

MirrorBoard – An Interactive Billboard

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Abstract

Although a lot of things have changed in the field of advertising over the past few years one thing has stayed almost constant: the billboard. Billboards play an important role in advertising; nevertheless a lot of people only perceive them unconsciously and thus cannot remember the advertising message. With MirrorBoard we want to grab people's attention and enhance memorization of the product by letting people interact with the billboard or by integrating the observer into the scene itself. Such posters might act as gateways to mobile services which allow the user seamless and natural interaction with the poster. This paper presents scenarios showing how people can interact with MirrorBoard and describes how such a system can be implemented. To evaluate a prototype system we conducted a user study, the results of which will also be discussed.

1 Introduction

Billboards, shop windows and posters are common forms of advertising, with higher acceptance compared to many other forms of advertising (Kern et al. 2008). With new display technologies and a decrease in prices for display and projection hardware, major changes are expected in the near future. Till now, most billboards still present paper posters showing static pictures and text. There is, however, an observable trend towards flat screens and projections replacing the traditional billboards in many areas. The main advantage of these is that exchanging the advertisement is easier and the frequency of change can be increased without additional cost. Advertisements always compete for the user's attention and hence dynamic advertisements on flat screens appear to be promising. However we believe that forms of advertisements that make users interact with them are even more effective. If people can interact with the billboard, implicitly or explicitly, we suggest that they remember the advertising message better. Furthermore by using this approach it is possible to offer new

services connected to the billboard to provide additional value to the user. Overall it is essential that the initial interaction invokes minimal effort for the user.

In this paper we introduce the MirrorBoard, which allows the user to interact with the advertisement in different ways. With respect to the presented prototype, several actions can be performed. The initial focus is on getting the attention of the user and involving the user with the advertisement. Additionally it should be possible to switch between different advertisements (e.g. changing products, views and colours) as well as to show additional information. Such advertising concepts are common for product lines where a range of types or variations can be shown (e.g. clothes, multi-coloured MP3 players). Letting the user interact with the billboard should provide her or him with more information than a static image and at the same time make her or him curious and thus more receptive to the advertising message.

In our study we focus on the ‘integration’ of the user into MirrorBoard. The basic idea is to draw the user into the advertisement and make him or her part of it. Think of a piece of clothing. The MirrorBoard could give you the impression of trying it on right on spot to see if it fits you. Displaying the user as if in a mirror and overlaying the piece of clothing could at least provide a sense of whether the style and colour suits the participant. Another area of interest is advertisements for holidays. The idea is that these billboards will place the user into the scene (e.g., on a beach or on top of a mountain) and hence attract their attention. To validate our assumption that this increases the attention of the user we evaluated the ideas with a user study comparing different types of billboard – varying from statically to interactive ones like MirrorBoard – in a real shop environment.

The paper is organized as follows. The next section relates our work to existing approaches. Section 3 describes different scenarios illustrating the usage of our concept. In section 4 we present a generic architecture for our concept and describe the two prototypes implementing different use cases of MirrorBoard. Section 5 describes the user study we conducted to evaluate our prototype and to provide evidence for our hypothesis. The paper is completed by conclusions and an outline of future work.

2 Related Work

The discussion of related work is twofold. First we give a brief overview of work on interaction with public displays in general and specifically interaction in advertising. Afterwards we introduce background information relevant to the implementation of the prototype we built.

(Liu et al. 2004) describe an electronic billboard system called Interactive Wireless Electronic Billboard using a data processing system equipped with a display device and short-range wireless communication capability, such as Bluetooth. They suggest its use in commercial product advertisements. The display device shows product advertisements while the data processing system uses a wireless communication interface to communicate with nearby mobile devices such as PDAs, which allows the user to interact with the billboard. Such kind

of explicit interaction is also part of our approach, albeit one of less importance. We think that it's hard for users to discover these features by themselves.

(Ryu et al 2007) present a method of navigating pictures on an ambient display using implicit user interactions. The display is able to detect if people are near the display. When the user is too far away from the display, it acts as a digital picture and does not attract attention. When the user comes within an appropriate range for interaction the display shows pictures that are related to the user and provides quasi-3D navigation using the TIP (tour into the picture) method (see (Horry et al. 1997) for details). The aspect of implicit user interaction is also featured prominently in our approach.

Design principles and an interaction framework for sharable, interactive public ambient displays that support the transition from implicit to explicit interaction with both public and personal information is described in (Daniel & Ravin 2004). Novel display and interaction techniques such as simple hand gestures and touch screen input for explicit interaction and contextual body orientation and position cues for implicit interaction are presented. Both the explicit and implicit interaction methods described give hints to how our current system can be further developed in the future.

In (Rukzio et al. 2004) personalized interactions with ubiquitous public displays are investigated to find out what forms of personalization and interaction styles are applicable in this context. Through this the authors show that there are different cases where personalization of services on public displays is useful. Of special interest for our prototype are the results of the study on waiting time and activities of people at bus stops as well as the perceived usefulness of different interactive services on billboards as expressed by the people in the survey.

Over the last decade joy of use and the fun in using interactive systems has become a focus for many developers. A systematic approach towards engineering enjoyable interactive system is given in (Hassenzahl et al. 2001). Creating a novel experience that users can enjoy and appreciate instantly was one of the goals when developing MirrorBoard. The resulting association of positive emotions with the advertised product provides the main value of the system.

3 Idea Generation

In order to discuss possible ideas, elicit reactions and develop new ideas we conducted a small focus group meeting. Five people, three men and two women, aged between 20 and 25 years took part in the focus group. The meeting took almost exactly one hour. To give the participants an impression of our idea we showed them a short video sketch. Afterwards we discussed various open-ended questions concerning different interaction types with billboards and also asked about usage of mobile services (e.g. buying products shown on the billboard with mobile payment technologies). Based on the result of the focus group we identified two main areas that appeared to be useful for new interactive billboards.

Explicit interaction with billboard

The people in the focus group indicated that they would like to use billboards like a catalogue. It should be possible to flip back and forth through images of the same or different products. If people are interested in a certain product they should be able to see different variations (e.g. different colours of a piece of clothing) or get more detailed information about the product. This form of interaction seems especially appealing at locations where people spend some time. The participants in the focus group could imagine browsing through a virtual catalogue for example while waiting at a bus stop.

Implicit interaction and personalized advertisement

During the discussions in the focus group we identified several scenarios where people could imagine and would value personalized advertisement. Participants stated that they would not mind if they are visualized on the billboard while watching a holiday advertisement. Seeing yourself on a beautiful beach or next to a famous sight like on a picture of a holiday trip you have already made appealed to the participants. Furthermore some could imagine to virtually try on pieces of clothing to get a feeling of how they fit them. It seems that the implicit interaction (see (Schmidt 2000)) of “being there” in front of an advertisement becoming a part of the visual display is attractive and has a low threshold for the user. There is no learning required and no additional devices need to be used. It appears that this type of interaction is suitable even for billboards where people just pass by.

The following section describes the architecture and the implementation of the prototype.

4 Architecture and Prototype

Figure 1 shows the architecture of the MirrorBoard system. The implementation consists of two main parts, a server part and the MirrorBoard itself.

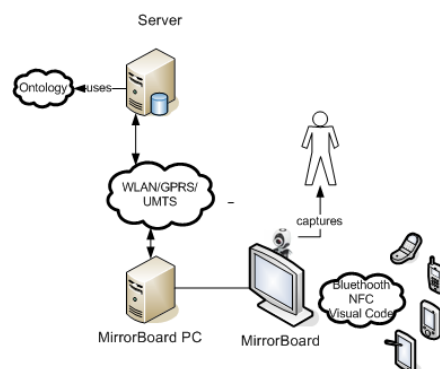


Figure 1: Architecture

Primarily the server is used as a repository for different advertisements and services. These components can be remotely deployed to various MirrorBoards thus saving costs compared to ordinary billboards with paper posters. We propose using an ontology to easily categorize services and advertisements and to allow easy and flexible deployment. The ontology must be able to deal with different types of services and different types of advertisement on the one hand and should take location information of the MirrorBoard into consideration on the other hand. Furthermore it could be combined with context or user sensitive data to further personalize the offered advertisements.

MirrorBoard itself has to integrate a communication and interaction infrastructure. A camera is needed to capture images of the persons for realizing the implicit interaction and personalized advertisement. For explicit interaction with the billboard technologies such as Bluetooth, Semacode (see (Semacode)) and NFC (see (NFC)) are integrated.

Implicit interaction and personalized advertisement prototype

Following the idea of grabbing people's attention and improving their attitude towards advertisements we created a prototype which integrated people in a holiday scene. We implemented background subtraction to create an overlay of the observer and paste it into the scene. If nobody is standing in front of the billboard, the system camera captures the 'empty' background, stores it and uses this information to extract observers and paste them into the scene afterwards. In Figure 2 you can see an image created with the prototype taken during a first test run of the system.



Figure 2: The prototype showing the integration of a person in the lab into an advertisement scene.

The background subtraction implementation blurs the saved background image as well as the currently captured image to get rid of camera noise. Afterwards a black and white mask image is created. The black areas are the ones that still show the saved background whereas the white areas show the current image differing over a certain threshold. Creating such a mask, however, doesn't always result in a clear body shape. Often there are 'holes' in the body of an observer (e.g. where the colors of the clothes closely match a background object). To close these holes as well as get rid of white foreground spots around the person the mask

image is dilated. This filter operation increases the size of the light areas and therefore closes holes inside the mainly white foreground region of the mask.

After blurring the map to make the transitions between foreground and background smoother it is eroded. This trims back the light regions again to approximately their original size and prevents the appearance of unnatural halos around the person. The map is then used to blend the currently captured image over a predefined advertisement image. We used the Java-based prototyping environment Processing (Processing) for implementing this algorithm.

5 Evaluation

To understand better how people interact with MirrorBoard we conducted an in-situ study. We wanted to find out if the MirrorBoard attracts people's attention more than conventional screen advertisements. Furthermore we were curious whether people would start to interact with it or if their behaviour would be similar to normal billboards. Our study combined observation in context (we watched people while passing the different types of billboards and took notes on their behaviour) and interviews (we asked people several questions concerning the billboard and their feelings when interacting with MirrorBoard).

5.1 Test environment

The MirrorBoard system used for the study was set up at a travel agency branch office in the centre of Linz, Austria. The main function of the prototype was to integrate observers into the scene, as described in the section above. The hardware consisted of a 42" flat screen representing the interactive MirrorBoard. Five different scenes of holiday locations were shown in a sequence, each scene appearing for 15 seconds. An AXIS 2120 network camera and a standard notebook computer were used to capture the observers, process the images, integrate them into the scene and display the combined image on the screen. We positioned the display to the right of the entrance (see Figure 3) so that people entering the travel agency were could see the display at first sight.

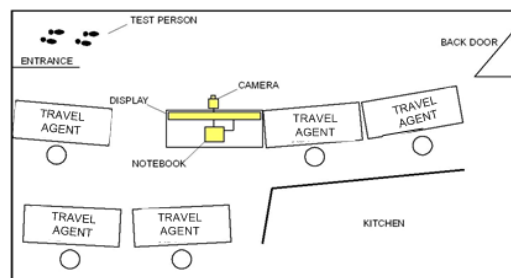


Figure 3: Room layout and prototype installation.

5.2 User study

The user study consisted of two parts: first the observation of people's behaviour when watching and interacting with the billboard and second interviewing the ones who noticed the billboard. The user study lasted about 4 hours. We first simulated a normal, static billboard, afterwards the animated MirrorBoard allowing users to interact with it. In total twelve people were interviewed. During the study no customer had to wait for a seat at a travel agent's desk. Most customers were entering the agency heading straight towards an agent and not paying much attention to their surroundings.

Observations

People entering the travel agency did not pay much attention to the static billboard. The big flat screen grabbed their attention at first but they didn't look at it in detail and also didn't show any noticeable emotions or feelings when seeing the advertisement. In today's world people seem to be used to electronic advertisement displays and it is nothing special for them.

After the static billboard the MirrorBoard application was displayed at the same spot as the static one. Some people discovered MirrorBoard themselves some were asked by the travel agents if they would like to try the new advertisement. When people noticed themselves inside the advertisement scene their reaction was surprise and they were curious about the features and its workings. Most said something like "Wow, that's cool" in their first reaction.

Typically after a few seconds customers recognized that they could walk around in the holiday scene and actively started to interact with the billboard. They positioned themselves at different locations within the scenes and even asked for a possibility to 'sit' on a deck chair shown on a beach (see Figure 4). Others were even trying to virtually touch items in the pictures like for example a camel that was resting in the sand in front of pyramids. From our observations we can conclude that people understood the concept and experimented for themselves with the system.



Figure 4: The prototype at the travel agency

We observed that interaction differed between the two genders. Even though the small number of subjects does not allow us to make a general statement we would like to report the observations. In our sample men were more interested in interacting with the billboard than women. They experimented with the billboard for a longer time than women, who tended to leave the area the camera captured rather quickly. When women were asked for their opinion, however, no such reluctance was noticed. People of both genders found the effect equally amazing and fun.

Another observation was that people who interacted with MirrorBoard did memorize the scenes that were shown rather well. They were able to remember the holiday locations (e.g. The Great Wall of China, pyramids, beach ...) and actively mentioned them in the interviews. This shows great potential for this form of advertisement, as it helps to make people more aware of what they are seeing.

Interview

In the interviews following the observations several people stated that they wanted to be in that scene in real life and that they had been longing for adventure and were in the mood for a vacation. They liked the idea of being shown at holiday locations. Even though it is just a picture it seems that it touched some of the users emotionally.

Most customers felt comfortable interacting with the billboard in the travel agency which is inside and only a semi-public space. Some people were uncertain of how they would feel in a more public space and how it would make them feel if their picture is captured and shown by a billboard in public. This is a matter that certainly needs to be examined more closely in a separate experiment in a public space.

Some of the people told us that they had wished to interact even more with MirrorBoard. Participants suggested making the scenes reactive, e.g. making the camel bleat when touching it. One test person went to such lengths as to suggest to be able to navigate through the motives by virtually touching different areas in MirrorBoard (e.g. starting with the world map and choosing a country) or by positioning oneself on a specific spot in the picture (e.g. following a sign that says "To the beach" and then finding yourself on that beach).

Regarding our question about what would be the most suitable place for such a billboard most participants suggested a shop window. It seems to be a good place to get the attention of window shoppers even outside business hours and customers could take their time to explore different possibilities of interaction with the MirrorBoard. Conceptually our prototype could be used for this, however from a technical perspective it is much more difficult. The outdoor light conditions are changing very often, which would make background subtraction a harder task. The location would need to be chosen so that the user is captured alone, as moving vehicles and other passer-bys in the background would be shown and could thus degrade the quality of the effect. Another suggestion made was to install MirrorBoard at a trade show where it is necessary to direct visitor's attention to a company's stand.

Several people criticized the mirror image as not being fluent while moving around. As our experiment was done using a prototype which was not optimized for performance this was

understandable. However, for a more advanced system image quality would have to match the users' expectations with regard to time resolution. In addition the camera's frame rate was limited at 15 frames per second, which let the movements appear jerky. With better hardware and some image processing improvements we should be able to provide an even more realistic 'mirror image'. These ambiguities did not hinder the people to use MirrorBoard but rather encouraged close personal engagement with systems (see (Gaver et al. 2003)).

Evaluation summary

The study and interviews showed that an interactive advertisement that draws people into the scene works and is accepted by the users. We were able to show that such a system generates a fun user experience which leads to a higher rate of people remembering the advertisement. People felt comfortable and interacted with the billboard. MirrorBoard is something to remember and allows people to be creative and interactive at the same time. The movements done by the people to interact with the advert may furthermore increase the effectiveness of the approach; see (Holleis et al. 2007) where it is shown that gestures attract others to watch. With improvements in system positioning and hardware the user experience might become even better.

Positioning MirrorBoard to face the waiting area was a good idea. Directly at the entrance would have been another option. With more waiting customers MirrorBoard could have been the perfect way of killing one's time.

6 Conclusion and Future Work

In this paper we presented a prototypical implementation of an interactive billboard named MirrorBoard. By letting people interact with the billboard they are more likely to remember the advertising message. The main part of the prototype consisted of integrating people in the advertisement scene using a camera and image processing algorithms such as background subtraction. We conducted a user study to get feedback on the prototype. People were curious when interacting with the billboard and actually tried to virtually interact with the billboard (e.g. walking on the Great Wall of China).

The results from the user study provided us with the basis for future work. As most people thought that shopping windows would be the ideal place for MirrorBoard we need a way to cope with a more volatile background. Furthermore the processing of the camera image has to be improved to avoid a jerking video and to allow for more fluent interaction. We also plan to make the billboard even more interactive. In the next prototype it should be possible to change the background image when walking to a certain destination, e.g., showing a beach when walking to a beach sign or showing hotel rooms when walking into a hotel.

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