

Research Design for Evaluating How to Engage Students with Urban Public Screens in Students' Neighbourhoods

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Abstract—Public screens are spreading throughout urban residential environments – in busses, trains, shopping centers, or at bus stops. Currently they are mostly used for advertising purposes, however, within the scope of this publication we focus on a new non apparent application area: the application of public screens in student villages. However, with new emerging innovative technologies and the increasing demand of students to use the latest technologies, there is a need and desire to bridge residents and businesses in the local vicinity. In addition, social networks shall help to foster a deeper integration of the community and its services. We present a study of the usage of public screen environments in the student vicinity of Kelvin Grove, Brisbane, Australia and Hervanta, Tampere, Finland. The study had three goals: (1) interviews with business owners to evaluate their needs for content and services; (2) student questionnaire to gain insights into consumer desires and expectations; (3) development of a roadmap and service concepts for public screens in student vicinities.

Urban screens, ambient media, public screens, urban informatics, interactive screens, consumer experience, student vicinities

I. INTRODUCTION

With the emergence of the Internet, networked devices and interactivity became fundamental part of our daily lives. Increased device capabilities, location based services, social media, the Internet of things, and many various new service types enable interactivity and communication – anywhere, anyhow, and anytime. One of these trends are public screens that are placed in urban environments and inside city facilities (e.g. restaurants, companies) accessible through anyone that passes by or enters the facility. Currently these screens are mostly used for advertising, and provide rather poor interactive features or communication medium.

As we can consider public space as the “city’s medium for communication with itself, with the new and unknown, with the history and with the contradictions and conflicts that arise from all those. Public space is the urban planning’s moderator in a city of free players” [6]. Thus, urban screens provide a fully new medium for communication and contribution to public spaces as infrastructure to [15]: promote interaction, formation of public sphere, promote social interaction, understand trends in the society, and support participation in the creation of public space [29].

Student vicinities are an ideal playground for the development of new services and content. Due to the close

proximity to universities, and the young age of residents they offer a good creative ground for experimentation and introduction of new services. Commercial facilities and businesses provide services for students and are competing for them as customers, and are faced with the rapid development of new technologies. For the scope of the study, we focus on two types of screens: public urban screens, such located within urban environments as e.g. bus-stops or central places; and public available screens within facilities as e.g. restaurants or commercial facilities.

The basis of this study was based on the example of two student vicinities: Kelvin Grove a northern suburb of Brisbane in Australia, and Hervanta a suburb of Tampere in Finland. Both student vicinities have rather many similarities, therefore are well suited for a comparison: both locate a university, diverse residents at young age, many shops, restaurants, companies, cinemas, leisure centers, cafeterias, bars, social services, health facilities, and other commercial facilities.

Kelvin Grove is a northern suburb of Brisbane in Queensland in Australia with approx. 5.000 inhabitants and a median age of 29 [17]. *Queensland Univ. of Technology (QUT)* is located within the village and has a close cooperation with the village services, especially with its cooperation within the scope of creative industries. The community in Kelvin Grove is rather diverse mix of residents – many of these students at young age. The villages’ desire is to create a place to experience a mix of art, culture, and technology to provide a special living environment. The village describes itself as the ‘creative heart of Brisbane’, and aims to “balance environmental, social and economic issues for long term sustainability” within its village planning initiatives [18].

As comparison and other component of the study, we have chosen a student neighborhood with similar characteristics. Hervanta is a suburb of Tampere in Finland with approx. 26.000 inhabitants, where 1/5th of the inhabitants are students. Similarly to Kelvin Grove, a university is located within the area: *Tampere University of Technology (TUT)*, the second largest university of Finland. Hervanta hosts various technology companies and research institutions and the worldwide first mobile phone call has been made within this village in 1991 [14].

Within the scope of this work, we present the basic research framework and study outline. We describe the study design, and some preliminary basic findings.

II. RELATED WORK

Currently there are rather many research works dealing with public screens and their integration into urban environments. Many urban screens are located at places as façade of architectural buildings, on the street, inside shops, at university campuses, bus stops, or in transportation vehicles. Within this section, we shortly review a wide range of studies relating to urban screens, and show their application areas. To classify different research works, we have to categorize these according their usage context. A very good basic research work is [4], explaining a few concepts of public displays.

Consumer Home Context: Much research work has been performed in the context of consumer homes, as e.g. the TV experience. These works provide insights into TV picture quality and the benefits for the consumer as e.g. [25]. As consumer homes develop towards multi-display environments, a few insights into integrating various displays with different roles allowing group based watching are researched in [33].

Commercial Context: However, where these examples are mostly related to TV experiences, other research works focus on specific services related to public screens. Self-service restaurants with self-service ordering systems based on ZigBee technology are a good example for the application of new interaction technologies, as well as screens in a public setting [13]. The retail perspective as service environment has been discussed in [28], where public displays are used to gain feedback from the social networks in a community to strengthen the product and retail branding. Especially the usage of pervasive computation and advertising paired with public signage in Valora kiosks seems to be a worthwhile path for further investigation. In

Public Outdoor Space Context: How screens can be used in an urban setting to deliver information and commercial advertisements through digital signage, facades of architectures, on the street, inside restaurants, and on public transportation has been studied in [30]. Thus public screens are becoming a technology that allows digital engagement anytime, anyplace, and anywhere as part of our lifestyle and behavior in public contexts. Another interesting work focuses on the combination of public displays with mobile phones to encourage users to support the sharing of opinions for urban planning [26]. Social applications, where people of different locations can communicate and interact with the help of public screens via social networking and user-generated content are another interesting application area (e.g. *Sapporo World Window* [5]).

Public Indoor Space Contexts: An interesting application is the presentation of information on public touch screens inside libraries (e.g. *BiebBeep*). In this application context additional information from YouTube, Twitter, video sources, or news services enhance the public library experience [32]. The personalization of content on public screens, especially to the language of the user, has been researched in [21]. Another interesting feature of public screens is the ability to diffuse information efficiently. Thus, with the utilization of a recommender system, the system can

suggest, prioritize, and recommend items of interest to foster information flow [27].

Technologies for Urban Screens: Besides the commonly known research works around networking, technologies, and interaction capabilities via Bluetooth, a few new innovations allow increasing the experience of public screens. A bit more advanced example is *MagicBoard*, utilizing SMS, VoiceXML, and web requests for interaction in a university setting [31]. Gaze based steering (e.g. in *EyeGuide*), where the system supports the user with eye-tracker technologies to interact with a public plasma display hands-free, and without any other additional devices [7]. One main challenge for public displays is still the integration of a diverse environment of devices that interact with the screen. This problem has been tackled with the *SynchroBoard* system [16], which provides a mechanism for solving this challenge.

III. RESEARCH DESIGN: METHODS & APPROACH

To conduct this study, we evaluated several methods that allow us to gain insights into how the behavior of a user community utilizing public screen displays can be evaluated. However, we were faced with rather a few challenges:

- Consideration of two culturally different student neighborhoods with eventually different needs;
- Developing a method that allows to assess consumer and business perspective;
- Acceptance of public screen services for various entities (e.g. businesses, consumers);
- Required technologies for public screens for enabling advanced modes of interaction and navigation;
- Content and service types provided on public screens to enable community and social interactions;
- Selection of a method that allows gaining insights into communities and their desired services.

To cope with these challenges, we considered a mix of the following methods has been evaluated:

- Action research and participatory design (see e.g. [1], [11]);
- Design Thinking (see e.g. [23], [22], and [3]);
- Interviews (see e.g. [20] and [24]);
- Questioners and Surveys (see e.g. [2] and [12])
- Asset based community development approach and analysis frameworks for community developments in urban neighborhoods (see e.g. [19], [10], [9], and [8]).

An ideal research approach for services in public screen environments seems to be action research combined with participatory designs. This method allows sharing the experience that is involved in the research and design of applications. However, within the scope of this we are not designing concrete applications and services, but rather attempt to provide a framework of needs. Therefore it was rather tricky to involve the consumers as co-investigators or engage them directly in the knowledge creation process as e.g. was applied in other public screen studies as e.g. [11].

However, within the context of the study, the consumers will be engaged as part of Design Thinking sessions within the context of lectures and course exercises. These sessions shall help to improve the study results and act as lead for further investigations (see e.g. [23] and [22]). Thus the method will not be applied directly for the scope of this study, but it shall help to support findings and create new ideas based on these.

However, we selected interviewing and the conduction of qualitative research interviews as most suitable method for obtaining insights about the needs of businesses. This approach allows us to get information about a broad aspect of issues around public screens, as well as these discussions give some new ideas. These interviews were further investigated and analyzed. Our approach used the methods as described in [20] and [24].

As the main problem of this research work was to evaluate potential services and implications of public screens, we selected the most suitable methods within the various phases of the research. For business owners, interviews seemed for us the most suitable method to find out more details about business owners needs and view on this topic. To conduct a questioner with students shall allow us more insights into what student's desire from public screens. The design the questioner we used the methods presented in [2] and [12].

However, to get further details about the discussions, we conduct further in-depth interviews and a design thinking session with particular students to provide an innovative and new view towards this topic. The results of the study ought to be discussed with other works related to community building (e.g. [19], [10], [9], and [8]).

The study has been divided into four phases, which are discussed within the scope of this section.

A. Phase 1: Evaluation & Background Research

The first phase devoted to an evaluation of the state of the art including existing services, user-needs, and analysis of basic requirements. To initiate the study it is better to have a general view towards current status and performance of the usage of public screens in different cases.

B. Phase 2: Interviews with Business Owners

In the second phase, interviews with shop and business owners offering services in student villages have been conducted and analyzed. The goal was the development of a shop owner's perspective of their needs, desired services, and potential involvements. Small shops such as restaurants, cafeterias, news agents, or pharmacies shall act as examples for common places where the public screens can be placed to enable community building and integration of new digital technology into people's daily life during daily situations.

Owners of small businesses of various kinds play the role of stakeholders and investigators and provide an essential point of view for the study. They acknowledge the features of the student neighborhood as well as the properties of their target groups. As the main goal was to bring new digital services on public screens into the shops and in public areas, they can service the target consumers better and attract more

consumers to gain higher profit. A critical review of the business owners allows meeting the expectations and the function of public screens from their perspective.

Interviews have been conducted on a face-to-face conversation with mostly opened questions. The idea was to gain valuable information about the openness of businesses to provide services and to guide the next phase of the study which was a student questioner.

C. Phase 3: Student Questioner

The third phase of the study focused on the needs from a student perspective. It shall help to evaluate student needs, visions, and expectations of urban screens in student villages and is solely targeted to student villagers. The questioner majorly aims at trying to get a vision from students of which services they desire – based on their established community culture, diverse backgrounds, and knowledge of the latest state of technologies. Due to the different backgrounds, and different sense of belonging to the community demands to provided services might be rather diverse as well. However, the students' attitudes and opinions shall identify trends, and to shape the path of building a digital environment they desire. To match their requirements with the needs of business owners shall help to find a common denominator to develop community assets and a digital service environment matching both' needs.

The main topics of the questioner have been clustered into the following main items:

- Technology and devices used within the scope of public screens
- Desired content and services on public screens
- Advertising and merchandising on public screens
- Location and settings of public screens
- Specific business offers on public screens

The questioner was directed to the students living in the Hervanta vicinity. These results shall also signify the different needs of two different student vicinities, and allow insights into common denominators in building community and digital service environments for students.

D. Phase 4: Follow Up

In the fourth phase of the study, several results of the study are integrated. Follow-up in-depth interviews with business owners and students shall allow further insights. The results shall show (1) possible digital solutions to facilitate engaging residents to contribute to the community building of student vicinities; (2) give understanding of user demands and their needs; (3) attitude and expectations of shop owners to provide and support these services; (4) provide understanding of the community networks and how social community can be created with public screens; and (5) how user experience, awareness of neighborhood, sense for community, and engagement of residence can be ensured by new digital technologies supporting public screen infrastructures. In the follow up phase, several results of the study are compared with other results, and a design thinking session between students shall help to gain more ideas and insights how urban villages can be supported by public screen environments.

IV. USER QUESTIONER

The following section compiles the components of the user questioner together. We target the questioner at approx. 500 students in Hervanta, and in Kelvin Grove. We expect a feedback of around 150 answers, thus in total we obtain estimated 300 answers from students. The questioner allows insights into qualitative information such as socio-demography of the respondents. The questioner is structured into four major categories, containing approximately eight sub-questions related to: technology & devices, content, services, and advertising & merchandizing. The main focus of the questioner is to highlight future trends of public screens in the context of a student's neighborhood.

The questioner is provided to the respondents as Google Documents as web-based survey. Final results will be analyzed with the help of the tools provided by Google, as well as a more precise analysis will be performed with the statistical analysis software SPSS or R.

To evaluate the questioner, we formulated most of the questions according the Likert Scale allowing five ordered response levels between "totally agree" and "totally disagree". Opened questions as e.g. "What kind of services would you like to have on public screens?" shall assure that students can state their opinions and contribute to the full context of the goals of the study.

In the following sections, the full questioner is presented:

A. Personal Information

- Gender (Male, Female)
- Age (16-20, 21-24, 25-28, 29-33, Over 34)
- Education (Lower than high school, High School, Bachelor, Master, PhD or Higher)
- Specialization (Information Technology, Media, Business, Automation, Others)
- Please of Living

B. What do you think about the technology and devices used for public screens? (Totally Agree = 5, Partly Agree = 4, I don't know = 3, Partly Disagree = 2, Totally Disagree = 1)

- 3D image will become the mainstream in public screens
- Internet should be available on public screens
- Public screens should have interaction possibilities
- Smart phones will be used to control public screens
- Public screens will have an operating system like computers do
- The X-screen concept, where consumers interact with public screens with more than one 'screen' (e.g. mobile, tablet) will become mainstream
- Bluetooth or short range communication should be used to have interaction with public screens
- Public screens will become a main platform to share information by different users in public places
- Cameras should be installed in public screens for interaction

- Where would it be good to have public screens (in order of importance)? (Restaurant, Bars and Cafeteria, Cinema, Bus Station, Train Station and Airport, School or Working Place, Transportation such as buses, Retail shop, Others)
- What do you think are the key-technologies for public screens?

C. How do you feel about the content in public screens? (Totally Agree = 5, Partly Agree = 4, I don't know = 3, Partly Disagree = 2, Totally Disagree = 1)

- Content concerning the campus life should be the most essential context on public screens
- Users should be able to update information and content on public screens on their own
- Public screens should feature more entertainment activities such as playing video games, listening to music and watching movies
- Public screens should let users choose products and information that they are interested in
- 2D maps and interactive search are very necessary on public screens
- Personal information such as name and photo can be published on public screens
- People should be able to have discussion concerning social or communal issues via public screens
- Public screens should enable users to vote or give feedback
- What content you would like to see on public screens (Please rank on the level of importance)? (News, Sports, Product promotion and special offers, Entertainment, Event information, Emergency information, Others)
- Would you like to add more ideas about potential content that should be available through public screens?

D. What kind of interactive services do you want to have on public screens? (Totally Agree = 5, Partly Agree = 4, I don't know = 3, Partly Disagree = 2, Totally Disagree = 1)

- Restaurants should have self-order services, which enable consumers to read menus and order dishes on public screens
- Users should be able to have personal log in on public screens
- It is important to have SNS services such as Facebook on public screens.
- Public screens should have check-in services such as Foursquare, which you can note your locations.
- Different operations (such as "public mode" or "private mode") should be available to guarantee privacy
- Public screens should enable communication with people elsewhere through the screen
- Health care services should be set up on public screens

- Multiple users can use the same public screen at the same time
- In retail shops, the display of social comments on brands and products will increase sales measurably
- What kind of services you would like to have on public screens?
- In which service contexts would you like to use public screens (e.g. at restaurants, shops, busses)?

E. *What do you think about advertising and merchandising in public screens? (Totally Agree = 5, Partly Agree = 4, I don't know = 3, Partly Disagree = 2, Totally Disagree = 1)*

- Micropayment should be included in public screens, and let consumers pay for services displayed on public screens
- Micropayments would be very safe on public screens
- Mobile tagging, which enables to scan product information and purchase immediately, should be used on public screens
- Advertising will still be the most commonly used application of public screens.
- Users would like to pay for the extra services on public screens
- In retail shops, displays of product-centric social network comments have a higher impact on sales than brand-centric comments
- What are the important properties that public screens should have (rank them on importance)? (Equipment quality, Image quality, Services, Content, Location, Others)
- How can you imagine public screens will look like in the future?

V. INTERVIEWS WITH BUSINESSES

To gain insights into the needs and requirements from business owners and service providers of student neighborhoods, we conducted the four interviews with business owners within the Kelvin Grove campus: pharmacy, newsagent, sandwich restaurant, and restaurant.

The following interview questions build the basic setup for the interview:

- Why did you buy the screen for your facility and how high were its' costs and are maintenance costs?
- What are the technical aspects of your public screen (Internet connectivity, TV channels, size, interaction facilities, ...)
- Who manages and maintains the screen and where does the content/or its services come from?
- Which services and content do you provide, and which services and content would help you to promote your business?
- Which services and content do you think your customers would like, which one would you like to have, and which one are currently used?

- What do you believe are the social aspects of your screen and how can people cooperate with the public screen?
- How could the public screen help to cooperate between businesses inside the neighborhood, be used in a university context, and for experimental services?
- Which regulatory and legal issues are you aware of that could restrict the usage of the public screen?

VI. DISCUSSION

Within the scope of this publication, we discussed our approach to evaluate the potentials of the utilization of urban screens in student neighborhoods. As this work is currently in progress, and solely phase 1 and phase 2 are completed, further results can be expected in the near future. This research work solely represents a discussion about our approach. Nevertheless, from phase 1 and 2 we have obtained a few potential insights into public screen services:

- The dominant content on public screens is currently advertising related;
- More functionality might be able to influence mood, atmosphere, or social behavior of students;
- Enhancing interactivity has impact on the experience;
- A critical element is near-field communication and its technologies;
- Communication between people in certain context might be enhanced through public screens and might become more natural;
- The discussion around local issues might be enhanced by public screens through the forming of ad-hoc social networks;
- Context dependent services are one factor to lead to the deployment of public screen services;
- Business owners benefit from a university-business eco-system, as content might come from the universities;
- Offering public screens offer businesses new opportunities to draw customers with special content;
- ...

Nevertheless, these are a few preliminary conclusions, but the provision of further details will be part of the follow-up of this study.

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