

CityWall: Limitations of a Multi-Touch Environment

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ABSTRACT

In this paper we discuss some of the successes of current multi-touch surfaces and look at what these interfaces enable. We work specifically with CityWall as a case study—a multi-touch display installed in the center of Helsinki. We then discuss some of the shortfalls, focusing on the limitations of technologies that unintentionally support novelty use and/ or disregard for content. We briefly touch on some of the ideas under consideration for the next stages of development to overcome these perceived shortcomings.

Categories and Subject Descriptors

H.5.1. Multimedia Information Systems:

General Terms

Design, Experimentation, Human Factors

Keywords

Situated public displays, urban environments, multi-user interfaces, group interaction, multi-touch, gestural interfaces, experience-design.

1. INTRODUCTION

In this paper we discuss some of the limitations and affordances that a multi-touch display provides. We have installed a large multi-touch display called CityWall in the centre of Helsinki to observe how group interaction happens naturally there. We conducted extensive field trials and based on these findings we look at what such a system enables in such a context. We look briefly at other related works—the breadth of these though is too wide for the scope of this short paper. The main focus then is to outline what works, what does not work, and to explore further why this is and finally to look at what kind of improvements might then be tackled. We found that users do not process the actual information on the wall, rather the activity is as if learning to 'play ball' in a new medium. We are currently exploring future developments for CityWall and in this paper we touch on some of the improvements under consideration. We are exploring in particular how CityWall as an environment can go beyond its novelty factor and truly address the user experience. There are many potential solutions we see in other works, particularly ones

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that work directly with the situated community. However simplicity of use has also shown itself to be a key factor.

2. RELATED WORK

Previously the social dimension of large display use has been studied in tabletop, ambient and large display research. *Tabletop displays* have been used primarily in collaborative work spaces. Research has presented new kinds of collaborative touch-based interaction techniques that also support multi-hand use [1, 2, 3]. *Ambient displays* do not usually involve direct interaction on their surface as they have been developed to investigate the ways in which displays can be situated in physical settings, representing movements of people in a space, displaying information that requires only peripheral attention, and increasing awareness of other users [4, 5, 6]. In this section we will briefly introduce some aspects of multi-touch systems that are currently in use, which relate to the kinds of issues we look at with the CityWall case study.

The settings of *large multi-user wall display* research have ranged from collaborative workspaces in office environments to more public settings such as schools. A study on BlueBoard, a touch-screen display that can identify its users, highlighted the benefits of visible physical actions facilitating learning from others, difficulties in developing turn-taking practices, and supporting ways to collaborate without necessitating anyone taking a leader role [7]. While CityWall does not identify its users, as a system it does readily support turn-taking and collaboration. A study on eyeCanvas, an interactive single user public display and bulletin board installed in a gallery café, highlighted the richness that messages containing not just plain text but also user contributed pictures and sketches can have and discussed ways to better enable 'conversations' [8]. Support for conversation is important for engaging users and we will discuss how this is missing in the current implementation of CityWall.

Another system, Dynamo, was installed in a school as a multi-user public display for multimedia sharing. This system supported the use of private content with dedicated spaces on the screen for personal purposes. During the user study various use patterns evolved, including ways to draw other people's attention through "upsizing" one's pictures, and staging video performances in the display [9]. We found similar activities in our user studies with the enactment of performative roles, upstaging, upsizing etc and also aim to include private data in the future development of CityWall.

Furthering the integration of multiple devices, a system such as iRoom (<http://iwork.stanford.edu/>) operates as a meeting, research and work space, combining large displays, wireless/multimodal I/O and mobile devices such as handheld PCs. Unfortunately it falls prey to the necessity for a 'wizard user' that is needed for solving problems and conflicts caused by the setup of changing

multiple devices. This is one of the pitfalls of connecting many devices to a system and needs to be considered when integrating private data and devices.

Another problem with dealing with private data has been encountered with Braccetto (<http://www.hxi.org.au/>). This large-scale multi-touch system, can be used both as a tabletop and as a vertical display, making this a very flexible system where groups can video-conference, as well as file share and problem-solve simultaneously. The system is designed for use by groups working in emergency situations like fires and floods. However, due to strict government security policies users can work only with limited access to restricted information at any one time. This makes the system as a portable environment—one of its aims—cumbersome to use, and stalls the immediacy of team work.

CityWall as a multi-touch gestural system (<http://CityWall.org>) is a vertical surface that works for multiple users 'playing' and sharing information remotely as well as locally. This system operates well in changing lighting conditions, both indoors and outdoors. The display is set as a permanent installation in an urban environment and initially aligned its 'openings' with local festivals and events. We will concentrate on this display—and the results of our field work—in the confines of this paper.

3. AFFORDANCES AND LIMITATIONS

For the remaining discussion we will concentrate on our case study, CityWall that was setup to investigate the interaction and situatedness of displays in an urban setting. CityWall can be used by people who take part in different events happening around Helsinki, as well as for daily life 'events'. It shows the digital media content people have captured in those events and then have submitted to Internet media sharing services.

We studied the use of the CityWall using two approaches. In a first series of studies at city events we recruited groups of visitors (around 6 participants per event) equipping them with mobile phones and applications to publish their pictures on the CityWall. These studies lasted a long weekend and were aimed at exploring how the CityWall supports groups at events [10]. A second approach was used to study passers by interaction at the display. The core of the study included observing interactions for eight days during summer 2007 [11]. A total of 1199 persons were observed to interact with the system in various social configurations. Videos of these encounters were examined qualitatively as well as quantitatively based on human coding of events. Many different types of interaction were observed during this time: crowding, massively parallel inter-action, teamwork, games, negotiations of transitions and handovers, conflict management, gestures and overt remarks to co-present people, and "marking" the display for others.

The multi-touch feature, gesture-based interaction, and the physical display size contributed to these uses. Unlike in most of the settings in which public displays have been studied in previous research, a real urban environment is populated by individuals and groups that are strangers to each other. In our study it was shown how people were configured in groups of users and crowds of spectators rather than as individual users. They were able to use the display both in parallel and collectively by adopting different roles. Learning from other users may be one of the key explanations for this: seeing someone else using the display made people aware that it was an interactive installation and when

standing behind the earlier users people learned more about its interactive properties.



Figure 1. Two people using CityWall.

The public location and size of CityWall created a sufficient space for a "stage" for multiple users who were able to adopt different roles, such as being teachers, apprentices, clowns, or members of the audience. In some cases, multiple activities were taking place at the same time at the display. Content on the wall and features of the interface were used as resources to coordinate the activity and to create events or interactions so they were meaningful in front of others: interaction could be perceived as a performance to others. The multi-touch feature of the interface was central, as it supported expressive gestures that helped participants in coordinating, communicating and acting out different roles.

3.1 Novelty and "superficial usage"

The CityWall project aimed at giving access to present and past events of the city by engaging passers by with tagged images. It became clear after on-site interviews that users were not always interested in the pictures but were mostly exploring the playful interface. The groups recruited at city events of course were interested mostly in the pictures they created and published on the CityWall. While it did occur that also passers by reported being interested in the pictures, the higher interest in the novelty and playfulness of the interface poses several challenges:

Novelty "factor": What happens when the novelty factor wears out? How do we keep users engaged with the installation? There have been cases of users coming back to the installation, to try it out again, sometimes this was users who were also professionally interested in the installation, or others that came back to show their friends how it works. Also a scenario where an installation constantly seduces passers by with its newly developed engaging interaction techniques is not feasible. Rapid design changes are not easily accomplished in such an environment.

Application design: It is difficult to distinguish in our study the contribution of the application to the success in terms of usage but also the non-success in terms of users not paying attention to the content. What if, for example, pictures would have been organized not only chronologically but also using more thematic groupings? Users might have found a more "meaningful" way to browse the content. The problem of evaluating a multi-touch installation then shows how it might be difficult to distinguish between the

contribution of the engaging multi-touch technique and how the application makes use of it.

3.2 Limitations

Our field studies indicate that one of the limitations of CityWall is that users only interact with the display after seeing it in use. So unless a more adventurous person, or somebody who knows how to work with the wall is active, then the display may be viewed as if it is a shop window or an advertising space and is not interacted with at all. As a work-around, we are looking to put in a time-out default setting displaying a life-size demonstration movie of people using the wall.

As it stands, the interface is designed for intuitive use, and so that novice users can and do easily participate. We have already discussed the novelty factor in section 3.1. As Csikszentmihalyi argues, to maintain optimal engagement tasks need to be within the realm of the possible, but must still stretch the participant [19]. Here once the participants learn to use the timeline; rotate, enlarge, shrink, slide, and throw the images; perhaps even bringing friends, or showing others how to use—all the while enacting the roles as discussed in section 3—they have achieved the finite potential available. There are no more tasks to stretch the participant. If we want something to be taken up on a continuous basis, it is important to consider the addition of varied levels of difficulty to continue to ‘stretch’ the participants beyond this initial learning curve.

Our field studies also indicated that other peoples images have limited relevance, unless the participants have some level of engagement with the place or activity. The tags and annotations to the images mainly give limited descriptors, so there are no stories that can be readily associated with the image, there are no reply comments that can be added onto at the site, so the only further discussions that happen at CityWall do so at an oral level, that is not then translated onto the digital display. Conversations and stories evoked at the wall are then lost. As well we found that most of the participants at CityWall were tourists to Helsinki, who had come there for either a festival or some event, so CityWall as an environment had no great ‘sense of place’ or on-going community engagement for them.

One of the major limitations we find with the current interface design is that if one user moves the timeline it, then the timeline is moved for all users and people lose the content they were ‘working’ with. So for example, if the current timeline is positioned at e.g. 21st May 2007 and 2 groups are playing with two different sets of images, and one user moves the timeline forward to e.g. 13th June 2008, then this move completely disrupts what the other group of users were doing with their images at 21st May 2007 and they can no longer access these. While this can facilitate interesting negotiations for groups at the wall (see Peltonen et al [11] and section 3) this severely limits the ability to engage in multiple interactive spaces and restricts entirely any threading of images—as *photographic-type conversations*—through time [8]. CityWall supports “one conversation space and that without threading” [8, p. 9] so there is no way—without extensive scrolling back through time—to link images that are responses to other images in this current interface. During Helsinki festival we did see the participants and organizers enacting image-based ‘conversation’ about the event on CityWall. There is of course further discussion on what constitutes ‘a conversation’ and if either of eyeSpace or CityWall allow this.

While we have analyzed the group dynamics and interactions at the wall, our studies have not analyzed the content there, nor the *persistent photographic conversations* that may be in play from the community who do regularly upload images there.

However, it may be that the participants to CityWall engage via Flickr only. For example, a search on Flickr for one of the tags used for CityWall, shows 319,049 results with one randomly selected image from the collection having 55 comments or exchanges (<http://www.flickr.com/photos/doc18/262860166/>), another with six comments, another again with eight. These participants may or may not be aware that their images (because of how they are tagged) are also selected and displayed on CityWall, so while the picture-based exchanges and comments are occurring in an online environment, their relevance in the large display in an urban environment is at this stage unexplored and unknown. Another limitation for the participants who do actively and knowingly engage with posting images to CityWall is that while they may post these images online or via their phone, they have to physically return to the wall in order to see their images large-scale. To enable follow-up comments on a multi-user multi-touch display requires consideration of the interface design. Replication of an online environment is not a feasible solution.

3.3 Affordances

Above, we have detailed some of the limitations that our field studies have revealed, so what then are the successes we have found with this multi-touch display? Some are already discussed in section 3, but we will add detail in this section to enable further discussions and to ensure we bear these in mind for any future re-design considerations.

Firstly, what we find is that it is that novice users to technology generally can easily participate with this interactive display. This is a no-nonsense system of use, with no need for difficult drill-down procedures or an intensive learning period to access the features. While we have discussed already this factor in terms of its limitations, it is important to consider technology proficiency. Where the intended audience is a passing general public, and an unknown quantity, novice-level use acts as a draw card for initial engagement, attracting the public in. Secondly, evidence from our video footage and interviews revealed an evident sense of achievement amongst these first-time users, of which the longer-term impact cannot be gauged. Thirdly, for participants who added images and saw these on CityWall, there was interest in the content—and a palpable sense of ownership and involvement in the ‘event’. Their contribution was evident to themselves and to others at the time—they often bought others along to show-off their images—as well as being written into the archival history of the event.

Finally, gesture and play as a pleasurable means to be able to interact was also evident, both with the display itself and with others interacting at the display. As Don Norman, a prominent interaction design researcher comments: gestural systems are “agreeable to the senses... [and] pleasurable to use. This [gestural system] engenders good feelings in users”. [13] This is an important feature of the CityWall display and should not be under-estimated—as is a facility in an urban environment that affords play and social activity. Video footage showed much laughter and enjoyment by our participants. However it is important to note, that while for some participants we witnessed an initial reluctance to participate, this rapidly evaporated after a few moves had been successfully negotiated. Confidence in use

then, was fast achieved, and advanced rapidly into playful, experimental activity. In this environment it was observed that participants felt free to play and explore without fear of making errors. [14] Our field studies revealed our participants interacting in playful ways—they go to the city centre for leisure and entertainment (e.g. for a festival) and then look for things to do. The beauty of a work like CityWall is that it affords a place for just such ludic activity. CityWall offers people something to do, something to be involved with and a place and means to easily meet and interact with other people through.

4. EXPANSION AND EXPERIMENTATION

How then do we work with the limitations and affordances in a meaningful way to extend and improve the current implementation? We discuss here some of the considerations under review. Of course the implementation requires we are as critical of our technical practices, as we are of the kinds of activities we are looking to support. Some of what is under discussion here is in the early stages of experimentation and discussion in a design-development-iterate cycle that the small CityWall team deploys as its process.

To support user's engagement to the content presented on a public multi-touch display, we need to add more interaction techniques other than just simple browsing, moving and/or resizing of the content and items. This could be facilitated by looking at how to further support the collaborative interaction we have witnessed happening at multi-user public displays, for example considering how to develop additional interaction techniques that go beyond multi-touch. We note that CityWall makes use only of multi-touch gestures and visual output. This could be extended to combine gestures, the acoustic feature of speech and multi-touch, as we see with an interactive gestural and voice-activated environment such as PuppetWall [15]. New interaction techniques need not include only additional modalities, but could also contain new gestures that would for example help to go beyond the current 2D paradigm of resizing, moving and rotating objects. With three dimensional objects and space the current interaction interface and paradigms could be extended to enable a more sophisticated and in-depth level of access to information and content.

In addition, current tabletop prototypes demonstrate the inclusion of several other interaction techniques. Mobile devices, physical artifacts and even something as simple as sound can dramatically change the user experience. For example, a mobile phone gives access to one's own data and/or habitual ways of working (e.g. personal devices). Adding the capability for users to access their own data creates design opportunities to extend for users how they may then interact with a multi-touch installation, and also for defining what the display might be used for (e.g. they may process the information, or act more efficiently with all resources at hand).

Having multiple users and both parallel and collaborative use happening at a public display raises the question of how to deal with conflicts that are unavoidable when users have different goals. For more in-depth use, where access to content on a deeper level is required, the ways to access multiple contents at different levels at the same time need re-consideration. A discussion around a design that enables and implements multiple timelines, allowing multi-use by groups and individuals is one potential way to resolve this. Recently work was published that proposes group gestures on multi-touch table top, which however was evaluated only in a laboratory setting [2]. According to our experience with CityWall, any design idea that structures group interaction should

be trialed in a naturalistic setting, so that all elements affecting the interaction between the users and the system are present and can be observed.

5. CONCLUSIONS

The evaluation of CityWall either recruiting groups at events or analyzing passers by interaction resulted in several findings. The studies showed the difficulty in prolonging engagement of specific groups or communities. The CityWall does not provide support for conversation threads, persistent conversations or other thematic groupings other than chronological. We believe these would be beneficial to target usage beyond sporadic or ephemeral interactions of passers-by.

The key issue is to how the CityWall is useful to users. Generally either a specific practice is studied and becomes the design target of the technology or the technology enables a new practice. We feel that we have not yet found a clear hypothesis for neither of these approaches. For example if the CityWall is to address public-picture-sharing it should take this practice more seriously.

The CityWall did support serendipitous social interaction in public space and a more conscious design along these lines could be attempted. That an urban environment provides for its citizens a place for play activity, for genuine exchange, and unplanned interactions with strangers cannot be under-estimated. Despite some of the limitations coupled with these features, these aspects need to be maintained in future developments—so we look to add more features without taking away the affordances that genuinely work well.

Currently the design does not concretely support any specific "practice". One aspect of practice is of including specific communities and groups. How then can the interface—and the types of interactions this allows—be expanded to allow for more in-depth and meaningful exploration of content? How can this content have meaning to the inhabitants of the place itself—and the citizens of the city claim CityWall as their own? To do this well we need to ensure we 'ask' the stakeholders in the space—the shop owners, the passers-by, the city-dwellers—what they need, and integrate the kinds of technologies and activities that fit well with their everyday activities, to allow them to meaningfully participate and co-author in their place. This requires we employ current critical cultural, technical, and community practices and ask what do our citizens want with their CityWall?

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