An Interaction Concept for Public Displays and Mobile Devices in Public Transport

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Abstract. Public displays increasingly find their way into public space and offer a wide range of information to the user. Currently, most of these displays just represent information without the chance to explore them or interact with them. In general, by technical enhancements in this field, more and more possibilities of interaction are given in different domains. This work presents interaction opportunities between public displays and users with mobile devices in the field of public transport. As a basis for understanding the usage and benefits of public displays it is necessary to have a closer look at different types of displays in the public domain, too.

Keywords: Interaction concept, mobile interaction, public display, public transport.

1 Introduction

In public space different kinds of content are spread through different communication channels, e.g. on so-called public displays. While the usage of analog posters, static information leaflets or different signs primarily focuses on functional aspects, public displays represent context-sensitive information systems whose contents can be adjusted dynamically. These systems offer free access to digital information on public screens to the user. For this reason, public displays increasingly replace conventional information and advertising media. Depending on their use, public displays present their content with or without attracting attention. The range of applications reaches up from passive screens of information to more active self-service terminals. Therefore we present various possibilities of usage as well as a concrete example from public transport.

2 Conceptual Explanations

In literature, the terms public display and digital signage are often used synonymously. In general, digital signage is a networked (audio-) visual information system [1]. The content can be digitally created, managed, and played anywhere on a digital device. For this purpose, information is provided by people, but also by sensors and databases (Figure 1 information delivery). A content management system

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(CMS) running on a server allows an organized information representation on displays. There is the possibility to control single monitors directly or combining several screens into logical groups (Figure 1 information presentation). The content can also be presented independently, to constantly communicate the relevant information (Figure 1 information assignment). While digital signage is a distributed system, a public display represents only an end device which shows digital content. Therefore, a public display can be seen as a part of digital signage.

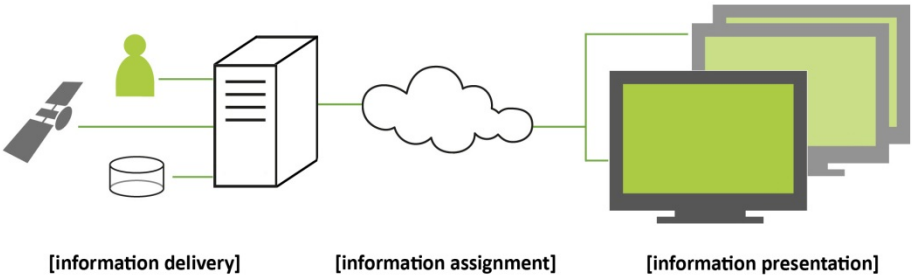

Fig. 1. Schematic construction of a public display system

To examine the interaction possibilities with public displays, different fields of application of public displays can be identified. Information screens or digital passenger information displays show the use of public displays as points of information (PoI) in a classical way. They represent the best solution to provide real time information to the target audience [2]. Typical installation areas are locations with high pedestrian traffic such as hotel lobbies, airports, train stations, department stores, shopping malls, self-service restaurants or museums [3]. In addition, kiosk systems and information terminals include users in an active way. Users can decide which information they want to receive, while they select information with offered input devices.

Points of sale (PoS) define places to purchase products or services - a physical location of a transaction [4]. The potential customers are pointed out to a product immediately. Ticket sales for public transportation such as trams, subways or railways or stamp-machines are just a few examples.

Another domain of public displays is the domain of so-called public playing. There are already some interactive games which allow users to play in public space. For example, a playing area is presented on a central screen and by entering an interaction area participants receive an invitation to play on their mobile device or by using different gestures.

In the field of public transport, information screens have been increasingly used since the first real-time information was installed in a metro station in Stockholm, Sweden in the 1980s [5]. It showed estimated waiting time in minutes and when a train was approaching, it also showed the destination of that particular train.

Self-service terminals in the form of ticket vending machines at airports and train stations are just a few examples for the usage of public displays nowadays.

The enhancement of possibilities of public displays as points of information is of particular interest for our work. Passengers consult displays at stopping points more often than printed information such as timetables [6]. Dynamic information displays in particular, are becoming more and more ubiquitous in modern public transport. Dziekan and Kottenhoff state that seventy to one hundred percent of people look at displays during waiting at a stopping point [7]. These displays show upcoming departures of trains, busses or trains at different stations leading to improved traveler information and service qualities.

3 Interaction Possibilities with Public Displays

For the mentioned kinds of application, interaction is necessary to enable the user to explore information. In case of the classical point of information, the display works as a simple information display. There is no interaction taking place according to human-computer interaction, since the user only acts as an observer who cannot participate in the event actively. Therefore we call this interaction a 1:0 interaction.

Apart from passive displays which just present information, we identified some interaction possibilities for public displays. A simple way to enable interaction is to combine displays with a keyboard, joystick or mouse. Due to technical enhancements in touch display technology this interaction option has increasingly found its way into public and semi-public spaces. It is an advantage, that these smartphone established touch interaction concepts can be used and so, the interaction between one display and one person (1:1 interaction) can be supported. However, strong signs of wear on the input device caused by dirt or vandalism make the usage of touch interaction displays in public space difficult.

By coupling with tracking systems or sensors, e.g. the Microsoft Kinect, better interactions, such as gesture- and voice-based interaction, with public displays can be provided. Based on the complex structure and strong context dependence of such systems they currently find just little use in public space. However, there are already successfully tested developments with gesture-based screen interaction [8].

Single or multi-touch screens as well as gesture- and speech-based technologies enhance the range of interaction with public displays. While they allow the user to explore information, they sometimes also have some disadvantages. For example, touching the displays is unsanitary and impossible in case of huge displays located too high on walls. Another disadvantage is the complexity of gesture-based displays which makes them difficult to build and to handle. Displays controlled by voice are limited in the public space, too.

Therefore, the use of personal mobile devices seems to be an alternative for interacting with public displays. The mobile device has to be connected to a public display, e.g. via Bluetooth or WLAN. The interaction can be graphically or gesture-based, whereby the gesture-based interaction can be carried out directly or with the mobile phone. Using the sensors of the mobile device, the input can be recognized. The input includes single-touch as well as multi-touch. Common touch gestures are presented and described in the Touch Gesture Reference Guide [9].

Furthermore, movements, which can be interpreted as different actions, can be carried out with the mobile device such as the interaction with touch gestures. This requires the use of sensors which are integrated per default to most of the current mobile devices, e.g. the gyroscope sensor. For example, the current orientation of a presentation in portrait or landscape format can be changed with that – both on the screen of the mobile device itself and on the associated public display. The mobile device can also be used with the help of tilting gestures for navigating in documents or moving of objects [10]. By doing so, the device is tilted over two imaginary axes, touching each other in the center of the device. Other gestures contain the throw and fetching gesture. They trigger, indicated by a fetching movement with the mobile device or a sweeping movement towards the body, sending and receiving data. Moreover, the shaking gesture, which can be interpreted by changes of inclination executed consecutively, causes deleting or resetting data.

Partly graphical forms of interaction base on the gesture interaction on the mobile device. A possibility, to use the data input in form of the keyboard on the mobile device, is to fill out forms shown on the display or to create documents. The data which is announced on the display can be presented in an abstract way on the mobile device, which can be carried out over colors, shapes, position, or signs. Content can be summarized to a region and represented as a specific shape on the mobile device, as shown in Figure 4. This abstraction is also suitable for detailed views by a certain area being closely zoomed in.

The interaction with public displays via mobile devices offers some advantages for us. Multimodal interaction possibilities are provided to the user. Furthermore hygiene problems and extensive technical constructions are dropped by the use of personal mobile equipment, which makes them interesting for various applications, for example in public transport.

4 Mobile Interaction for Public Displays in Public Transport

Due to frequent changes of schedules, printed timetables require intense maintenance and manpower. Therefore, a low-maintenance public display seems appropriate. In addition to a cost reduction for transportation companies, useful services can be put into practice. Schedule notices offer various information which must be processed for the use on a display. This affects the entire route map, single route schedules, departure times of various routes, fares for tickets (reduced, normal, group, etc.) and alternative routing.

This variety of data can be represented by the display size in a general view. For more detailed information it requires a higher level of detail. This can be produced individually and does not depend on a fixed time interval in which the content is updated automatically. The passenger must be able to interact with the display. This interaction is realized on the mobile device of the passenger, whereby a mobile device is connected to a public display. The use of the personal mobile device also enables data transmissions to the mobile device and the secondary use of this information, for example for route planning.

The concept of mobile interaction with a public display was realized prototypically for a fictional transport service. The passengers get the information mentioned above as well as the name of the current stop, date and time. This type of representation is also described as an information mode in the following Figure 2.

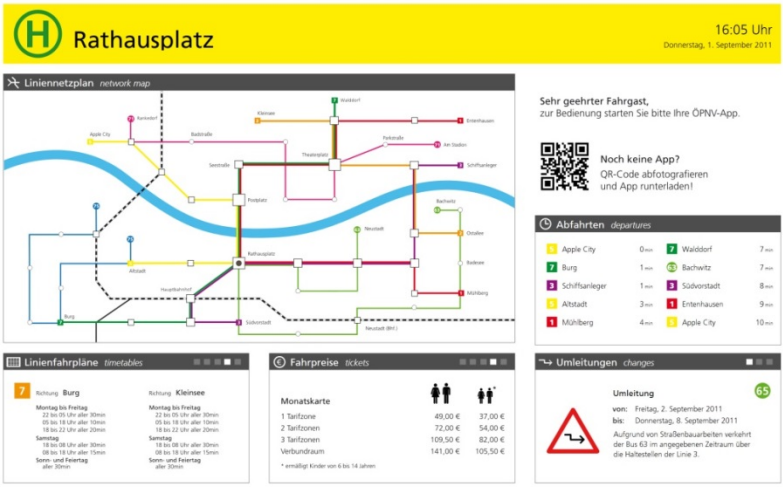

Fig. 2. Information mode of a Public Display

The user receives detailed information by connecting his mobile device to the display, which is performed by the user´s mobile application. The display presentation changes to an interaction mode as shown in Figure 3.

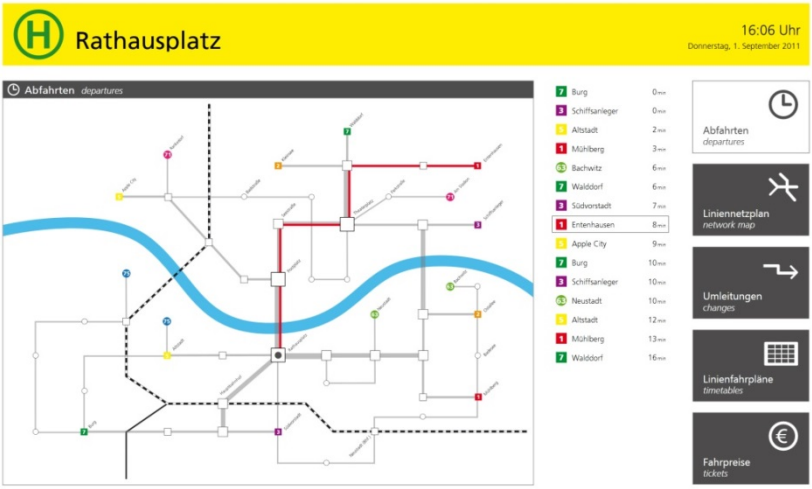

Fig. 3. Interaction mode of a Public Display

In the information mode the public display can be used completely for content representation. In the interaction mode the public display splits up into two areas – content on the left hand and navigation on the right hand (Figure 4). This splitting is also abstracted for the mobile device so that the user can interact with the mobile device as expected. The right area of the mobile device enables the user to navigate through the different kinds of content on the left hand side with help of different touch gestures. Different interactions are also possible with this concept, e.g. zooming in or moving content in the content area.

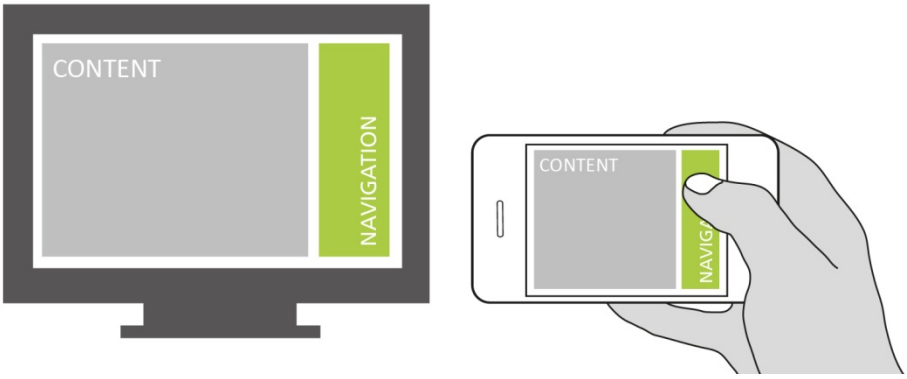

Fig. 4. Interaction concept for public display and mobile device

From the right navigation area, certain lines can be selected, information about alternative routes gathered, stops looked up, fares for certain routes calculated and tickets purchased. The information is presented in the left content area. In this way, the user is allowed to obtain details of separate areas of the journey planner individually and optionally transfer these to the personal mobile device. Therefore, the concept can be understood as a first step towards better interaction between mobile devices and public displays in the area of public transport.

This concept is also applicable to other domains. For public transport, the public displays can be used to simplify operation and maintenance of bus and tram stops, because, in conventional use, it is expensive and complicated to maintain every stop in a wide network. With displays information can be modified from a central point. Furthermore, the range of information can be more extensive and can include timetables, maps, tickets and different kinds of messages.

5 Conclusions and Future Work

To investigate the possibilities of interaction with public displays in public transport, different areas of application have been identified. They showed different forms of interaction with public displays, which are already used in public spaces, including the interaction with different input devices, such as touch, gestures and speech. The

interaction between personal mobile devices and public displays has been identified as a suitable way to obtain information in the field of public transport.

In this context we implemented a scenario to show the functionality and potentials of mobile interaction. Our prototype enables the user to interact with different kinds of information, e.g. timetables, network maps or tickets. Implemented as a base we can enhance our prototype with various opportunities, such as transferring important data to the mobile device.

Planned and shown as interaction between one display and one mobile device (1:1 interaction) the concept can be extended to more displays and more devices as well. This offers new possibilities in the field of public transport and the customer service. An example of 1:n interaction refers to passenger TV, which is already offered by many carriers. To obtain background information on individual topics, one or more users can use their mobile device to interact with the passenger TV. However, for n:m interaction across multiple displays and devices, an example is to use the interaction to find people joining a group ticket. Because of technical improvements of public displays and mobile devices, the interaction with these two technologies will become a more important service in public transport.

Another field of research is the adaption of public displays depending on the user's context. For example, important information can be highlighted on displays to help people finding their information. Furthermore, issues of privacy and questions about several users interacting with one display remain subjects of research. Sharing personal data on a public display was tested successfully by Peltonen et al. [11]. They developed a large public display where users can share their own media content using mobile devices. The so called CityWall was installed in a city center to show events happening in the city. In public transport, this kind of interaction and contextualization could be useful, especially to integrate traffic information such as delays or disruption.

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