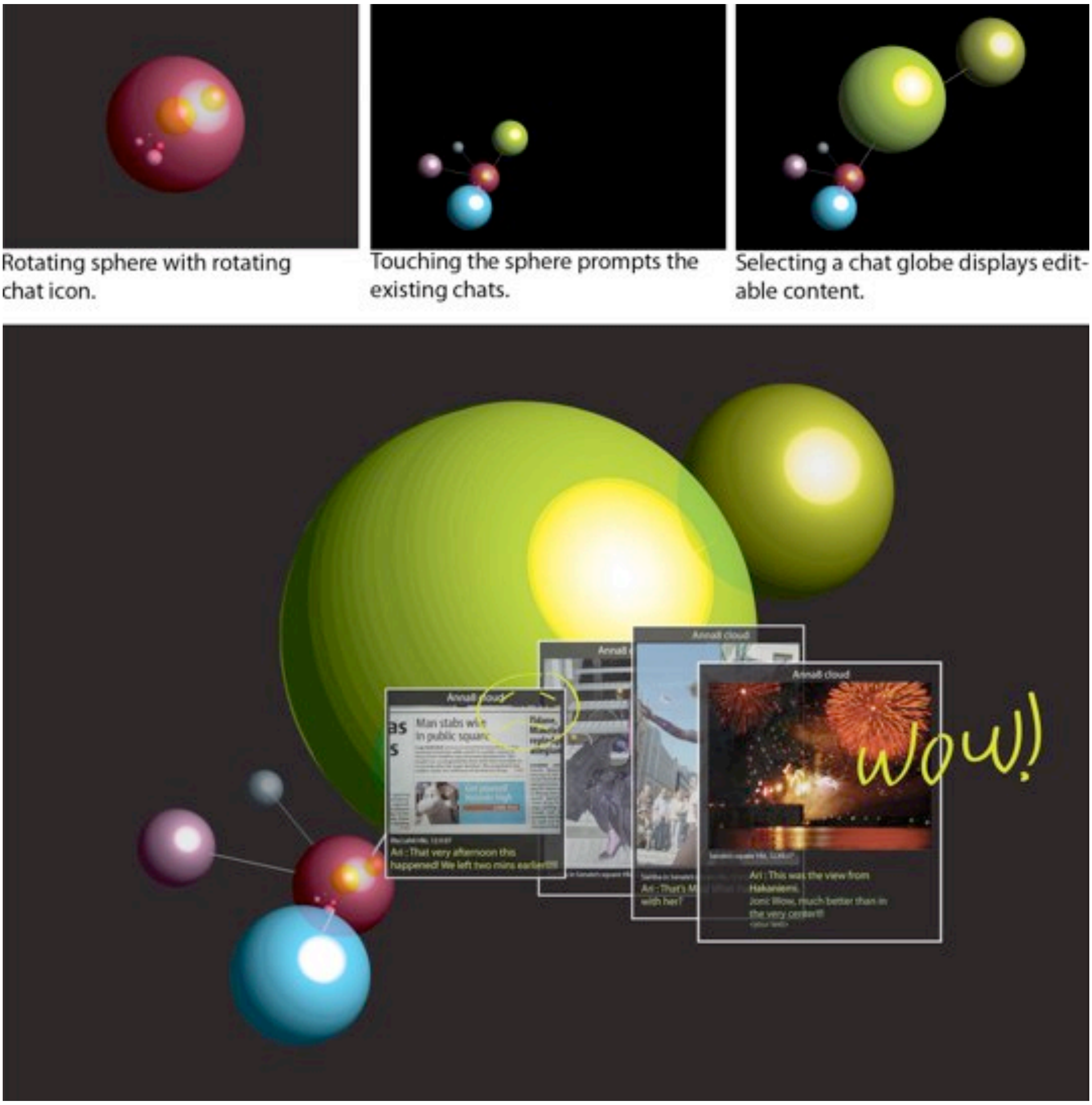

Figure 8. People comment and add images and annotate the content to join in community conversation

6.3.1 MMS Entrance

MMS Entrance is a mobile application enabling users to enter media into a background system using Multimedia messaging from mobile phones. Background systems can be, for example, Multi touch display, Hypermedia database (HMDB), and MapLens (through HMDB). This media (photographs, video files, accompanied by text and metai-nformation) can then further be used in various ways, depending on the showcase. So far, Large scale events showcase has plans to use the tool. The component is not directly used by end users, but placed in proximity of the media server so that the media (arriving in MMS messages) extracted by MMS Entrance can be send to the media server using Bluetooth.

MMS Entrance has been implemented and basic testing has been done. It has not yet tested with large amounts of messages arriving rapidly. Next steps include testing the MMS Extractor with large numbers of text and images to CityWall through HMDB.

Framework for collecting media

Basically, MMS Entrance with Bluetooth Media Dispatcher is a framework for collecting media from mobile users. Traditionally, MMS messages have been used to one-to-one communication, or in some cases for one-to-many distribution of mobile content (advertising, news, entertainment). In our case, MMS's are used to collect media from users on the move, related to events and community building and mobile story telling (The communications pattern is therefore many-to-one (from the users to the storage), then utilized again by many, e.g. with large displays. Research on MMS Entrance comprises mainly of the studies related to the usage of the overall chain of components (MMS Entrance ➔ Bluetooth Media Dispatcher ➔ HMDB ➔ various systems utilizing the media) used in the WP7 scenarios and field trials.

Testing and public demonstration

Testing will be done prior with an aim to implement during EU City of Sciences week, 2008. IPCity is involved in City of Sciences week, which is an exhibition held over three consecutive days with 80 other exhibitors at Le Grand Palais, Paris in November. Successful testing means we will implement and run field trials as part of CityWall implementation at this event.

Specification

Table 1. Specification table of Bluetooth Media dispatcher

Hardware and OS	Symbian OS, Series 60 user interface, Nokia smartphones
Software	Symbian C++ implementation utilizing the components within Symbian OS and S60
Core Features	Extracts media from MMS messages, creates metadata file describing the media, sender and sends the media and metadata files over Bluetooth using OBEX protocol to Bluetooth Media Dispatcher
Status	Beta prototype, needs stress testing.
Intended users	Showcases where users enter media to be used in other tools.
Showcases	WP7
Relevance beyond project	Not tied to specific scenario, is usable in general contexts.

6.3.2 Bluetooth Media dispatcher (UOulu HIIT)

Bluetooth media dispatcher is a service for receiving and dispatching media files and related metadata over a Bluetooth™ connection using OBEX (Object Exchange) protocol. The service works in Linux and Mac OS X and uses a modified open source Avetana and BlueZ Bluetooth™ stack.

The service is used by the MMS Extractor interaction tool, which receives Multimedia messages (MMS) on a Symbian smartphone and extracts media and metadata from the message and sends the media files to the Bluetooth Media Dispatcher. These two tools can be used together in the IPCity showcases for receiving and handling media, e.g. in Environmental Awareness Urban renewal (community feedback, for example) and City tales (users entering tales of the city using MMS (recorded sound, 3GPP videos). The media files with metadata are then stored to the HyperMedia DataBase (HMDB) to be accessed by other components and services within the IPCity.

Development & research

Current status of the Dispatcher is that it is being modified to use the new version of the HMDB that has now stabilized after bugs in added features have mostly been fixed. This integration work is ready by the end of January 2008. As the media arrives over Bluetooth™, the media files and associated metadata will be saved to HMDB either using the APP (Atom Publishing Protocol) or the new Java API of the HMDB. After this, a larger scale laboratory test will be conducted, before actual field trials, to assure the system performs adequately also under stress.

Testing and public demonstration

The testing and field trials related to this component need to be first tested before being trialled at European City of Sciences week. For implementing both these technologies successfully with CityWall we will need to by-pass the use of HMDB as there have been problems with implementation.

6.4 Music machine for users in Paris and Helsinki (or between two walls) for City of Sciences Week

In this design, users can interact with a pattern-based sequencer and simple on-screen virtual musical instruments using multi-touch gestures, and engage themselves in ad-hoc collaborative music making sessions. The sequencer and the instruments are designed to be intuitive so that they can be played without prior musical training or special instruction. However, the design shall also support increasing challenges by allowing freedom in the interaction, so that learning and mastering the tools can be rewarding. The compositions are stored for later playback as control streams (MIDI files), and they can be annotated with textual metadata. Stored musical works can also be later augmented or edited in order to support continuity of engagement.

For the Paris installation, we plan that the Music Machine shall be extended so that it will become possible to perform collaboratively in near real-time, between two CityWalls. Because of the network latencies, each site has a master clock of its own to keep the performance in sync. This means that the exchanged control messages are delayed by the length of the sequencer pattern cycle (e.g., for eight beats) until they are played at the remote end. The participants are given the illusion of real-time interaction, however (see figure 9). We shall also investigate whether a low-bandwidth webcam stream can be transmitted between Paris and Helsinki to further increase the feeling of presence in music making. Then, a portion of the CityWall display space appears as a transparent interactive surface that the remote participants can play on, possibly having an eye contact with the fellow music makers.

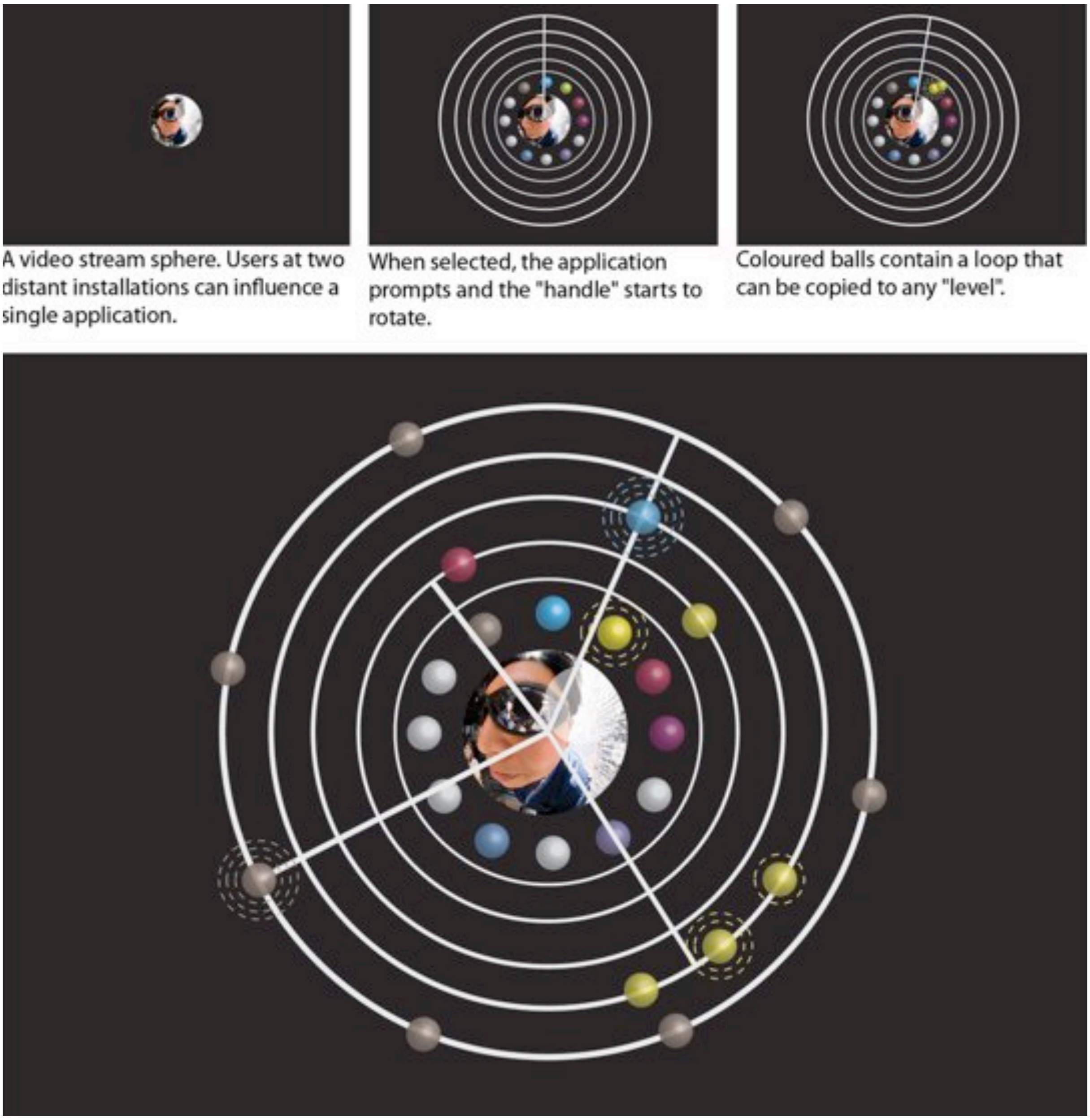

Figure 9. The music machine allows people to see and interact by playing music together in remote locations.

7 Platform Changes

The original CityWall installation runs on the Linux platform, and has been carefully designed to address the requirements of the application described in 5.1.1. As such, the implementation is not easily extensible beyond photo browsing functionality, so the more complex requirements given by scenarios 5.1.2 and 5.2 are not well supported in the existing code base. Furthermore, because the original application is quite intimately coupled with the low level Computer Vision software component developed in WP4, the adaptation process could not be directly based on the existing framework.

A widget-based multi-touch SDK was developed for Linux and OSX platforms to address this shortcoming, reusing most of the generic code of the original implementation. Although it is much more productive to work with the newly introduced widgets, it was seen that a considerable amount of time would be still invested in writing the trivial functionality. Because much of that triviality was already available in Windows platform, and because the development tools are more advanced there, the SDK was ported to Windows. The time invested into porting seems to be well spent, also when considering future extensions of the CityWall (see 6.3 and 6.4).

The SDK port consists of 9 custom Dynamic Link Libraries (DLLs) and 14 third party software components, which constitutes a relatively complex solution environment. The large number of external dependencies arises from the differences in Unix- and Windows-based operating systems. To simplify the maintenance and deployment tasks, a native version of the port was devised, resulting in a solution that uses one merged custom DLL and two third party components. The enabler for the complexity reducement is .NET framework and Windows Presentation Foundation (WPF), which overlap and extend the functionality supplied by the initial port. Another benefit is in the support for further extensions, both in custom and in third party code base.

In summary, the current CityWall framework is built on the previous code base, but runs now on top of Windows .NET/WPF layers. The CityWall backend shall include also XMPP (for CityWall-CityWall connections), MMS (for mobile phones, as described in 5.4), OSC (for music machine), and an optional RESTful HTTP interface, so that it will be possible to integrate components from other workpackages, if needed.

8 The Four Applications Together

In Figure 10 we show the four applications together operating within one interface for multiple users. Each 3D interface effectively manages as a solo timeline, independent of the others. We are developing a series of 1) flatland, 2) 2 ½D and 3) 3D gestures by designing a set of intuitive gestures that flick between 4 different modes of interactivity, The fourth mode facilitates drag and drop and/or linking objects.

Figure 10. The four applications in the one multi-touch interface

When perceiving technology mediated information users may have a feeling of presence, the perceptual illusion of nonmediation [9]. The key dimensions of presence are spatial, social and co-presence [7, 9, 14, 18]). Spatial (physical) presence is the feeling of “being there” in a mediated environment. It also includes a psychological component (feeling immersed, engrossed, engaged). Social presence implies “being together with another” or a sense of being together [5, 1]. Co-presence is a subdivision of social presence and defined as “being socially present with another person” [13]. It has the implication that people are physically separated from others but still feel a sense of togetherness in an electronic communication network.

It is apparent that when the computer interface is very frustrating, the more attentional resources are allocated to the interface itself. As a result, the media stimulus is assessed less immersive, and the sense of presence is reduced. If more attentional resources are expended, task load will also increase. In fact, there is some evidence that presence is negatively correlated with mental workload. It is also possible that user-relater factors modulate the effect of task load on presence [8].

9 Second Demonstrator: Maplens

9.1 Overview of the application

MapLens is an application for Symbian OS (Nokia S60) mobile phones that accesses an image of a paper map with the phone camera, analyses and based on the features of the image, identifies the GPS coordinates of the map area visible on the phone screen. Currently we use an image analysis component developed by the Technical University of Graz (TUG), which requires black dots placed on the paper map for localization (figure 1). Based on these coordinates, the tool fetches data based on location from the HyperMedia Database (HMDB) using the phone's Internet connection. HMDB is a Database Management System with additional layers supporting easy handling of metadata with hyperlinked media such as images, videos and sound. The data is downloaded as an XML based KML file generated by the HMDB, that includes metadata about the place-marks in the file, and a link to the media related to the place-mark. The user is then able to view the data based on the location of the media and the other related metadata (e.g. author, description, date/time). Information set as tasks for the users and for testing the system is visualized on the phone as map overlays. In figure 11 on the left can be seen some example overlays.

Figure 11: the technology in use with a physical map–the interface showing the additional dynamic information

In the first user trial the environmental awareness brief was addressed by including information about battery recycling centers and air quality readings, visualized as overlays, fitting the IPCity project brief and creating the game for the users.

In figure 12 we see a typical scenario of use where a battery recycle station may be moved without notice and without signage to indicate alternate close locations. The MapLens user can go then to the nearest physical map (e.g. at a bus stop) and find out where the nearest alternative battery recycle center is located. The same information could probably be retrieved from the Internet by searching WWW, but using a mobile phone's small keyboard and screen is an awkward way to search and view maps. We see that using a mobile phone as a dynamically updating filter for real maps is a more convenient way to browse maps.

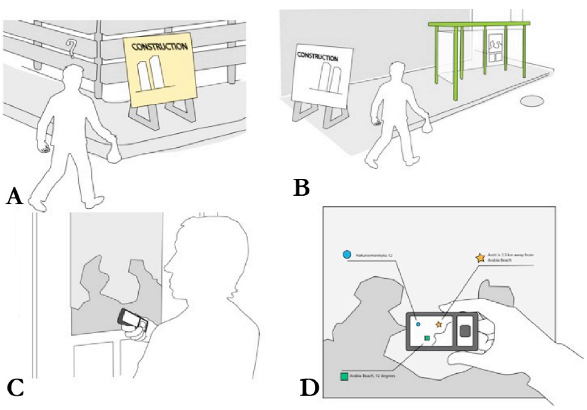

Figure 12. A: Person takes batteries to battery recycle centre. It is closed. B: Person goes to bus stop C: uses MapLens, reads from physical map D: MapLens dynamically updates and displays nearest battery recycle stations.

9.2 Organization of the first trial as a game

The first user trial was organized as a location-based treasure hunt game. Participants were required to follow clues and complete as many as possible of the given tasks within a set time frame (forty minutes in the case of this trial). Within the game social interactions highlighted dynamics of cooperation, competition and connection (both within and between the teams). An element of friendly competitiveness was established in the pre-phase game-orientation, with the promise of prizes at the end for the team with most tasks achieved in the given time.

The participants used both digital augmented map information provided by MapLens in conjunction with physical maps to locate given sites and achieve set tasks. The game in turn tested the usability and robustness of the augmented mobile technology that dynamically accessed information needed by the users to complete their tasks. The aim of the game (and ultimately that of the technology in the IPCity project) was to extend awareness of environmental issues and help users obtain more easily knowledge of how to live in an urban environment in a sustainable manner.

The simple use-scenario enacted in the first user trial asks users to dispose of batteries in a safe manner, and to take air quality readings of their environment and note the variations in these readings at different locations, which they locate by exploring the visual cues of the places (figure 13). The teams inevitably bump into each other in the relatively small mapped area where the game takes place. This encourages playful competitiveness, social interaction and a sense of joint purpose [16].The geo-spatial nature of the game ensures players explore their immediate urban environment. As well, replicating real-life time-pressures, setting tasks with clear goals while providing immediate feedback ensures focus and non-disruption of *GameFlow* [16] to complete the game.

Figure 13. The participants collaborate and augment the system with their own techniques.

9.3 Iterating Augmented MapLens and the Game

9.3.1 A planned trial with a revised Game

We identified from the users that some aspects of the game scenarios were enjoyable but others were problematic, so in future trials we aim to expand on the former and improve or discard the later where possible. In the second trial we intend to add an expanded variety of tasks with more in-depth clues, so e.g. people who not know Helsinki can easily navigate. We also intend for our participants to be actively engaged in finding out information on their environment, so they may better comprehend the impact they can have upon it, both positive and negative. Consequently, the game sequence might now include:

- visits to obtain information from for example;
- the Natural History Museum on e.g. past means of transport;
- the railway station to obtain information on a train schedule, price and duration;
- the follow-on task then being to calculate the carbon footprint from a car, a train and a plane for the same journey from an online site that offers such comparisons.

Users will also recycle 'waste' to two kinds of recycling areas, as well as visiting green areas of the city. As an example for the green visits, one task will be to walk bare-foot in the grass in a park, and upload a photo as evidence; another to gather a specific leaf (the leaf also found as a clue at the museum); and another to bring back a sample of sea water to be tested for toxicity levels. By these means our participants will be better informed about their environment, test the technology to achieve their tasks, and enjoy the nature and leisure in Helsinki.

To further emphasize the competitive element of the game, users will be required to take photos with their mobile camera phones during the trial as part of their various task completion routines. The photos will automatically upload and be visible to all users on MapLens, meaning that the players can track each others positions during the game phase—both in terms of GPS location (leaking information on where the clues lead) as well as indicating progression through the game.

The second user trial will be implemented 9th August 2008 in Helsinki city centre. A scout club and their families are being recruited for a larger study where we look to involve approximately 20 teams with 20 phones.

9.4 New Planned Features in MapLens

As MapLens is still in prototype development, we will add new features for these trials, and again enhance the functionality based on the feedback. Usability problems found in the first trials included lack of support for left-handed users and the need for manually updating media from the HMDB. This iteration of MapLens will refresh the media content periodically. Left-handed use will be supported, where the user will be able to hold the phone in a landscape position either way, and media will display correctly. Also zooming in to a smaller area of the map and included tags will be improved. Currently multiple maps are supported, but map switching is done manually.

In the second trial we will switch from using the tagged paper map tracking by the TUG to a natural feature-based tracking component developed by the University of Cambridge which does not require map instrumentation at all. In an offline stage, the system learns a statistical description of distinct features of the map image. At runtime, a fast classification approach identifies features and calculates coordinates of the visible part within the map from the known locations of these features [17]. This allows us to use existing maps already available in public places, instead of specifically enhanced maps.

In the previous implementation it was possible to view images only, but now we add sound. Moreover, image capture augmented with GPS coordinates is added to MapLens itself, in order to provide a single application to the user. We use the third party application ShoZu [0] for uploading content to the public media-sharing site Flickr.

Finally, for research purposes, we plan to enhance the logging of user activities to better study when, where and which kind of content users were generating and/or consuming and how this relates to the overall user activity with MapLens.

9.5 Revised Evaluation Approach

In the planning for the second trial we improve our evaluation methods by adding a control group who complete the same tasks via other mobile means (but with the same information to hand). They do not use the augmented MapLens technology, rather full digital maps displaying the same environmental information as MapLens. We will also include the two pairs of participants from the first user trial again in this trial, so that we can get feedback that compares both the technology and the game aspect from the first user trial with this second one. As well to this, we will add a much larger group of participants—seventeen teams of new users—who are all first-time users of this version of the technology and the game. Combining the two pairs from the first trial, the one control pair and the new pairs there will be twenty teams with twenty phones in total for the second trial.

We posit that by adding two types of comparative control groups, a larger sample and more complex tasks run as game-type sequences, we can fulfil our aim to again test the robustness, usefulness and suitability of the technology for real-use scenarios (and gather suggestions from user for other uses), as well as add to the body of knowledge in expanding evaluation techniques useful for pervasive computing scenarios.

Presence is a multi-dimensional phenomenon that is related to 'being there' in one environment and to the 'perceptual illusion of nonmediation' (e.g., Witmer & Singer, 1998). It has been argued that presence is necessary for effective performance in a computer-mediated world: With an increased feeling of presence the user is attending more intensively to the task at hand, and thus his/her performance is improved (e.g., Draper et al., 1998).

This approach typically calls for using multiple methods to triangulate the phenomena. Understanding such abstract phenomena as "experiences" and "activities" calls for a multi-method approach triangulating the phenomena by considering various indices and sources of data ranging from accounts of subjective experience and observations of action in situ to the contents of the digital artifacts acted upon, as well as records of how they were interacted with at the interface.

Since this is a bottom-up, data driven analysis, we recommend using a sort of grounded theory approach (Strauss & Corbin, 1990). The point is to find salient and typical use-related phenomena in the data, describe and categorize them. In our analysis of MapLens's field trials, we first analyzed the data first extracting individual instances where MapLens was used, then categorized the appropriations in an iterative process where several researchers (up to 15) participated. In this analysis, it is important to understand what was the intentions and roles of the participating agents, what was being done and particularly how the system's features were utilized, and what could be eventually achieved through all these activities.

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11 Publications to date on aspects of re-design:

AVI 2008: Public and Private Displays workshop (PPD 08)	CityWall: Limitations of a Multi-Touch Environment	WP3, WP7	Morrison, Ann, Jacucci, Giulio, Peltonen. Peter.	Presented as workshop paper
British HCI Location Aware Games Workshop	Using locative games to evaluate hybrid technology	WP7	Ann Morrison, Giulio Jacucci, Peter Peltonen, Antti Juustila Gerhard Reitmayr	Submitted
Shareable Interfaces for Learning Workshop, Brighton, UK, 2008.	Sustaining Engagement at Public Shared Interfaces	WP3 WP7	Ann Morrison & Antti Salovaara	Submitted

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