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Content Sharing on Public Screens: Experiences through Iterating Social and Spatial Contexts

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ABSTRACT

This paper describes the design and study of public urban screen applications aiming to facilitate urban dwellers to control content shown on public urban screens. Two types of content sharing are presented: aggregating existing social media content about particular locations for sharing, and sharing online videos with collocated people at a public urban screen. The paper describes an exploratory study, an observational study, as well as an interpretational study in regards to application usage and user experience. Sharing content on public urban screens can pique the curiosity of users towards collocated people and the application itself resulting in raised awareness of collocated people.

Author Keywords

Urban Screens, Mobile Phones, Urban Informatics

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

In recent years, public urban screens have been installed and deployed in public urban places to inform and entertain urban dwellers with a wide variety of content such as public transport timetables, art installations, live transmissions of large sports events, or local advertisement. Such uses of public urban screens usually involve uni-directional communication that pushes information to the public. The widespread adoption and use of mobile devices, which enable a constant connection to the World Wide Web, provides new opportunities to interact with the urban space (Foth et al., 2011). One opportunity to interact with the urban space utilising mobile devices could be, to open up the mostly closed environments of public urban screen installations and allow urban dwellers to share content that they choose on such screens. These types of digital augmentations could reshape urban life through new interaction possibilities (Kjeldskov and Paay, 2006). The research field of Urban Informatics is interested in “*the study, design, and practice of urban experiences across different urban contexts that are created by new opportunities of real-time, ubiquitous technology and the augmentation that mediates the physical and digital layers of people networks and urban infrastructures*” (Foth et al., 2011, p. 4). One opportunity to design and study the urban experience created through real-time, ubiquitous technology is to employ screens in public urban places to influence the experience of people through digital content and services.

This paper presents our research on public urban screen applications and how they can be utilised to enable an open dialog allowing users to create and share digital augmentations. “*Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody*” (Jacobs, 1992, p. 238). While this citation arises out of an urban planning context, we believe that being able to share content on public urban screens provides opportunities to create and customise the experience of spending time in a public urban place. The prospect of opening closed public urban screen environments to the general public and creating participatory systems similar to the Web 2.0 paradigm, is starting to be recognised in the research community (Davies et al., 2012). This paper sets out to explore how public urban screens can be utilised to enable content sharing utilising urban dwellers’ mobile phones. We are interested in the question how sharing content on public urban screens can influence the experience of spending time in a particular urban space. We present findings from three iterations of a public urban screen application deployed in two urban settings focusing on sharing data between collocated people mediated through such screens.

The remainder of this paper is structured as follows. We first review the relevant literature followed by a description of our research approach. Three design interventions are presented whereby each iteration focuses on a particular phase of this research: exploration, observation, and interpretation. The paper concludes with a discussion of the findings and presents future work in this area of research.

LITERATURE REVIEW

Public urban screens have become a common feature in public urban places. We often see – at least in developed countries – information displays on public transport systems, commercial advertisements on the digital façade of buildings, and increasingly on interactive touch-screens around central business districts. Public urban screens are increasingly present and influencing our everyday interactions with information, place, and people. There have been numerous technical endeavours to enable interactions amongst collocated people via urban screens and networked technologies. *Discussion in Space* (Schroeter, 2012) utilises urban screens and mobile phones to involve citizens in urban planning and design decisions through situated digital augmentations. *PhotoSwapper* (Eriksson et al., 2007) enables urban dwellers to share pictures from their personal mobile devices with collocated people through visualising the images on a public screen to stimulate social user interaction. *Opinionizer* (Rogers and Brignull, 2002)

visualises humorous and provoking statements on a public screen encouraging bystanders to share their thoughts by commenting using a laptop computer, resulting in real world social interactions. *CHIplace* and *CSCWplace* are public screen applications showing digital content from an online community in combination with content generated in the physical space enabling unplanned encounters with the content as well as raising awareness of the digital activities in the physical space (Churchill et al., 2004). *TiltRacer* (Vajk et al., 2008) is a gaming application utilising mobile phones as an input controller to play a car racing game visualised on a large public display.

Social media services have been used in public urban screen applications for various purposes such as viewing and uploading images from the online photo sharing service Flickr, browsing videos from a dedicated YouTube account, or using the account information from the social networking service Facebook for authentication to browse personalised content (Hosio et al., 2010). Munson et al., (2011) compared two public screen applications: the *Thank You Board* and the *SI Display*. The *Thank You Board* enables users to send structured thank you messages to a public display utilising a website containing a form for messages generation. The *SI Display* visualises Twitter messages on a public display directed at a specific Twitter user with the @username syntax. The study revealed that people preferred the *SI Display* due to the flexibility and openness of the system. In contrast, the study also showed that users were uncertain about the purpose of the system and what messages were appropriate to send to the screen. *Instant Places* (Jose et al., 2008) utilises a public urban screen and a Bluetooth device scanner, which periodically scans the surroundings for discoverable device names. The gathered device names are visualised on a public display whereas the system allows two modes for advanced screen interaction. First, users can specify tags in their Bluetooth device name. Second, users can specify a Flickr username in their Bluetooth device name, which triggers the system to visualise the photo stream of the particular username. The study showed that such a system could facilitate situated messages regarding place and collocated people within.

FunSquare (Memarovic et al., 2011a) is a public urban screen application deployed in the urban computing testbed of the city of Oulu, Finland (Ojala et al., 2012). *FunSquare* aggregates environmental context data such as temperature or wind speed with facts from various categories such as sport or history and composes fun facts visualised on the urban public urban screen infrastructure of Oulu. Additionally, a trivia quiz has been deployed presenting multiple-choice options of matching environmental context data with facts. An initial user experience study showed that people appreciated the connections between the local context and global facts while others were confused by the sometimes odd correlations. It was also reported that “*Oulu’s UBI-displays were often ignored by passers-by, making it difficult to observe many interactions with [the FunSquare] content*” (Memarovic et al., 2011b, p. 8). While focussing mainly on non-interactive content, research on display blindness has shown that public urban screens are often ignored by urban dwellers (Huang et al., 2008, Müller et al., 2009). Research in Oulu further states that

urban dwellers do not interact with public urban screens simply because they do not know that the installed public urban screens are interactive and suggest further research into how people can be motivated to interact with such systems (Ojala et al., 2012).

This paper presents real world deployments of public display applications enabling content sharing from existing social media sites utilising urban dwellers’ mobile devices. In contrast to previous studies, our approach focuses on social media and the possibilities to share such information with collocated people using mobile devices. This research combines the efforts of using existing social media services to control content on a screen (Munson et al., 2011), and combine and aggregate this information with additional social media resources (Jose et al., 2008), to enable digital in-place augmentations (Schroeter, 2012) through sharing data (Eriksson et al., 2007, Rogers and Brignull, 2002).

APPROACH

Our approach in relation to the research problem and research question can be subdivided into three separate phases: exploration, observation, and interpretation.

The exploration phase begins with the concept building (Choi and Seeburger, 2011), then development, and finally an initial evaluation of a public urban screen application that enables urban dwellers to share content with their mobile devices. This first research cycle called *Sapporo World Window* (SWW) was initiated as part of a commercial research project winning a tender to get access to ten public urban screens and deploy an application in downtown Sapporo, Japan. The public urban screen application was deployed and initially studied. However, conducting research in urban centres can be unpredictable (Kellar et al., 2005). Due to events beyond the control of the researchers, the research site in Sapporo was made unavailable after the earthquake in March 2011 and its major implications. A new site was selected and a scaled down version of the application was then introduced into Brisbane, Australia, in order to facilitate the observational phase. Observations were conducted to investigate if and how urban dwellers interact with such a system. The third phase, interpretation, involved a redesign of several parts of the system informed by the results of the observational phase. The newly designed and deployed system has been utilised to collect data about how people make use of the system and also utilising an online survey to collect data of people’s motivation and perception of the application.

The three steps of this research project – exploration, observation, and interpretation – helped to form an understating of how to engage urban dwellers with public urban screen applications. While the change of the research site was beyond our control, it opened up new insights into the role that the situated context of a public urban screen plays. This further corroborates previous research calling for multi-location evaluations due to the importance of the location of a public urban screen (Ojala et al., 2012). The following three sections describe each phase in more detail.

EXPLORATION

The exploration phase was conducted to gather first insights into content sharing on public urban screens in Sapporo, Japan. Sapporo is the capital city of Hokkaido, the northernmost island of Japan. The city has recently completed the 4-year development of a public underground passage that links two major train stations. The passage is designed to promote Sapporo as a *Creative City* especially in the domain of media arts. As such, the passage integrates a hybrid physical/virtual space named North 2, which contains ten large urban screens with webcams and audio speakers (Choi and Seeburger, 2011). Sapporo City Council invited application proposals to transform North 2 into a “public media space for communicating messages based on citizen’s creative activities about creative industry, tourism, art and culture, local government publicity and so on.” We proposed an open social media mash-up for knowledge exchange about creative hot spots and other interesting locations in Sapporo. It was accepted.

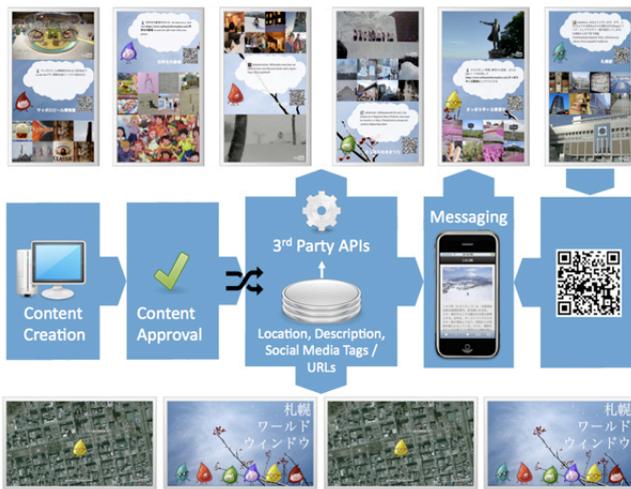


Figure 1: SWW system overview



Figure 2: North 2 space screening SWW

Sapporo World Window

We created SWW, an interactive screen-based application that focuses on enabling and encouraging people to share their creativity and knowledge about places in and around Sapporo. Six screens attached to the west-side wall of North 2, display a QR code and a collection of people’s creative outputs including videos, images, and comments about places in Sapporo from various social media services such as YouTube, Flickr, Foursquare, and Twitter. Use of QR codes is prevalent in Japan today, with most mobile phones natively equipped with QR code readers. As such, QR codes are featured prominently on the visual interface of

SWW. By using QR Codes linking to mobile websites, pedestrians can easily find out more about the places shown on the screens, including what it is, how to get there, and what others have said about the places, as well as expressing their own thoughts. In turn, SWW helps people to turn the passageway into a social place, a *point of connection* that thrives on and inspires people’s sharing of creativity and knowledge with the locals and visitors alike. Figure 1 visualises the overall system enabling SWW. The system consists of three main components: (1) website for content creation, (2) screen applications, and (3) a mobile website for each screen. Content created through the website is stored in a database for generating the screen applications and the respective mobile website when requested. Figure 2 shows the North 2 space screening SWW.

The initial concept of SWW contained an application feature to interact with collocated application users through the mobile user interface (Choi and Seeburger, 2011). Due to the fact that the application proposal was written without the opportunity to visit the space beforehand, we decided to remove this feature from the application proposal after being able to inspect the underground passage due to spatial and social constraints: the underground walkway is mostly used for travelling through the city. Therefore the application has been designed for passive interaction allowing passing urban dwellers to engage with the content without the need to directly interact. Additionally, mechanisms to interact with, contribute to, and create SWW content are provided.

Exploratory User Study

For the exploratory user study, we invited 10 participants to the underground space to interact with the application in the real environment. At the time of conducting the study, the construction of North 2 had already been completed but the site was not open to the general public. Participants consisted of 8 male and 2 female university students and staff, aged between 21 and 37. We first asked the participants to fill out a one-sheet paper based survey to gather demographic information and general questions about how they use the current underground passages in Sapporo. Following this, we asked them to explore the North 2 space and interact with the SWW screens as shown on the bottom part of Figure 2 followed by an open-ended semi structured focus group. The whole study was conducted in Japanese assisted by a Japanese interpreter. It lasted for approximately 90 minutes, was video recorded and transcribed. The same interpreter who was present at the study verified the English transcription.

The study participants mainly use the existing underground passages for travelling through downtown Sapporo or meeting someone in the downtown area especially during cold days, as the passages provide a warmer environment. Participants expected that they would use the new underground walkway for the same purposes. However, after viewing and interacting with SWW as well as other content to be deployed in the space, the participants expressed that they would come to see and “play” with the provided technology and information. One emerging theme from the study was that seeing user-generated content in

public urban places was perceived as novel. Despite the growing amount of public displays in urban environments in Japan and around the world, interactive user-generated content and services in public places still remain uncommon. Participants found it difficult to differentiate between purposefully prepared promotional content and user generated Web 2.0 content. Participants highlighted three likely scenarios in which they would use SWW. First, participants expressed that North 2 would be a great meeting place, and that they would probably interact with the screens while waiting for someone in the space. Second, users pointed out that they would more likely use the application when they are in a group rather than on their own. The third scenario is directly related with the physical characteristics and constrains of the underground space. Because there are no shops or cafés in the vicinity of North 2, the space is constantly in flux. Participants said they would likely stop and interact with the screens if they see content that deals with subjects of their interest. This highlights the need for locally produced content about various niche and locally-specific points of interest rather than well-known and touristic locations. One participant stated: *“If I [could] get some non-mainstream local, ‘underground’ information about smaller clusters to which some of my friends may belong, then it’s going to be a lot of fun for me [to use SWW].”*

Study participants described SWW as a fun tool for local knowledge exchange within the city, which can transform the public space into a place of social collaboration and thus animating and promoting Sapporo as a whole. The exploratory study provided promising insights into how SWW and the concept of content sharing on public urban screens could be used and perceived by the citizens of Sapporo. After conducting this exploratory user study, the aim was to conduct further observational studies on how real users interact with the system during their daily lives. Previous research identified the discrepancy between laboratory and real-world studies (Ojala et al., 2012). An observational study could provide further knowledge into how different levels of engagement with SWW – from spectator to participant, then to content creator – can change people’s experiences of the public urban place.

OBSERVATION

Following the exploratory study, usage data of how urban dwellers interact with public urban screen applications and share data was required to provide more insights into the concept of content sharing on public urban screens. An observational study has been conducted at an urban public screen installation at a shuttle bus stop at a university campus in Brisbane, Australia.

Brisbane Hot Spots

Due to the change of location for the observational study, SWW had to be redesigned and adapted towards its new application context. The concept of SWW has been repurposed for the public urban screen in Brisbane. Several distinctions had to be considered for Brisbane Hot Spots (BHS): (1) instead of having access to 10 HD screens, BHS had to be recreated to operate on one screen; (2) instead of showing BHS in portrait mode like SWW, BHS has to be

recreated to operate in landscape mode; (3) the user interface which had been designed for a Japanese audience had to be redesigned; (4) no audio is available at the bus stop location. Figure 3 visualises the public urban screen at the bus stop showing BHS.



Figure 3: Public screen at a bus stop in Brisbane, Australia

Observational User Study

To get insights into how urban dwellers interact with BHS, a covert observational study has been conducted. Over a time span of five days, the researchers went to the bus stop 7 times for one-hour intervals to observe if and how people react and interact with BHS. The covert observations found three categories of potential users: (1) Walk by: People pass the bus stop screen and are able to watch the content while walking by. (2) Sit: People sit on the benches of the bus stop. (3) Stand: People stand in the vicinity of the bus stop and are able to watch the content while walking by.

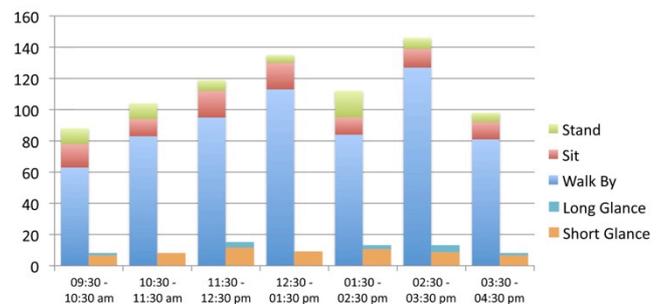


Figure 4: Observational data of people at the bus stop

In addition to this categorisation, all people in the above categories have further been grouped into groups according to their level of involvement with BHS. (1) Short glance: People notice the content on the screen and have a short glance of around 1 to 2 seconds but then move their focus of attention to something else. (2) Long glance: People notice the screen and look at its content for a longer period of time. People in this category passively engage with the screen’s content. (3) User: People who stop, look at the screen’s content and scan the QR code to get more information about the content on the screen. Figure 4 shows the results of this observational study. During the 7

observations distributed over 5 days, 802 people could be observed as potential users. Out of these, 63 people could be categorised into the group of people who shortly glanced at the BHS application, and only 11 people looked at the screen's content for a longer period of time. Out of the 802 observed potential users, not a single person tried to scan the QR code shown prominently on the screen. During the observation, several factors influencing the interaction with the urban screen have been revealed and are discussed in the next subsection.

Findings

While the reported numbers of the observational study presented above are quite low in terms of people noticing and interacting with BHS, the observations revealed several indicators how the design of the space and the setup of the screen influenced these results.

Screen orientation. The main activity for people who sit at the benches or stand near the bus stop is waiting for the next bus to travel to a second campus location. Therefore, people mostly observe the streets to see if the bus is driving down the street. The public urban display on the other hand is attached to the lower end of the bus stop roof as shown in Figure 5. As most people are facing the street, the content shown on the public display is not in a position where it is noticeable for people waiting at the bus stop.

Screen location and bus stop location. Figure 5 shows the bus stop with benches and the urban public screen attached to the lower end of the roof. However, the actual location where the bus stops, is about 15 meter further down the road. During peak hours, students immediately start queuing at the actual location where the bus will stop instead of waiting at the bus stop booth. On one occasion it could be observed that even if the queue of people waiting for the bus is going all the way down to the bus stop booth, people still face the streets and therefore ignore the screen.

Flow of people. Through observing the bus stop, several patterns of how people traverse through the space could be identified. Due to the buildings surrounding the bus stop, the main stream of people is not directly passing the urban screen at the bus stop. The black lines in Figure 5 indicate the flow of people. As visualised in Figure 5, the main flow of people is going from a university building located opposite the bus stop towards a mixed use building on the left side of the bus stop using the pedestrian crossing and vice versa. Additionally, as visualised in Figure 5, a significant amount of people who passes the bus stop walks on an angle towards the garbage bin to dispose their rubbish and walk away from the bin on an angle resulting in not noticing the public screen.

Looking down, not up. People who actually sit or stand at the bus stop mostly look down and focus on their mobile device rather than looking up towards the public screen.

Public interaction. Due to the way the screen is attached to the bus stop roof and the orientation and angle of the screen, people who want to experience the screen's content mostly stand right underneath the bus stop roof between the two benches. Interacting with BHS through scanning the QR code visualised on the screen results in a public interaction

visible for collocated people. As reported in previous research (Brignull and Rogers, 2003), social embarrassment through this sort of public interaction can be a key factor why people do not interact with public urban screens in this way.



Figure 5: Pedestrian stream at bus stop location

Environmental conditions. The bus stop roof is made out of transparent glass resulting in low visibility during sunny days in Australia.

Summary

The observational user study confirmed how rarely people notice and look at public urban screens (Huang et al., 2008, Müller et al., 2009). Not a single interaction in terms of scanning a QR code could be observed. On the other hand, the observational user study revealed how the design of the public urban place and the display within can influence and hinder interactions. An artful integration of screen and space is required.

The initial design concept behind BHS is based on SWW. SWW on the other hand was particularly designed for the characteristics of the North 2 underground space. SWW would have been exposed to over 100,000 people a day in a more open public urban place with urban dwellers having different backgrounds than those at the bus stop in Brisbane. Potential users who spend time at the bus stop where BHS was shown were mainly university staff and students travelling to the second campus location in Brisbane. Given the fact that people who spend time at the bus stop mostly have to attend classes or meetings at the second campus and are generally familiar with Brisbane and its surroundings, the whole concept of aggregating social media about interesting locations seems not as suitable as it would have been within the Sapporo context.

The results of the observational user study provide implications into how to design an application for the bus stop screen context. The next section describes the third iteration of studying the concept of content sharing on public urban screens incorporating the lessons learnt from the exploratory and observational study.

INTERPRETATION

The results of the observational study described in the previous section resulted in a reiteration of the current interactional and conceptual process of information sharing on public urban screens. The observational study showed that the spatial and social context of a public urban screen application has to be carefully considered to create

engaging public urban screen content sharing applications. To gather deeper insight into the concept of data sharing on public urban screens, we redesigned the current implementation deployed in Brisbane incorporating the findings and experiences from previous iterations and conducted further user studies. The following design principles derived from the observational study were embedded in this iteration.

Private interaction. Instead of having to scan the QR codes as the only means to interact with the public urban screen application, such applications should utilise mechanisms which enable users to control and interact with the content shown on the screen in a private way.

Lightweight content. SWW and BHS are based on aggregated content from various social media services showing media for a particular location. Users are able to create new content through an online form, which is then shown on the urban screen upon approval. However, the content creation process involves some thought in form of researching content from existing social media sources. This complexity of process hinders in-situ content creation while in front of the urban public screen. Additionally, the SWW user study described earlier showed that study participants would more likely interact with the urban screens if the content would show subjects of their particular interests. Therefore, the third iteration should employ a simple and in-situ approach for content creation, sharing, as well as consumption while being in front of the urban public screen.

Auditive experience. To draw more attention to the urban public screen, speakers are utilised for audio output in addition to the visual information shown on the screen. This should help to get the attention of people when environmental conditions such as bright sunshine hinders visibility of the content shown on the public screen. However, audio should only be played if a user interacts with the system possibly resulting in what Brignull and Rogers (2003) call the “honey-pot effect”.

YourScreen

The concept behind SWW and BHS is to share favourite locations through aggregating various sources from existing social media sites. To incorporate the previously mentioned design principles, this concept had to be significantly changed. Instead of sharing locations on public urban screens, the new iteration named YourScreen, enables urban dwellers to share online videos. YourScreen aligns to the concept of a music Jukebox, enabling urban dwellers to consecutively play videos on the public urban screen visible for all collocated people. YourScreen provides private means to play online videos hosted by the video storage service YouTube on the public urban screen while waiting at the bus stop. To enable urban dwellers to watch YouTube videos on the public urban screen, existing social media services have been repurposed to submit videos to the YourScreen application. Similar to the SI Display application (Munson et al., 2011), our public urban screen has been equipped with a user account from the micro-blogging service Twitter. Additionally, a fan page on the social networking service Facebook has been created.

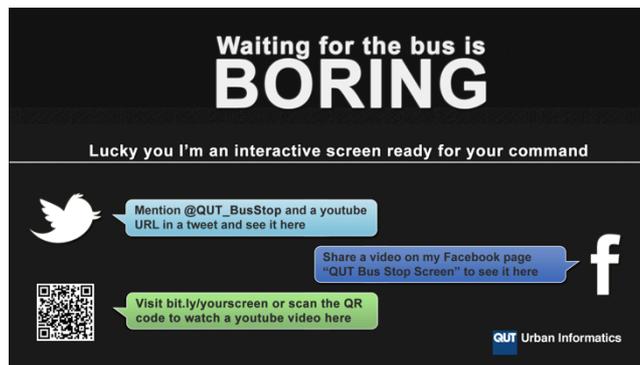


Figure 6: YourScreen application waiting for submissions

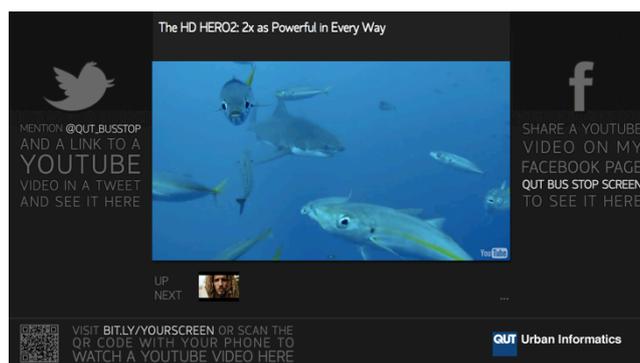


Figure 7: YourScreen application playing a video

Through utilising these services, private means for interacting with the public urban screen are provided to urban dwellers as they are able to send a link of a YouTube video to the YourScreen Twitter account using the ‘@TwitterName’ syntax or share the link on the fan page on Facebook. While the observational study described in the previous section showed that not a single observant scanned the QR code, we decided to additionally add a QR code linking to a mobile website enabling video submission for urban dwellers without accounts in the utilised social media services. However, in this iteration we also visualised the URL encoded in the QR code at the public urban screen application. Figure 6 shows the waiting screen of the YourScreen application explicitly stating the purpose and functionality of the application. Once the YourScreen system receives a video submission via Twitter, Facebook, or the mobile website, the waiting screen shown in Figure 6 fades out and the video screen as shown in Figure 7 fades in and starts playing the video. If multiple videos are submitted at the same time or while already screening a video, the received videos are added to a playlist visualised underneath the currently played video in Figure 7. After all videos in the playback queue have been screened, the video screen fades out and the waiting screen re-appears. The waiting screen in Figure 6 and the video screen both state explicitly what functionality the urban screen application offers and how to interact with the screen. As stated in the literature review, previous research emphasised the importance of stating what an urban screen application is designed for and what it has to offer to stimulate interaction with an interactive public display application (Brignull and Rogers, 2003).

Through utilising Twitter, Facebook, and a mobile website for video submission, YourScreen can be used by a variety of smart phone models, touch devices, as well as portable computers without the need to develop various mobile device applications for multiple operation systems. Additionally, the utilised services enable ad-hoc and in-situ interaction with the YourScreen system without the need to download and install software.

Data Collection

YourScreen has been deployed at the same public urban screen (Figure 3) that has been studied during the observational phase. While the interaction with the screen itself is private in a way that collocated people cannot know who submitted a video, we have access to the usernames of people who submitted videos through the utilised social media services and email addresses from people who used the mobile website. Given that urban dwellers spend approximately 5 to 10 minutes at the public urban screen before the bus arrives, we decided to employ an online survey stating open-ended questions to gather more insights into the motivation, experience and perception towards the YourScreen application. Additionally, all video submissions have been stored in log files to collect insights into how urban dwellers make use of such an application and what type of content is shown on the public urban screen. Therefore, we replied to Twitter messages containing a YouTube URL with an invitation to fill out a survey and commented on Facebook entries shared on the YourScreen fan page. The survey URL has also been shown to users who used the mobile webpage after submitting a video. The possibility to win an MP3 player has been offered as an incentive for users to fill out the survey.

Results

The data presented in this section is based on a 10-week real-world deployment of the YourScreen application. During this time period, 183 video submissions have been received from 79 distinctive users. The average user submitted 2.4 videos (standard deviation (SD): 3.2, maximum (max): 19, minimum (min): 1) to the screen. More than half of all video submission were received through the micro-blogging service Twitter (52%), followed by the mobile website with 44%. Only 4% of the received videos were shared on the fan page of the social networking service Facebook. Altogether 16 responses from application users could be collected through the online survey. The next subsection presents the quantitative data about application usage recorded through the YourScreen system followed by a presentation of the quantitative data collected through the online survey.

User Interactions

All video submissions have been logged in regards to their YouTube categories. The majority of over 65% of all submissions are in the categories music, comedy, and entertainment containing for example music video clips, funny excerpts from comedy TV shows, or celebrities. The remaining categories mostly focus on specific interests such as car tuning (auto and vehicles), screen cast from massively multiplayer online role-playing games (games), excerpts from sports events (sports), political speeches

(people and blogs), new technological developments (science and technology), or charity movements (nonprofits and activism). The analysis of the logged categories in combination with the survey results shows a trend towards two screen usages. First, urban dwellers who submit a video such as popular music videos and ‘funny’ videos, which might also be liked by the majority of collocated people. Second, urban dwellers who selected more specific videos such as political speeches or excerpts from sports events, which might be of particular interest for the user or to share this particular interest with collocated people. As reported in previous research, some users try to ‘troll’ or ‘game’ public urban screen applications (Schroeter, 2012). In the case of YourScreen, some users tried to ‘game’ the system by submitting up to 10 hour-long videos containing audio/video loops of the same video sequence. Another user ‘trolled’ YourScreen through submitting a slightly sexist video 10 times in a row. Besides these two cases no other instances occurred.

Through logging timestamps of video submissions, two peaks of interactions could be recorded. One peak of interactions is situated around lunchtime in the early afternoon and the second peak in the early evenings. Due to the location of the urban public screen, the first peak of interactions can be explained through the vicinity of restaurants and people passing the screen on their way to lunch. The second peak results in the heightened visibility of the public urban screens content due to the early sunsets in autumn Brisbane. Additionally due to the visibility of the screen’s content, more interactions have been received in cloudy and rainy days rather than sunny days. During the real world study of YourScreen, we noticed that the application attracted some urban dwellers who extensively used the application over the period of deployment whereas most of them always played the same video. Overall, comparing the recorded interactions with the previous iteration of BHS, incorporating the proposed design principles could encourage interactions with YourScreen.

User Experience

After interacting with YourScreen, 16 users filled out the online survey, 9 male, 7 female, aged between 15 and 35 (mean: 23.1). Out of the 16 participants, 13 responses were collected from students studying on various levels (high school, undergraduate, postgraduate) and the remaining three responses were collected from university staff and nearby service employees. The qualitative data from the online survey has been organised around reoccurring themes followed by searching patterns and connecting threads (Seidman, 2006). The data presented highlight the subjective user experiences (Hassenzahl and Tractinsky, 2006) aggregated around these themes.

We asked in the online survey what participants’ first impression of the public urban screen application was. Generally, the idea of being able to control the content of public urban screen has been perceived as “*awesome*”, “*cool*”, and “*an interesting concept*.” One response in particular mentions that “*the idea of employing a choice of entertainment that people can relate to (TV) as well as request for their favourite video is a good and well thought idea*.” Showing TV program in public and semi-public

urban places is a common utilisation of public urban screens, but empowering urban dwellers to have a say in what is shown is a novel concept.

We were interested in what motivated urban dwellers to submit a video to the public urban screen. Three themes could be identified: idle time, curiosity, and reactions from collocated people. Due to the context of the YourScreen application, urban dwellers spend time close to the public urban screen waiting for the next bus. One participant explains that he *“was waiting for a bus one day and decided to try it”* and a different response reported that the participant *“had some free time and was interested.”* Having nothing to do while spending time in public can result in YourScreen interactions. The responses showed that the concept of sending content to the public urban screen has been perceived as novel and piqued urban dwellers’ curiosity. People wanted to test the functionality of YourScreen *“to see what happens”* and were surprised that the submitted videos were played immediately. One response states that *“first [it was] curiosity I would say. [I] Wanted to see, what will happen in the screen and around me, if I send the request.”* This and other statements show that YourScreen piques urban dwellers’ curiosity towards the application itself and the reactions of collocated people.

YourScreen raises the awareness towards collocated people. We asked participants why they choose the video they submitted. Some participants based their video submission on what they thought other collocated people might like. One participant states, *“I thought [my video submission] was pretty broad, and would cater to other people’s tastes as well.”* Another participant explains his considerations for his submission: *“I think the action in the video would have been an entertainment to everyone present at the stop,”* whereas another participant states that with his submission he *“wanted to rock out the street a bit.”* Another group of participants selected videos based on their own tastes and preferences. For example, participants mentioned that they had submitted videos of songs that were stuck in their head, submitted their favourite song, or music videos by their favourite bands.

We wanted to know what reactions by collocated people urban dwellers observed after they submitted their video choice to the public urban screen. Due to the nature of the application’s context, half of the participants reported that the bus arrived shortly after they submitted their video and one person tried the application while being alone at the bus stop. However, other participants reported how collocated people reacted to their submissions. For example one participant who submitted a ‘funny cat’ video explains how she noticed that other people ‘were weirded out’ whereas another participant states that his video submission *“changed the mood of the surrounding area, and really caught people’s attention.”* Other reactions reported include that people were confused and even scared after the YourScreen application suddenly started to play a video, collocated people were laughing at a funny video submission, and one participant stated that the collocated people *“seemed new to this and few of them interested in watching the song.”* Another participant gives a detailed description of the surroundings: *“There were three people*

standing fairly close to the screen, because it was raining. One person was scared coz the screen suddenly plays the video, and mainly because it was a loud first beat. The other 2 people were on their headphones, doesn’t seem like they care.” It seems that through having the ability to send content to a public urban screen, people are not only aware of what content they might submit and for what kind of audience, but also observe their surroundings or as one participant states that he *“might try different type of videos to see different reaction of people. E.g. news/comedy/viral videos.”*

After interacting with the YourScreen application, we wanted to know what urban dwellers think about the ability to send content to a public urban screen at a bus stop location and how they felt when their video submission was played on the screen. YourScreen gives urban dwellers something to do while waiting for the bus and has been perceived as *“a really cool idea and a great way to pass time.”* Another participant states that from now on, he does not have to worry about missing the bus because there is something to do while waiting. In general the adjectives used to describe YourScreen are: awesome, fun, pretty cool, amazing, brilliant, and ingenious. Participants reported that they felt excited and thrilled when their video was played. *“The first time I did it, I was quite excited. It came up straight away on the screen and I thought that was brilliant. I would say, the volume needs to be turned up.”* Another participant reports his experience of seeing a video he submitted to a public urban screen: *“This was the first time I encountered such an application [...] I felt thrilled.”* Other participants described the feeling of seeing their submission played through the YourScreen application as impressed, interested, slightly amused, super cool, and enjoyable. It has also to be noted that one participant felt dissatisfied and embarrassed because only the audio without video was played due to an outdated version of a browser plugin. Another participant who played her own music video to observe reactions from collocated people reported that she felt apprehensive due to the public exposure. The previous example where the YourScreen application has not screened the video and only played the audio shows how bugs of a public urban screen application can negatively influence people’s experience.

Overall urban dwellers enjoyed interacting with YourScreen and many people used the application more than once. The interaction possibilities of YourScreen created a community around the bus stop. One participant explains: *“I’ve tweeted at the screen whilst at the bus stop. On this particular occasion, I was listening to a song at the [...] library and decided to tweet it to the bus stop, just in case there were people there. I like the song that much.”* The statement shows how the participant was aware of the YourScreen application and people possibly spending time at the bus stop and wanted to remotely share her experience of listening to a music video. Another participant explains her emotional connection to the people spending time at the bus stop: *“I was at home and I felt bad for the poor people who were at [university] that day. Thought I’d give them something to watch while waiting for the bus.”* These statements show how YourScreen can create a sense of community in public urban places.

DISCUSSION

We set out to explore how public urban screens and mobile phones can be utilised to share data in the urban space and how this might be perceived and experienced by urban dwellers. A comparison and synthesis of research results and findings in the area of public urban screen applications and their impact seems challenging due to the varying contexts of public urban screens: city centres (Memarovic et al., 2011a, Ojala et al., 2012), social events such as a book launch or welcome party (Brignull and Rogers, 2003, Rogers and Brignull, 2002), a university setting (Munson et al., 2011), a lab environment (Eriksson et al., 2007), a campus bar (Jose et al., 2008), and professional events (Churchill et al., 2004, Vajk et al., 2008). Our data shows that while location sharing did not entice interactions on the public urban screen at the bus stop location, sharing videos could create user interactions and a positive user experience while waiting for the bus.

Previous research found that both, the spatial and the social contexts of a public urban screen influence the occurring interactions (Ojala et al., 2012, Taylor and Cheverst, 2012). While, for example, a public urban screen in a swimming hall building resulted in collaborative interactions between collocated people (Ojala et al., 2012), our observations showed that a more isolated social context exists at the bus stop. The research presented in this paper is based around two different spatial and social contexts, the underground walkway in Sapporo, Japan and the bus stop location in Brisbane, Australia, whereas the concept of location sharing has been adapted to a different context as initially designed for. While both public urban screen applications enable content sharing, various differences in the interaction design and presentation have been made to suit the respective spatial context. The underground walkway in Sapporo is a transitional space, which is used by urban dwellers to comfortably traverse through the city and does not provide any street furniture such as benches to allow urban dwellers to rest and spend time in the particular space. The bus stop on the other hand is mostly a dead-end space where urban dwellers wait for public transport to arrive. While people are actively traversing through the transitional space, people are passively waiting at the dead-end space. We suggest that in public urban places, in which urban dwellers passively spend time such as at a bus stop, public urban screen applications should actively encourage interactions through stating explicitly what they have to offer resulting in an immediate response from the application after interaction. On the other hand, in locations in which urban dwellers actively engage in activities such as walking from one place to another, public urban screens should be passively broadcast for example previous interactions and provide additional means such as QR codes for interactions for interested urban dwellers. The public urban screens deployed in Oulu, Finland, offer a hybrid approach of passive mode showing media presentations and the (inter-)active mode when sensors detect urban dwellers in the vicinity (Ojala et al., 2012). Further research is needed in the area of how to visualise interactivity in public urban screen applications when the screen is deployed in a transitional space showing passive interaction possibilities.

The study conducted with YourScreen showed how public urban screens can be utilised to create a connection between people at the bus stop as well as between remote, non-present people and people at the bus stop. Previous research found that public urban screen applications could raise the awareness towards the events held within a community through sharing such information on public urban screens (Taylor and Cheverst, 2012) and raise the awareness towards online communities in a physical gathering of such a community (Churchill et al., 2004). This study showed how public urban screen applications could raise the awareness towards collocated people in a public urban space. This awareness is created through enabling urban dwellers to control the content on public urban screens. For example, being able to select and show an online video on a public urban screen makes application users carefully consider their submissions towards how other people might like it and react. Our data shows that application users either selected videos suiting their own interests or selecting videos that other people might like.

Urban planners and designers create opportunities for people to for example stand, sit, and move to activate public places (Whyte, 1980). This study showed that public urban screen applications could activate public urban places through sharing content on screens and mobile interactions. Applications such as presented in this paper enable urban dwellers to customise the urban experience by being able to control and push content to public urban screens. Being able to take an active role in public urban spaces through sharing content on public urban screens results in novel experiences raising awareness towards collocated people.

Utilising existing and well-known social media services and promoting them on a public urban screen resulted in interactions between urban dwellers and the urban environment. The advertised Twitter account for the public urban screen at the bus stop received 27 messages from urban dwellers not containing a URL to an online video. Instead, messages contained feedback about the application: “[I’m] back at Kelvin grove and I just watched an @amazingphil video in public! :D it was funny too :) use @QUT_BusStop and a link :)”, messages directed at the bus stop itself: “Need a shaded shelter at @QUT_BusStop”, the bus service: “where is ma bus!!!!”, or messages describing activities and moods of urban dwellers: “Ditching lectures to go shopping in the city with @[username] :).” It seems that creating and attaching social media to public urban places can itself create open and uncontrolled messages in reference to people, place, and technology. While previous research which utilised Twitter for communication between a mobile device and a public urban screen reported that the openness of a system through not restricting the Twitter usage made people unsure about the displays’ usage and hindered some people from interacting (Munson et al., 2011), our research shows that stating strict rules of how to use the social media technology can encourage urban dwellers to break these rules and reappropriate the technology towards their desire.

CONCLUSION

This paper presented research towards enabling urban dwellers to share content on public urban screens with collocated people using their mobile phones. The study presented in this paper described three research phases: exploration, observation, and interpretation. The three phases were spread about two different social and spatial contexts resulting in a conceptual and interactional shift within the studied concept of content sharing on public urban screens. This paper set out to explore how public urban screens in combination with mobile phones could be utilised to create a more social and enjoyable feeling while spending time in public urban places. We conclude that utilising existing multimedia content in combination with being able to anonymously share and showcase such content can result in a positive experience piquing users' curiosity towards the public urban screen, collocated people, and how they might react. In this way, the research showed that observational studies of public urban screen environments are an essential part in designing engaging applications.

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