

Application of Input Methods with Public Displays

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Abstract— More Interactive displays than ever are popping up in public space. With the technology available today, they can offer a broad variety of input methods. Some are simply responding to people passing by, others are allowing the user to explore detailed information through a touch interface. They can react to sound, motion or even the mood of the user, which leads to a wide range of use-cases. In this paper you will be given an overview of the most widely-used interaction methods with public displays and the threshold people have to overcome in each phase of the interaction.

Index Terms— Public Displays, Interaction Methods, Requirements, Human Factors

1 INTRODUCTION

Technical applications are getting more and more complex. We find them in our smartphones and computers, but we can also experience them in urban space. Public displays don't necessarily need to be boring static signs anymore. We have sensors to analyze nearly everything and thus we are given a variety of methods to tell a computer what to do. These techniques can be used to create a modern form of interaction in public space. Displays should invite the user to participate. With modern sensors and new possibilities, we have to rethink and optimize the way people interact with installations in public space, making them intuitive to use and easy to adapt. Displays often fail to get the attention of the people passing by or they can't motivate those who notice to engage in interaction. By using sensors and letting the installation react to the people, those issues can be addressed. The article below will give a summary of the most common input methods and where to place them in the cycle of user interaction.

2 RELATED WORK

Various experiments have been carried out to understand social behavior in front of public displays. A 2.5 meter wide touch display - the CityWall - was used in Helsinki, Finland to analyze social learning and public interaction [6]. A different, gesture-based experiment made use of an object that most of us carry around: A smartphone was wirelessly linked to a display to see which movements people would come up with, when asked to perform a given task. Before all of these relatively modern experiments there was the Hello.Wall in 2003 [7], which already used sensors to determine the users position in front of the installation. Prante separated the periphery of the display in different zones and gave the wall a variable task, depending on where the person is standing. Michelis [3] split this classification even more. He explained the different phases of approaching a display - from passing by to direct interaction. Müller et al. [4] also mention these phases, while additionally describing the different methods of interaction with a public display. I will join the work of Michelis and Müller and take a look on how interaction methods can help to overcome the threshold of approaching a display in public.

3 INTERACTION METHODS

In general there are two possibilities individuals can interact with the machine: The user can tell the computer more or less directly what he wants him to do; Schmidt calls this *explicit interaction* (e.g. command line or speech input), whereas with *implicit interaction* you expect the computer to understand your actions or behavior and react in a certain way, just like an automatic door would open the moment the sensor detects a motion [8].

3.1 Presence and Gesture

An early approach to presence sensing displays was the Hello.Wall, which Prante and his team developed in 2003 [7]. It is made of 124 cells, with each of the cells containing a LED cluster. The wall responds once a person passes the *notification zone* in some distance to the installation and displays adequate notifications depending on the person and the kind of application. If the person comes even closer and enters the *cell interaction zone*, he can playfully interact with each single or several cells at once. In case there is nobody close, the wall displays general unspecific information. The wall itself is a good example for both implicit and explicit interaction. First it simply reacts to bypassing people and then gets into direct contact with them.

It was Kray et al. [2] who took it one step further. By applying new technologies like a smartphone and wirelessly linking it to the display, they made the experience even more interactive. Making use of the internal sensors of the phone, they utilized it as a controller for movements. In their study they gave the participants the simple task to perform unspecific gestures with their phone to trigger a specific task. Interestingly many of the participants came up with the same movements to trigger the action, leading to the final conclusion, that certain device configurations and activities may be well suited for gesture control, as long as the gesture-set is clear and intuitive.

3.2 Touch

Another interactive wall comes from Helsinki, Finland. The CityWall, installed by Peltonen et al. [6], was used to analyze social learning and public interaction via a multi-touch display in a busy public street. The 2.5 meter wide installation allowed multiple user to participate at the same time and in this case the main function was to let users view and rearrange displayed pictures of the city. They found that users at the display were attracting others. Most of them were acting separately, but sometimes, mostly after a conflict between two parties they started to interact.

Hinrichs et al. [1] had a study similar to the mentioned CityWall, where they analyzed different input methods for an interactive table at the Vancouver Aquarium. The rear-projected display allowed browsing through the Aquarium's large collection of media items, with information about the arctic environment, via touch. In his observation he found a wide difference in gestures, especially between children and adults. But not only the age was crucial, the interaction context, the intention and the social context were decisive, too. Hinrichs showed, that a certain gesture, even if it had shown to be generally preferable, is not enough. It is important to support a variety of single- and multi-touch gestures for every particular action.

3.3 Body Position and Posture

Additional information about the user can be helpful. His body posture can indicate if he is facing the display directly or if he is simply walking by. His position can also reveal the part of the display he is currently watching, so the screen can split up, making space for a second user. Or, combining both, the content of the screen can move with the user.

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3.4 Facial Expression

Cameras, which observe the viewers facial expressions, can be used in various ways. Most notably they provide a great instrument to get analytic data in relation to the content, by answering questions, such as: "How long does someone look at the content? Which part of the display is preferred by the viewer? Do they like it?"

In their trial, Müller et al. [5] investigated exactly these topics. They hung up electronic displays, called ReflectiveSigns, in different locations of their university department to analyze people's preferences in content. Their aim was to calculate the expected view time for each type of content depending on the signs location. The information they got from the sensors were later compared to feedback from semi-structured interviews with a smaller part of the users. The system was developed in order to help schedule the view time of the content, by learning the audience attention for certain content, but the study showed that the location of the sign bears an even greater potential than the right choice of content. That is why sensors for facial expression can help to understand the user and optimize the content, location and behavior of your display.

3.5 Voice Input

Voice sensors can be used for both implicit and explicit interaction. By analyzing ongoing conversations the computer can search for keywords or estimate the number of people nearby and change the display of the screen corresponding [4].

Explicit speech input is also a possibility, but a little more complicated. Although we see this technology emerging as a hands-free technique in mobile operating systems nowadays, the use in public space is somehow more challenging: First of all there is a lot of surrounding noise, which makes it hard to only get the information of the actual user. Then again, how would you define the various instructions? Different people might use different commands to trigger an action.

4 INTERACTION PHASES

Since the rise of displays in public space there has always been the issue on how to grab the attention of passers-by and get them to interaction. An interesting study by Michelis et al. [3] from 2011 approaches this issue. He presented an illustration of the different phases of interaction (see figure 1). The first of the six phases, he explains in his study, includes practically everyone, who happens to pass the installation in a certain distance. Once a *passer-by* reacts to the display - which is the case for most of the people - he can be considered a *viewer*. He becomes a *subtle user* as soon as he shows intention to cause some reaction by the display. After this initial interaction people can position themselves directly in front of the display, interacting and exploring the features of the device. This person is called a *direct user*. In case there is more than one display, the user can interact with other displays and will be called a *multiple user*. Sometimes you can also experience *follow-up actions*, e.g. users taking pictures of themselves or the installation.

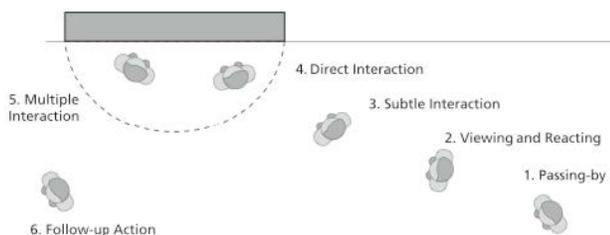


Figure 1. The Audience Funnel ([3])

With these six phases in mind, we want to take a closer look on how different interaction methods can encourage people to overcome the existing threshold in the crucial situations and enter into the next phase.

First of all the display needs to get the attention of the *passer by*. In his study, Michelis used a camera sensor to mirror the person to the

display. They will see themselves or a movement in the corner of the eye and pay more attention to the display. If the person is closer from the beginning, you can start using gesture based input to get them into initial interaction. Seeing that their movement will cause a reaction from the display, will make many people curious and eventually leads them into *direct interaction*. This phase provides the most options for different input methods: touch surfaces such as the CityWall, gesture based input like Hello.Wall or Michelis' interactive camera mirror are just some examples. This is also the time where you can use additional information such as body position or facial expressions to understand the user's preferences and behavior. A great example for a display, which grabbed the interest and attention of people easily comes from the social organization Misereor. They carried small change donations over to the digital age by letting people swipe their credit card between two display, which led to a contribution of two euro¹. Each swipe was combined with an animation on the display, e.g. slicing a piece of bread with the credit card. The campaign made people interact in a playful way and grabbed the interest of others at the same time. Giving people an incentive to interact is important, because many of them are experiencing a certain shyness in public. For each phase there is a threshold to overcome. Not all of the passers-by will look at the display and not everyone, who looks at it will engage in interaction. Public displays must be designed to lower this threshold and sometimes it helps, if the display starts with an initial subtle interaction, which makes the user wanting to explore it.

5 CONCLUSION

Before installing an interactive display in a public space you have to decide on the right input method. Depending on the use of the display you might end up with a different solution. If you have a complex interface with many different options and functions you might be best with a multi-touch display, where you can define many different input gestures for navigation. Nonetheless you should check, that the interface is kept simple and intuitive. Hinrichs showed, that it is important to support a variety of both single- and multi-touch gestures, because of different user habits mostly between young and old [1].

For more simple applications on the other hand you should be fine with a presence or gesture based input. For example, if you just want people to be able to scroll through a collection of pictures, they could do so by wiping their hand in the air from right to left. Instead of a costly multi-touch display, a regular display and an attached motion sensor are fine. Additional information can always be gained in implicit ways: By using voice sensors you can estimate the number of people in front of the screen or listen for specific keywords in their conversation.

One thing you should keep in mind is the social component: While in general users will attract new users, seeing others struggle with the interface or embarrass themselves in front of it, might scare people away. Therefore some input methods are best used passively, where users barely notice them, but get an implicit result nonetheless and some methods, like touch input, are a perfect way of explicit interaction.

Some thoughts should also go to the different phases of user approach. If the person is directly in front of the screen, you can let him use a broad variety of input methods, from touch to voice. But at first he must be motivated to engage in interaction: By letting the device react to people nearby (e.g. through motion sensors), you can attract people, which would otherwise just have passed by.

¹<http://www.2-euro-helfen.de/news/detail-ansicht/article/kreative-spendende-das-placard.html>

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