Communicating the Interactivity of differently shaped Displays

Gilbert Beyer
University of Munich (LMU)
Amalienstraße 17
80333 Munich, Germany
gilbert.beyer@ifi.lmu.de

Andreas Butz
University of Munich (LMU)
Amalienstraße 17
80333 Munich, Germany
andreas.butz@ifi.lmu.de

CHI 2013 Workshop on Displays Take New Shape: An Agenda for Interactive Surfaces, April 28, 2013, Paris, France.

Abstract

Several works discussed how displays in public can grab the attention of passers-by and communicate their interactivity [1,4,6,7,8], yet the proposed interaction techniques mostly assumed that the display is flat and rectangular. Results on the effectiveness of such concepts may not hold true for novel non-flat shapes of displays. In this paper, we discuss the challenges and some techniques to initiate user interaction with non-flat interactive displays in public space. As a starting point, we present our findings on the touch-free interaction techniques we used on a digital advertising column, an example of a cylindrical shaped display, and describe how different visual feedback to the unaware movements of passers-by succeeded in communicating interactivity. At the workshop we would like to discuss how this implicit initial interaction phase can be designed for further novel shapes of displays and interaction techniques.

Author Keywords

Shaped displays; communicating interactivity; implicit interaction; public displays.

Introduction

When people encounter a new display in public space, they normally don’t expect it to be interactive. After the display has grabbed their attention it therefore has to

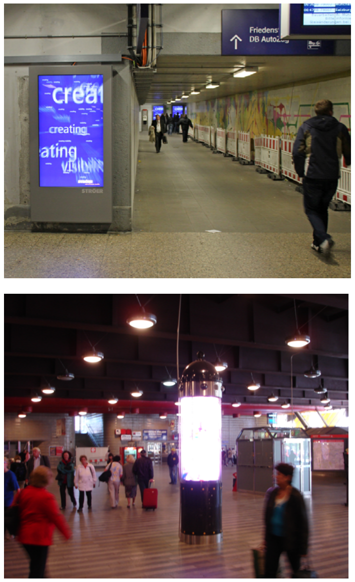

Figure 1. Different conditions for encountering an interactive display: a, flat displays are indicating a direction and are often deployed such that they are approached frontally, e.g. at the end of tunnels b, freestanding cylindrical display that can be approached from all sides and at diverse angles.

communicate that there is a possibility to interact. An important requirement for an interactive interface in public space is thus an *unaware initial interaction* [1]. In practice this is often realized with the help of computer vision techniques, which has the advantage that – in contrast to touch – the approaching user does not have to know about the interactive possibilities. Communicating interactivity is especially important for displays that aim to engage novice or untrained users. It is therefore also a helpful strategy for exhibits in amusement parks, museums and exhibitions.

Signaling interactivity by letting users unwittingly control the display has mainly been discussed for public displays and media façades. With regard to different screen effects, [6] and [7] found that *mirror images* of users work most effectively for that purpose. [4] used user silhouettes, and on a cylindrical column we used just objects moving along with users for the unaware initial interaction [1]. In addition to visual effects, other environmental conditions affect the understanding of interactivity, such as the presence of people in front of displays (see e.g. [5]) as well as intersections of the interaction space of displays and walking paths [8].

So far, different types of interactivity signals have been investigated for flat rectangular displays that indicate a clear direction and assume that users *approach* and *position themselves frontally.* In fact, in public spaces flat displays are often positioned such that they are approached frontally (see Fig. 1a). Thus, interactive content and interactivity signals are often designed for this special case, and may not apply to non-flat shapes of displays. Recently, however, novel types of shaped and deformable displays have been presented, such as spheres, columns, curves and more complex shapes.

While already the design of *explicit* and *aware* interaction (touch or touch-less) with such displays represents a challenge, visual feedback to *unaware* movements is even harder. It has to be visible and recognizable by passers-by and capture their attention by providing appropriate feedback to their motions. In the following we discuss some challenges and types of visual feedback that appear to be suitable to communicate interactivity with shaped displays.

Challenges for Communicating Interactivity with New Shapes of Displays

In practice, effective initial interaction is primarily a matter of *content that suits the medium* [4], i.e. the visual feedback must be suitable to communicate interactivity with the type of display. New display shapes create specific requirements and design strategies and content cannot simply be transferred from flat displays for the following reasons:

Deformation of Content

Content designed for a flat display is often not properly mapped or even deformed on a shaped display and therefore perceived differently, creating a different visual effect. For example, a life-size mirror representation of the user will be distorted on a curved display. If the display is convex, mirror images of the users or surroundings will be squeezed, if the display is concave, they will be stretched, as in a hall of mirrors. With more complex shapes such images might appear even more unfamiliar and eventually lose their entire effect.

Partial Visibility of Content

With many convex and complex forms of displays, only a section of the whole screen will be visible at a time. Visual feedback to movements of passers-by must be

Figure 2. Different types of visual feedback used on a Digital Advertising Column: a, spatially limited particle visualization b, abstract user representation allowing to display many users c, simulated frames for testing the influence of discontinuities on the recognition of interactivity.

displayed within the part currently visible to the user. On the other hand, content displayed beyond the visible part will make the initial feedback visible to passers-by on other sides of the display. In this case all observers should be able to clearly attribute the feedback to the person who triggered it.

Content to User Mapping

On a curved screen, a constant mapping of the individual feedback to users around the screen has to be ensured. E.g. on a convex screen such as a column, the virtual space assignable to a single user is smaller than the physical space around the display, and only a squeezed video image of bystanders or the surroundings can be displayed. Thus, for mirroring all people around such a screen, space-saving abstract representations might be a solution (see Fig. 2b).

Direction of Effect

With curved shapes, it is sometimes difficult to determine the optimal direction in which the visual effect should be displayed (for a column, compare [3]). Flat displays are indicating a direction and are ideally positioned such that they are approached frontally and directly. In contrast, non-flat shapes often can be approached from different sides and at various angles. The challenge is thus to display visual feedback such that it is still within the field of view of passers-by, but at the same time cannot be wrongly attributed by other close-by viewers to themselves.

Seamless Continuation

Not all shaped displays provide a seamless surface. If visual feedback is following passers-by as they move along the surface, bezels and edges might cause discontinuities that make it difficult to understand that the feedback relates to one's own movements, and in this case suitable visualizations should adequately signal the transitions (see Fig. 2c).

Case Study: Communicating Interactivity with a Digital Advertising Column

In the following we describe our solution for and experiences on communicating interactivity with a digital advertising column, a cylindrical screen with which we conducted a four-week field study [2].

Technical Setup

To realize a continuous interaction space around the column, we used 8 *Microsoft Kinect* sensors and a high performance hardware setup and a software solution to handle the transitions in overlapping sensor regions. The Kinect sensors were integrated into the column as unobtrusively as possible to minimize the effect of recognizing interactivity by the sensor hardware. The content shown on the column was a simple ball game.

Communicating Interactivity

The initial interaction with the column happened at two levels. We first intended to display a cut-out mirror representation of the user, but due to the distortion of the life-size user images on the curved surface (as described above), we decided to use a more abstract and space-saving "Skeleton" representation. In field and video observations we observed that nearly all passers-by almost immediately understood that the column was interactive when unintentionally interacting with the display (on average after about 1-2 seconds). This was also confirmed in later interviews with users. We observed several first-time users already starting to interact while still approaching the column from the distance. Users quickly recognized the abstract skeleton representation as their virtual counterpart. It provided an effective initial interaction, probably also because many users were approaching the column directly.

When users approached the display from other angles, two challenges arose: (1) Technically, the Kinect skeleton detection is optimized for frontal interaction and usually will not detect users passing tangentially. (2) Perceptually, the side view of a skeleton appeared too unobtrusive to grab the attention of passers-by, especially at the border of their attention and field of view. Thus, to make users aware of the interactive capabilities of the column when they were not approaching it from such an angle that a skeleton could be detected from the very start, we used a particle representation as visual feedback to people's movements, triggered only by the sensors' depth information. The application then switched to the skeleton representation as soon as a skeleton could be detected. The particle visualization had to be eye-catching, but at the same time should not take so much space that it would interfere with feedback to other users interacting with the column. When fine-tuning this feedback, we found that particles were optimally displayed slightly ahead in the direction in which users were passing the column. Most passers-by recognized the particle cloud moving along with them, many then slowed down and changed their body orientation such that their skeleton could be detected (see Fig. 2a).

Conclusion

In this paper we discussed the challenges that arise for shaped displays to communicate their interactivity and, by means of an example, presented how suitable visual feedback to unaware movements can be designed for such displays. Especially for new shapes of displays communicating interactivity might be important, as people may still not have the expectation that they are interactive. For each individual shape suitable solutions have to be found that best serve that purpose. It would also be interesting to explore how deformable displays can communicate their interactivity by reacting to the unaware movements of users.

References

[1] Beyer, G. *Die Digitale Litfasssäule als Werbemedium. Entwicklung eines Konzepts für Visualisierung und Interaktion.* Diploma thesis. Berlin University of the Arts (UdK), Berlin, Germany, 2008.

[2] Beyer, G., Köttner, F., Schiewe, M., Haulsen, I., Butz, A. Squaring the Circle: How Framing Influences User Behavior around a Seamless Cylindrical Display. To appear in *Proc. CHI '13*, ACM Press (2013).

[3] Beyer, G., Alt, F., Klose, S. Isakovic, K. Sahami Shirazi, A.,and Schmidt, A. Design Space for Large Cylindrical Screens. In *Proc. 3rd Workshop on Pervasive Advertising and Shopping*, Helsinki, Finland, 2010.

[4] Dalsgaard, P. and Halskov, K. Designing Urban Media Façades: Cases and Challenges. In *Proc. CHI '10*, ACM Press (2010), 2277–2286.

[5] Fischer, P.T. and Hornecker, E. Urban HCI: spatial aspects in the design of shared encounters for media facades. In *Proc. CHI '12*, ACM Press (2012), 307–316.

[6] Michelis, D. and Resatsch, F. Unlocking the Interactive Capabilities of Large Outdoor Displays. *Information Display 23*, 3 (2007), 24–29.

[7] Müller, J. Walter, R., Bailly, G., Nischt, M., Alt, F. Looking Glass: A Field Study on Noticing Interactivity of a Shop Window. *Proc. CHI '12*, ACM Press, 297–306.

[8] Ten Koppel, M., Bailly, G., Müller, J., Walter, R. Chained Displays: Configurations of Public Displays can be used to influence Actor-, Audience-, and Passer-By Behavior. *Proc. CHI '12*, ACM Press (2012), 317–326.