Extending Large-Scale Event Participation with User-Created Mobile Media on a Public Display

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ABSTRACT

Most large public displays have been used for providing information to passers-by with the primary purpose of acting as one-way information channels to individual users. We have developed a large public display to which users can send their own media content using mobile devices. The display supports multi-touch interaction, thus enabling collaborative use of the display. This display called CityWall was set up in a city center with the goal of showing information of events happening in the city. We observed two user groups who used mobile phones with upload capability during two large-scale events happening in the city. Our findings are that this kind of combined use of personal mobile devices and a large public display as a publishing forum, used collaboratively with other users, creates a unique setting that extends the group's feeling of participation in the events. We substantiate this claim with examples from user data.

Categories and Subject Descriptors

H5.2 [**Information Interfaces and Presentation (e.g., HCI)**]: User Interfaces – *prototyping*.

General Terms

Design, Experimentation, Human Factors.

Keywords

Public displays, multi-user interfaces, mobile media, large-scale events, mobile and ubiquitous multimedia.

1. INTRODUCTION

People use their mobile devices to capture memories of events in which they have participated. After capture, this media content is traditionally moved to some other form that is more suitable for private viewing. In large-scale events with hundreds or even thousands of participants a large collection of media is created by the participants with their digital cameras and camera phones. This raises the question whether the collective experience of the participants and the content they have captured could actually be combined and made use of so as to enhance the common event experience in a fruitful way.

Large-scale events are social, economic, and media-intensive happenings. "Large-scale" refers to the amount of multiple sub-events taking place under a common framework that holds the name of the event and defines the nature of its sub-events. Typically large-scale events such as festivals and sports competitions last several days. The different sub-events may be running in parallel or in a sequence, one event after another. In addition, they may be spread out over a wide area. One of the most salient features of large-scale events is the large number of visitors, ranging from thousands to hundreds of thousands of people attending one or several of the sub-events on different days. Spectators organize themselves in groups investing resources such as time, energy and money to experience together something set apart from everyday life.

In this paper we introduce a system that can be used for extending the feeling of participation in a large-scale event and transforming passive "bystander spectatorship" to a more active form of engagement. CityWall, a multi-touch screen at the Helsinki city center can be used by people who take part in different sub-events. It shows the media content they have captured with their different capturing devices (digital cameras, mobile phone cameras) and then submitted to Internet media sharing services. We have evaluated CityWall's use with mobile camera phones, and will report the analysis of field trials organized during two large-scale events – the Eurovision Song Contest and the Helsinki Samba Carnaval. With these trials we aimed at investigating ways of using information technology to support active spectatorship. The results of this research effort are useful for developers who build applications and services for spectators in large-scale events on the one hand, and for researchers and practitioners investigating media-sharing applications in the urban context on the other.

2. ACTIVE SPECTATORSHIP

Active spectatorship is a concept that refers to seeing spectator activity (spectating) of an event as an engaging and interactive experience with lots of social interaction with other spectators [4, 7, 8]. This approach is in opposition to the idea of spectating being passive watching of events unfolding on a stage, podium or a playing field. Active spectatorship has parallels with the notion of active user [3], which emphasizes that users are not just systems automatically processing information they are provided with.

MUM'07, December 12-14, 2007, Oulu, Finland.

This paper focuses on urban events. As in other large-scale events, a single spectator has a hard time witnessing everything the whole event offers. Previous work on large-scale event spectatorship in rallies [8] noted that the primary interest of the spectator is to experience the event in action and socialize with other spectators. In studies investigating new interfaces, spectators were traditionally seen as passive consumers of mobile media and only recently has their role as active creators of media been considered [4, 6, 16].

Statistics show [8] that spectators organize themselves in groups when visiting an event. Typically a group prepares its activities by regarding the event beforehand. However, the resulting plan is not rigid but can be changed flexibly in the course of activities during the event. When a group splits into subgroups, on-the-fly on-site planning becomes difficult to manage and the group needs to develop methods to be aware of what each subgroup is doing [8, 16]. As one technical solution to this problem, most mobile awareness and presence systems for group coordination provide both user-controlled and automatic cues of users' situations and in this way provide information what group members are up to [5]. Typically, such cues relate to users' locations, their proximity to other users, or to their current activities [19]. Holmquist et al. [5] found while testing an awareness device in rock festival and conference contexts that mobile awareness systems can be useful in fostering a feeling of connectedness between friends and in finding opportunities to meet new people.

As mentioned, active spectatorship is also a social phenomenon. Participants are able to get more out of events if they can express and share experiences through e.g. verbal, performative, material, and technological means. Some of this activity is also directed at people outside their own group. Groups may display their identities with similar costumes and establish traditions that they maintain if they visit the event many times. Such traditions include e.g. reciting previous experiences and telling recurrent jokes or stories [7, 8, 16].

3. RELATED WORK

The development of systems for active spectatorship can benefit greatly from recent studies on mobile media sharing. Topics of particular relevance include studies on amateur photography (c.f. [9]), and the conversational use of pictures in multimedia messaging [10]. There have also been studies showing how other users' comments on online photos changes their lifecycle [17]. While recent years have seen much research on mobile leisure applications for communication, aside from our own research with mGroup [6, 16] and its successor CoMedia [7], there have not been many attempts to support media sharing specifically at large-scale events .

However, the study presented in this paper is not only about mobile media sharing, but combines it with large display design and research. In our system the media created by users was not shared to other users' media devices but was posted to a large public multi-touch display where users and other members of the public could go and browse through spectators' photos of the event. This created a different social stage for user-created content sharing than in messaging within a group of peers.

The social dimension of large display use has been studied both in tabletop, ambient and large display research, albeit not in as open walk-up-and-use settings as in the case presented in this paper. *Tabletop displays* have been used mainly in collaborative work spaces. Research has presented new kinds of collaborative touch-based interaction techniques that also support multi-hand use [12, 14, 22]. *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 [18, 20, 21].

Large multi-user wall displays resemble most closely the display technology we have created. The settings of research on them 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 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 [15].

TexTales, a wall resembling a photograph installation in an area of buildings under a threat of being run down, aimed 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 [1].

Dynamo, a multi-user public display system, was installed 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 various 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 [2].

Related to these studies, our work aims at building bridges between the two kinds of systems in two ways. Regarding research and design of mobile media sharing applications, we aim to facilitate new ways of engagement in the event by making the content in the phone publicly available to all event participants. Regarding large display research, our work aims to contribute to the understanding of the uses of public displays in particular in large-scale event contexts, bearing in mind the need for participating the spectators in the event experience in new ways, in our case as co-creators of electronic event content.

4. THE SYSTEM

The system for distributing user created content and displaying it in a large display was implemented by using two freely available systems – ShoZu[1] on mobile phones and the Flickr[2] photo service on the Internet. The large display called CityWall was built in our laboratory. This chapter describes the interaction between these components.

[1] See www.shozu.com

[2] See www.flickr.com

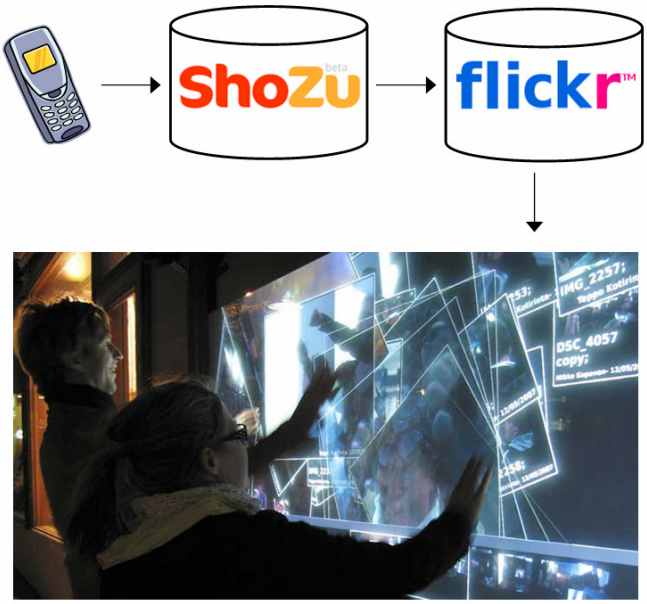

Figure 1. Information flow from the mobile to the CityWall.

4.1 The Mobile Camera Phones

To support groups at an event there is a need for a way to share media content between the group members. In addition, the system should not be a single stand-alone application, but rather it should be integrated into the existing media sharing services, to support richer set of use cases.

To facilitate easy media capture and sharing we gave the users camera phones that included software to upload pictures to the Flickr web site (see Figure 1). For this purpose we used the ShoZu application. As soon as a user took a picture, ShoZu offered 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 checked Flickr for new content and downloaded it to the wall. The computer judged relevance of content based on the tags associated with Flickr's photos: only pictures tagged with the event's name were downloaded. With this arrangement, the group could take pictures during the event and later view them also on the CityWall. The pictures were also available for viewing on the Internet to anyone having access to Flickr, which gave the users more benefit (and motivation) for publishing photos.

In our study, ShoZu was installed on Nokia N70 multimedia camera phones. The camera in this model can be activated by simply sliding down the cover in front of the camera lens and then pressing one button. This allowed an easy means for photo publishing on the Internet from any mobile setting.

4.2 CityWall: A Large Public Display

The main features of the CityWall technology are 1) multiple hand tracking capable of identifying uniquely as many fingers and hands as can fit on 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

Figure 2. Screenshot of CityWall with Flickr content.

citizen, without requiring special skills or previous knowledge. The four technological features create the conditions for a multi-user and multi-touch installation that is appropriate for a public space. The setup is technologically similar to HoloWall [11]. It allows placing all the equipment indoors out of the public space. A normal safety glass coated with a semi-transparent vinyl can be used as a projection screen.

CityWall is especially suitable for navigating media, photos in particular. As explained, the current version gathered content tagged with certain keywords ("Helsinki" and event names in our case) in next-to-real-time from Flickr. Figure 2 shows a screenshot from CityWall with Flickr content displayed on 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 rubbing it left or right. The timeline can also be compressed or expanded to show the contents retrieved during a full day or just during a couple of minutes. This was found to be important as the frequency of uploaded media may vary greatly.

Interaction design of the top part (B) of CityWall has followed two 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., with 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.

5. FIELD TRIALS

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

5.1 The Eurovision Song Contest

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

Figure 3. Users at CityWall.

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.

5.2 The Helsinki Samba Carnaval

The other event was the annual Helsinki Samba Carnaval. It 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.

5.3 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.

5.4 Data Collection

The following methods were used for data collection:

Background questionnaires were used to gather information on 1) what kind of communication technology the users were already familiar with, and 2) to inform the users how the media content they submitted was going to be used.

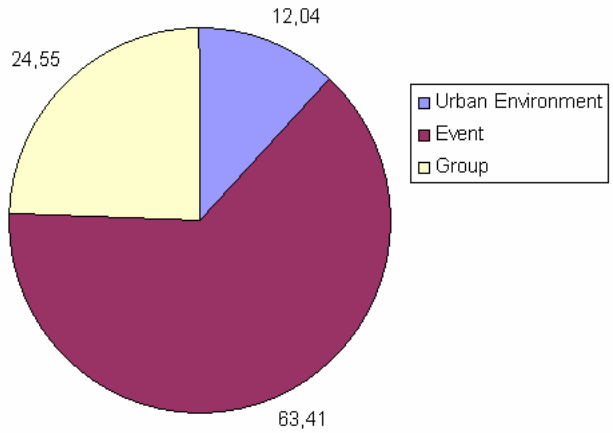

Figure 4. Targets of photography in percentages.

Video observation. The users were videoed when they 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 (see Figure 3 for a screenshot captured from a video).

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.

Content analysis. This 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.

Interaction logs for each phone. For instance, each viewing of a message was logged, as well as detailed data on how each feature was used.

6. FINDINGS

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.

6.1 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.

As seen in Figure 4, 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 5.

6.2 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 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.

6.3 Having Fun Together at the Wall

The Eurovision group visited the CityWall quite often, 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"

Figure 5. Example photos of urban scenery (A, B), event (C, D) and group (E, F) taken by users with their camera phones.

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."

7. DISCUSSION

CityWall multi-touch display technology combined with mobile camera phone and photo sharing services was found to be a way to enrich the experiences of the subjects observed in this study, groups of users attending two large-scale events. The users reported focusing on and being more present at the events through the use of the mobile cameras. Event experiences were relived and wrapped up in a fun way at the CityWall when users browsed through the pictures of the events afterwards together. We have shown that new technology can be used in this way to transform spectators of events from passive observers to actors who participate in the events by (re)constructing the event with their own content.

7.1 Ubiquitous Media at Large-Scale Events

More in general, this field study helped us better define what ubiquitous or urban multimedia could be in a large-scale event context.

The visitor groups invested resources such as time, energy and money to co-experience something "extraordinary" set apart from their everyday life. The spectators observed in this study did much more than just "watch": with mobile devices it was possible to get more out of the immediate spectating experience and also gain a new kind of experience in reviewing the captured media at the wall.

This study was a continuation of our previous work (see [6, 7, 8, 16] on supporting active spectatorship, In particular, the work has been focused on supporting the following three aspects:

- *Co-experience in a spectator group*. Participation in the event is a social experience, creating needs to maintain awareness of other group members, coordinate joint plans and convey expressions (verbal, mediated, embodied)
- *Engaging with the event*. Passive observation of unfolding events can be turned into a social and cognitive experience by providing spectators with new means for participation. This includes for example enabling spectators capture important moments (both at the stage and within the group) and share them with others.
- *Ubiquity and distribution of experience*. Spectatorship consists of a larger set of activities than just a participating in the main events. In the case of Eurovision Song Contest and Samba Carnaval, it also covered moments of eating, using public transportation, walking in city streets and so on.. Ubiquitous multimedia for events should take advantage of such moments.

These three aspects come together in the CityWall, which was an attempt to create urban multimedia beyond the personal media in mobile phones. To create successfully ubiquitous multimedia at events, we see at this point that the following two components are needed:

- A *mobile component* (such as the ShoZu application – see [7, 16] for other examples) that runs on a mobile phone and allows its users to access and create situated media situated.
- An *installation component* (such as a large public display like CityWall) that enables the collective and collocated interaction with spectator created media. The public display provides a better means for spectators to interact, alleviating the limitations of small screen space of mobile devices.

To experiment with further possibilities of new technology, we are currently working on ambient and pervasive computing as a third component. Our aim is to investigate systems that require less explicit interaction with a device but still provide the users with an awareness of the ongoing social event.

7.2 "Placing" Media: Problems and Opportunities

In our previous research on supporting spectators with mobile phones [16] we have noticed the importance of collocated (e.g., shoulder-to-shoulder) interaction in the creation of enjoyable experiences. When a mobile phone is circulated between group members and the content shown in the screen is discussed,

ridiculed and reviewed, the media in the phone serves a natural part of shared social moments. This observation was one of the motivations to build a large media wall like the CityWall at which some of these activities could be better supported. However, while the mobile phone is always with the users and by this definition can be a platform for ubiquitous media creation, a public display as the CityWall needs to be "placed" in a specific location.

When deciding where to place such a public display one can consider at least two types of locations: 1) a central location of the event 2) a central location of the city. In our trials we chose a city central location between the bus and train station terminals. Our choice was determined partly by the city central location of the Helsinki Samba Carnaval, but also by the fact that the spectators of the Eurovision event spent only evenings at the non-centrally located concert venue, and would have had better access to the city centre at other times.

Participants observed that one of the motivations to take many pictures was the awareness that these would have been shown in a public space at another location. We see "placing" media also as an opportunity to create an alternative place in the city that provides awareness of events.

7.3 Future Work

From the suggestions of users from this study and from our own observations, the CityWall could be developed further by focusing on the following new features: 1) The possibility to filter pictures displayed on CityWall by users (this could be done with Bluetooth identification or user defined keywords), 2) The possibility to remove one's pictures from the CityWall (although our test users had no complaints), and 3) The CityWall could also present something more than just user contributed data, something that would be useful for the general public. A new location for the display should also be taken under consideration to minimize the effects of the sun causing reflections and affecting the use of the display. Use of mobile media capturing devices could be enhanced by better batteries or considering giving the spectators of events the opportunity to recharge their mobile devices at the CityWall while browsing through the pictures.

Finally, to further enhance event engagement, the application should offer content more closely related to the events. The event organizers could have a possibility to present the content on the CityWall in a more meaningful way where user interaction with the wall is recorded and feedback used to rank the pre-popularity of the event from user responses. An event calendar could then be implemented, that would also show content from the future where preference and popularity is being dynamically generated by daily interactions and not just user contributed media from past events. This would require further design of navigation structures to incorporate the increased level of complexities due to integration of these advanced features. These are more challenges to designers and developers of the system to maintain the beauty and simplicity of the wall while increasing functionality and coming up with novel innovative solutions.

8. ACKNOWLEDGMENTS

This work has been funded by the 6th Framework Research Programme of the EU, through the IPCity project (FP-2004-IST-4-27571).

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