Vortrag gehalten bei: Visual Adaption of Interfaces ; an ITS 2013 Workshop, Oct 6-9, 2013, St. Andrews

ADAPTIKs: Adaptive Information Keyholes for Public Libraries

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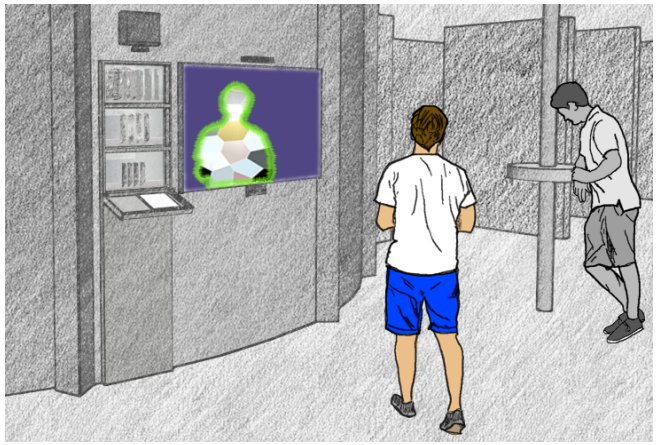

Figure 1: Accessing information through an adaptive keyhole

Abstract
When considered through the lens of ubiquitous computing, interactive wall displays represent a promising infrastructure to provide information services. In the context of public libraries the design has to take particular account on two domain-specific aspects. First, libraries are valued for their calm atmosphere. Thus, interaction has to occur in an unobtrusive manner. This is challenging as interactive displays need to catch passers-by's attention to communicate interactivity. Second, given that public libraries are demographically diverse places, a low barrier to entry has to be guaranteed to provide access to the largest possible number of visitors. With ADAPTIKs we present the concept of an interactive display that makes use of visual adaption as a means to unobtrusively attract the visitors' attention. The concept bases on a contextual analysis and illustrates how the visitors' position and body movements can be used to generate an adaptive silhouette that acts as a keyhole to an information landscape.

Author Keywords
Public Displays; Ambient Displays; Gesture Interaction; Public Libraries

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

Konstanzer Online-Publikations-System (KOPS)
URL: http://nbn-resolving.de/urn:nbn:de:bsz:352-255950

Figure 2: The ambient wall display by [7]

Figure 3: The Magical Mirrors system [4]; photo-taking as a typical 'follow-up' action

Figure 4: People interacting with their silhouettes at the Looking Glass system [6]

Introduction

The self-conception of public libraries has changed fundamentally in the course of the digitization and the shift of knowledge work towards the World Wide Web (WWW): modern libraries no longer consider themselves as mere information archives but also as information service providers. Thereby, central library tasks and roles were transferred from the physical into the digital world. Public libraries, however, represent physical and social places for encounter. In addition, as a comprehensive source of digital and analogue information, they make an important social contribution to the diverse public sphere. In particular in terms of demographic aspects, public libraries need to provide appropriate services that ensure access to both, traditional analogue media and the expanding provision of digital information. At this point we see the potential of public displays as an easily accessible entry point for information services.

Based on prior research in the field of public displays and on a contextual analysis we present the concept of Adaptive Information Keyholes for Public Libraries (ADAPTIKs). ADAPTIKs is intended to serve two purposes: first, as an information service that extends the library's local collections with services from the WWW, and second, as a platform to investigate the effects and potentials of visual adaption on public library visitors.

Interactive Public Displays

Numerous public display prototypes and observation-based theories have been established within the last decade. Most of them either describe phases that passersby traverse when getting in touch with such systems (e.g. [2], [7], and [4]), while others focus on design issues that refer to one particular phase or aspect, for example the initial contact with the system (e.g. [6] and [3]).

Typically, these phases start with an uninvolved passerby who is unaware of the display's presence and ideally ends with this passerby explicitly interacting in immediate proximity of the display. Across these phases, the passerby has to pass several critical thresholds ([7], [4]).

Addressing their impact on public awareness and social acceptance, Brignull and Rogers [2] propose a 'public interaction flow model' that bases on the observation of their 'Opinionizer' system. As a key finding, they conclude that displays have to motivate people by communicating a low risk of social embarrassment as this was identified as a major reason for avoiding public displays. They made another observation which they called the 'honeypot effect': when someone was already interacting with the display, the likelihood of bystanders to interact, too, increased. Furthermore, they emphasize the importance of unambiguity and propose light-weight interaction scenarios for public displays.

Vogel and Balakrishnan [7] present an observation-based framework which provides guidelines on the general design of public displays and suggests several interaction phases (figure 2). In order to avoid distracting stimuli for passersby and preserve the ambient character they propose to design for 'calm aesthetics'. According to their observations, interaction starts with the 'Ambient Display' phase, an idle mode in which visual updates appear slowly on the display. The last interaction phase consists in 'Personal Interaction' with the display, for which they propose direct-touch interaction.

The audience funnel [4] bases on the observations made with 'Magic Mirrors', an in-the-wild installation mirroring the environment and applying optical effects on passers-by's gestures (figure 3). The model describes the interactive journey in 6 phases, of which the first 4 phases

Figure 5: In-the-wild investigation of the effectiveness of atomic visual signals [3]. Evaluation takes place within the personal interaction phase.

Figure 6: Visitors interacting around a seamless interactive column display [1]. In another condition framedness was simulated by virtual frames on the cylindrical display.

largely overlap with those introduced by Vogel and Balakrishnan [7]: Passing-by, Viewing and Reacting, Subtle Interaction (conscious remote interaction via gestures), Direct Interaction, Multiple Interaction (users returning to the display), and Follow-up Action (e.g. photo taking). Furthermore, their work provides conversion rates, indicating the fraction of passersby between the interaction phases. For example, from 'passing by' to 'subtle interaction' a conversion rate of 33% was observed.

A comprehensive design framework is provided by Müller et al. [5]. It bases on the interaction phases from [4]. As part of the framework, a set of display metaphors, such as the 'poster', 'mirror' and 'window' metaphor are discussed. Another contribution consists in addressing the aspect of self-presentation in the public sphere and respective design implications.

In [6] Müller et al. investigate how the property of interactivity is perceived by passersby (figure 4). As a result, mirrored user images and silhouettes caused significant higher conversion rates. Additionally, they observed a so-called 'landing effect' which describes the situation when passengers walk back to the display if they had noticed interactivity after having already passed the display.

Kukka et al. [3] investigated the effectiveness of atomic visual signals, such as color vs. grayscale. For personal interaction at the display, their prototype provided a touch-based questionnaire on the subjective evaluation of the visual signals (figure 5). They discovered gender-specific differences in terms of aesthetics perception. In addition, and similar to [2], they observed strong honeypot effects. On the contrary, however, they also observed 'display avoidance', which was explained by the disruptive abundance of displays in the surrounding environment. Similar to [6] the mirror and the silhouette metaphor revealed the highest conversion rates.

Beyer et al. [1] investigated the effects of form factor on passers-by's behavior (figure 6). On a circular interactive display they observed that logical constraints, in the shape of a rectangular frame, influences the self-positioning of people interacting with the display.

Prior research shows that public display design underlies a variety of critical parameters. Yet, the fact that the vast majority of findings refers to the observation of prototypes in general public spheres. This leads to the conflict already described in [2]: people typically carry out other activities which makes it difficult to attract and captivate them for any purposeful, in-depth activities within the personal interaction phase. In contrast, public libraries are no context-neutral ground populated by passengers or passersby. In fact, they are populated by visitors who can be well defined by a set of context-based characteristics such as motivations, intentions, and routines.

Public Libraries: Contextual Inquiry

To gain insights into the target domain, we conducted a one-week contextual inquiry. In sum, data from 114 subjects (107 visitors and 7 librarians) were gathered on a random base. From observation notes, audio recordings, and interview notes 357 work activity notes were generated. Frequent themes were identified and structured with the help of an affinity diagram (figure 7). In the following the top findings that were taken into account for the ADAPTIKs concept will be presented.

Visitor characteristics Visitors represent a heterogeneous mixture in terms of socio-demographic

Figure 7: Affinity diagram consisting of work activity notes and revealing frequent contextual patterns such as visitor groups, motivations and search patterns.

characteristics such as 'age', 'social background', and 'cultural background'. In matters of technological skills, i.e. interacting with digital media, elderly people indicated little experiences. Library terminals providing access to the catalog system were sparsely used in general. As the major reason for that, people named negative experiences. Those who used the terminal remarked that their process flow was interrupted after catalog research, as navigation to interesting items was a complex undertaking in general. Some of the visitors who avoided the terminal, stated that they conducted computer researches at home, prior to the library visit. A remarkable proportion of elderly people stated that they possessed an e-book reader and took use of the library's e-books offer. Web service were almost exclusively used by people under the age of 50. Except for a small proportion of young smartphone users, the use of web services within the library was rather limited.

Visitor motivations and sources of inspiration

Several groups of visitors could be identified by distinct visit backgrounds. The most prominent group was formed by the *'Hunters and Gatherers'*. Visitors belonging to this group are strongly motivated by the wealth of physical artifacts and the exploration of serendipitous discoveries. Hence, browsing and exploring is positively associated with the state of preoccupation and considered as a pleasant contrast to everyday life. Hunters and Gatherers can not be assigned to any specific demographic group. In most cases hunting and gathering occurs at exhibition tables and shelves, on which books are exposed with their front cover. Apart from serendipitous discoveries and inspiration through book covers, visitors indicated that they get inspired by friends. Considering inspiration through the media, younger people tend to web-based reviews and recommendation platforms, whereas elderly people refer to traditional media such as magazines and radio.

The *'Gap Fillers'* form another large group of visitors. They are characterized in that they visit the library within free time slots, which are often dictated by family matters. Gap Fillers can at the same time be Hunters and Gatherers as well, depending on personal interests and the individual visiting context (e.g. with or without their children).

The *'Newspaper Readers'* are consistently formed by seniors. Unlike other visitor roles, which may change over visiting time, people from this group visit the library exclusively for that single purpose.

'Collectors and Deliverers' visit the library exclusively to collect preselected distinct items or bring back lent items. In many cases these visitors were at the same time 'Gap Fillers' having an accordingly small times slot.

From these findings the following implications were derived for both, interaction and content design:

- Provision of a low barrier to entry to avoid social embarrassment. This is particularly important given the diversity of potential users.
- Notification of interactivity has to occur in an unobtrusive manner to preserve the calm atmosphere.
- As intrinsic motors the visitors' explorative mood shall be exploited to attract attention and facilitate interaction.
- Visitors shall be provided at least a playful experience (subtle interaction) and ideally personal interaction to deepen their exploration.
- News seem to be a good entry point as events of the day are not per se bound to any demographic

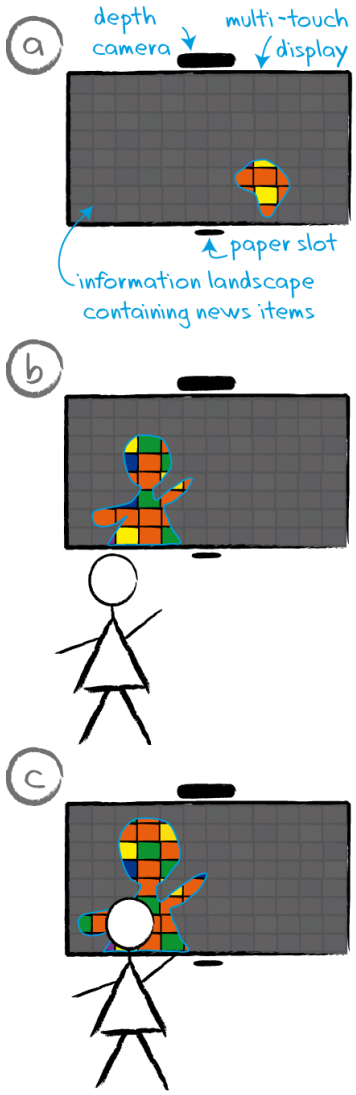

Figure 8: From 'Passing by' to 'Subtle Interaction'

group. In addition, news favor curiosity through steady updates. Above all, elderly people such as the newspaper readers, might get attracted as well.

- The exploration of news shall lead to further information which relate to the keywords of the headline (e.g. containing persons or countries). Furthermore, visitors shall be pointed to a selection of local media, e.g. novels or movies, which relate to the news items (e.g. the headline 'Pope Francis arrives in Brazil' may suggest biographies of Pope Francis, or novels such as 'Illuminati').

ADAPTIKs

The ADAPTIKs concept comprises an information service that allows the diverse library visitors easy access to both, the library's local collection and information from the digital world. The concept bases on a depth camera, a large multi-touch wall display and a printer (figure 8, a). For we interpret 'calm aesthetics' [7] as a matter of physical integration, too, all devices are embedded in a library wall. Hence, the printer is not visible, only the paper slot (figure 8, a). Besides, the display shows a homogeneous content overlay that refers to the ambient wall color.

Behind the overlay there is an information landscape containing headlines of daily events. These headlines are arranged within tiles of a mosaic style map, which provides a similar view to that of the book covers on the exhibition tables. If no visitor is detected by the camera within a certain range, the display remains in idle mode. In this calm state the display shows circular silhouettes appearing and moving smoothly in a random manner in order to discreetly attract the visitors' attention. These shapes provide small peepholes through which parts of the information landscape can be seen (figure 8, a).

If a visitor enters the subtle interaction phase[1] (either accidentally or by attraction of the peepholes), a new keyhole which bases on the visitor's silhouette is generated (figure 8, b). While studies (e.g. [6] and [3]) have shown better conversion rates for photo-realistic representations, we chose silhouettes to provide a keyhole metaphor. At this stage the visitor can explore the information landscape by controlling their personal keyhole through body movement. In addition, the visitor is rewarded by approaching the display as the personal keyhole grows, conforming to expected naïve physisc (figure 8, b and c).

The transition to the next phase, personal interaction, is crucial as a shift from interaction by body movement to touch-based interaction needs to take place. The shift is communicated implicitly as the keyhole disappears, telling the visitor that there is no need in interacting with gestures anymore (figure 9, d). At his point an explicit call-to-action trigger may be necessary, though.

During personal interaction the visitor has touch-based access to the fully revealed landscape containing the news tiles. A simple pointing gesture triggers a semantic zoom. Afterwards details such as the according full text and a mashup of several web sources providing information on the topic are provided. Content ranges from opinions (from social media APIs) to editorial content. In addition, items from the local collection are displayed and enhanced with reviews and recommendations from social media platforms (figure 9, e). We are aware of possible precision and recall issues when connecting news items with items from the local collection. Yet, we consider a certain

[1] Phases follow the naming convention of [4]

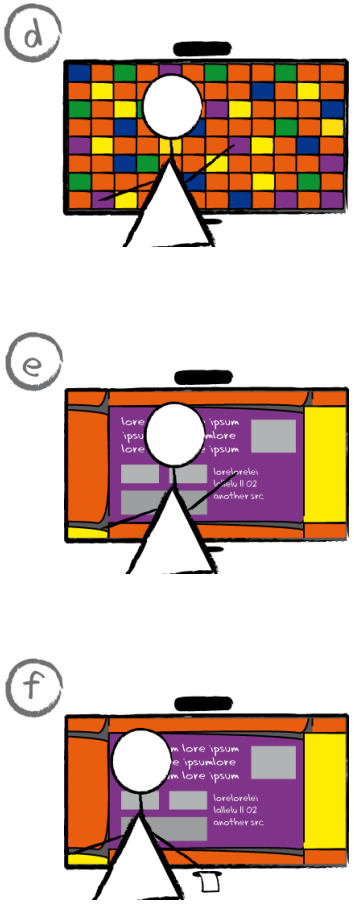

Figure 9: 'Direct Interaction' enabling the opportunity for 'Follow up Action'

degree of fuzziness as beneficial, given the importance of serendipitous discoveries.

Finally, the visitor can trigger a print-out containing item-related facts (figure 9, f). Apart from the title of the selected item, the small fact sheet contains a navigation hint to the medium, a cipher and a QR code (containing the cipher). This opens two principal follow-up actions: First, the visitor can directly navigate to the item, and second, the visitor can go to a website where the detailed information, which is provided on the large display, can be downloaded. The second step can either occur on a computer (e.g. at home) or via a QR-reading device (e.g. a tablet or a smartphone).

Conclusion and Future Work

We have presented ADAPTIKs, an information service concept which uses adaptiveness to attract visitors. Situated in a public library we will use ADAPTIKs as a platform to investigate the potentials of adaptiveness in the light of the visitor activities and motives that were identified within the contextual inquiry. Due to the chance of visitor categorization (e.g. in terms of roles and motivations) and the meaning of space within the library environment, we consider ADAPTIKs a promising concept to provide novel visiting experiences. Given the fact that many visitors come on a regular base also rises the question if the system needs to adhere to light-weight interaction (as proposed by [2]) in the long run.

In addition to existing tracking information, time-based visitor tracking can detect walking destination and speed. Given that, tracked visitors may be assigned to the identified visitor groups and provided appropriate content: A fast moving visitor holding a book in their hands and moving towards the exit might be identified and assigned to the 'Collectors and Deliverers' and does, for the sake of calm aesthetics, not need to be attracted at all. Aside from the identified visitor groups, individual characteristics such as the color of clothes may be tracked to individually adapt display aesthetics.

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