VENTANA

Interactive Shop Window

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1 INTRODUCTION

„A gesture[..] is any physical movement that a digital system can sense and respond to without the aid of a traditional pointing device.[..]“ [1] stated by Dan Saffer in his book Designing Gestural Interfaces.

Have you ever found yourself waving in front of a water tap in a public restroom just to find out that there is no automatic turn-on mechnism? These mechanisms with their primitive gestures have already become very popular and are used almost everywhere. People have become to widely accept this kind of interaction and intuitively use it.

With the introduction of new sensors, touch-less interactions can be much more complex and powerfull and can be used for much more than just turning on a water fosset or flushing a toilet. In this new field, we as interaction designers, must be carefull not to over challenge the user‘s acceptance and always ask ourselves whether a gesture is the right solution for the desired function. Will people understand it easily and is it really the most efficient method?

My researched uncovered, that many of the gesture interfaces proofed to complicated and overwhelming to the user. They did not follow a logic and did not support intuitive body-language to accomplish tasks in the digital space. Nevertheless, I believe that the untapped potentials of these emerging techniques and technologies will be the next big thing for us interaction designers.

With my project I wanted to design a gesture driven interactive shop window and find out how people will use it.

2 BACKGROUND RESEARCH

New gesture controlled applications are released on a daily basis. But even though such applications are very popular many of them fail because the gestures are to complicated. New technologies like multi-touch or depth sensing cameras are getting cheaper. This technologies will be widely available to the public and will increase the amount of gesture controlled applications. Having inexpensive technologies wildly available will increase the amount of applications outside the research field.

In my research I focused on a three criteria:

Gestures
Gestures are an important part of my interactive shop window. In my research I looked at applications which mainly focus on gesture tracking or interaction through gestures. I looked at this type of interaction because it is an important way of input when designing an application for a touch free interaction.

Public space
Interactive shop windows are usually located in public space. Therefore one criteria was public space in connection with interactive installations.

Tracking methods
Different projects require different tracking methods. I looked at different technologies to track the user interaction with a focus on Microsoft Kinect related projects. An easy tracking methods will be important for my project because it has to work fast and smooth.

2.1 RELEATED WORK

GIUC: A Gesture Interface for Ubiquitous Computing
GIUC [2] is a vision based gesture interface for ubiquitous computing environments. It uses a normal webcam to track the users hand. GIUC is based on a tracking and recognition algorithm combined with a particle filter algorithm. So far it is built to reconize six predefined gestures, each based on approximately 800 pictures. It has been tested for indoor environments.
One big advantage of this system is, that it requires nothing but a normal webcam. The disadvantage in this system is, that at the time of development, it was only able to run at 15 frames per second. For fast applications like games this might be too slow.

Marker-less Gesture Based Interaction for Design Review Scenarios
This prototype [3] uses computer vision methods to analyse camera images from a stereo camera setup in order to track 3 dimensional objects. The user can use gestures to control a visualisation software. The study showed, that gestural in-

terfaces have a potential to increase the users efficiency by exploiting a far wider range of actions to manipulate a system, compared to a traditional interface. Using 3 dimensional movements to control a 3 dimensional interface makes it easier for users to understand what they are doing. The prototype showed an example of such a 3 dimensional interface without physically touching any device. A usability test was run with 17 participants. A short task together with a description about the handling of the gestural interaction was handed to the participants. All of them solved the task successfully. The overall result of this prototype shows that using gestures in 3 dimensional systems can be very rewarding.
One of the biggest advantage in this system is, that it does not need expensive devices, two cameras are sufficient. I see great potential in the use of a 3 dimensional system combined with a 3 dimensional interface. A disadvantage of such a system clearly is, that the users have to learn the gestures before they can use the system. Learning a gestural set which is not intuitive can be frustrating.

Using a Depth Camera as a Touch Sensor
Microsoft Research explored depth-sensing cameras to detect touch on a tabletop [4]. Using this technology instead of a capacitive touch screen has the advantage that the surface doesn't need to be instrumented or flat. An additional feature is the possibility to track the arms and hands of the users. The technique they used to track the data was Microsoft Kinect. In this setup the camera is above the surface. Its easily possible to track hover status and body parts of the user. The performance of such a system is not as good as it would be with a capacitive display but it's still good enough for a big variety of useful applications.
An advantage of this technology is, that it doesn't matter what kind of shape the display surface has. The tracking information can be useful and offer a wide range of opportunities for new applications. I see a disadvantage in projecting from above to a surface. Projection over the hands and arms can be quite strange while using the application. If a person leans over the surface all information behind the body cannot be tracked or displayed, this can lead to problems.

Information Book Beijing Planning Exhibition Hall
In the interactive information area at the Beijing Planning Exhibition Hall they have a virtual book. The shape looks like a huge real book. A projector displays information on it. An infrared camera tracks movements over the book. If a page turn gesture is performed a new site will be displayed. Using such an obvious pattern makes it easy for people to understand. One problem I saw during my observation was that most people don't read the displayed information anymore. Most users just performed page turns a couple of times. This project is very similar to Microsoft's Using a Depth Camera as a Touch Sensor but with a less functions and gestures. Because it can only do one gestures and nothing else it's very easy for people to understand.

[fig 2.1] Virtual Book at Beijing Planning Exhibition Hall

Analysis of Natural Gestures for Controlling Robot Teams on Multi-touch Tabletop Surfaces
In this project [5] its mainly about the natural gestures of user and what gestures they would use for certain tasks. In an optimal environment, a normal user should be able to interact with the interface quickly and naturally without explicit instructions. The paper aims to find the most natural gestures for controlling robot teams, regardless of detectability or input technology. In user tests they tried to find the most common gesture for certain tasks.
Using a user centred gesture design is in my opinion the best way to get an easy and usable interaction with the software. One disadvantage of such an approach is that some cultures and people have different ideas how an gesture interaction should work. Therefore its hardly possible to find a solution which fits for all peoples.

User-Defined Gestures for Surface Computing
User defined gestures in the context of surface computing were analyzed by Jacob O. Wobbrock [6]. 20 participants generated over 1080 gestures for tabletop devices such as Microsoft Surface. Unlike most other gesture interaction studies, this study used non-technical users and let them design the gestures. Using a user generated gesture set instead of a system engineer set can lead to more problems in recognizing them on the technical side but will help the user to easily pick it up and use it.
One of my critique point of this study is, that the users could not change a behaviour after moving on to the next one. It could be quite likely that some of the gestures would have been more suitable for other functions.

Using Hands and Feet to Navigate and Manipulate Spatial Data
This project [7] is about an application to manipulate spatial data using hands and feet. In the example they built a geographical information system based on NASA‘s world. In addition they evaluated the difference between hand and hand & feet gestures to control the application. The users had to solve geospatial tasks and rate the overall experience afterwards.
Using different input methods like in this example is an interesting approach. Especially with a controller like the Nintendo Wii Fit Balance Board. But this interesting thing limits the usability too. Users need to be able to stand. For handicapped people this can be rather difficult or impossible.

g-stalt: a Chirocentric, Spatiotemporal, and Telekinetic Gestural Interface
The g-stalt project [8] is a 3 dimensional graphical space filled with over 60 cartoons. This movies can be viewed and rearranged using gestures. The system is a marker based system which tracks points on a glove. The software allows the user to navigate in a 3 dimensional graphical environment filled with video material. The videos and visual interface are projected to a large screen. While building the gesture set, they had a focus on real world gestures for certain behaviours. Whenever possible they used such gestures which led them to many gestures.
The main problem was the time to learn which gesture is responsible for which function. Using complex gestures for the control can be frustrating or disappointing.

Worlds of Information: Designing for Engagement at a Public Multi-touch Display
The project [9] is about an engaging multi user and multi touch display in public space. The focus of this project is engagement and group use of such a system. One of the problem they faced was the use of 3D with a multi touch display. Building gestures for a touch display to manipulate a 3 dimensional object was rather difficult and not all users did understand that.
Building a system with a complex abstract layer can make it difficult for inexperienced users. On the other hand having a 3 dimensional interface can engage new users. One thing, I really liked at this project is, that they build parts of the system and tested it on an exhibition. With the user feedback they got, they could improve the overall user experience.

Gestural Entertainment Center for Canesta
Kicker Studios built in 2008 an gesture controlled interface for an entertainment system [10]. They used a user centred approach and tried different gestures with participants. During the development process they looked for similar gesture patterns to reduce the size of the gesture language which users had to learn. In the design process they found out, that a Minority Report like interface is very tiring and to dramatic. The final interaction with the system focused on a easy to learn interaction using only a small set of gestures to control the system.

Gesture Space at ETH Library
In 2010, Kai Jauslin built for the ETH library a gesture controlled application [11] to display historic resources held at the library. It uses intuitive gestures to control the content. For his bachelor project at the university of the arts in Zurich he used to project all information on the floor. In his work for the ETH library he changed to a wall projection. The part I really like of his project is, that he did not focus on many gestures. Most gestures he used were mainly simple and could get adapted easily by a wide variety of people.

[fig 2.2] Gesturespace at ETH library

Microsoft Kinect for Xbox 360
Microsoft Kinect is a RGB camera combined with a infrared camera for depth sensing to interact with games and entertainment system without a classic con-

troller.[12] It was developed by Microsoft for the Xbox 360 and is mainly used as game controller. To start the different games Kinect developed a gesture based interface and added some helpful tools. To start the tracking a wave gesture needs to be performed. This is indicated with a small animation. A small display always shows what the camera sees. If hands are detected they colour it on the small display and show a cursor on the screen. Nearly all information and actions are displayed using roll-over. There is no touch or press function to start a function. All “click” events will be started using a time based interaction. There is no push function for buttons integrated. All buttons are “magnetic” to make it easy for the user to activate it. For functions like pause a special gesture needs to be performed. This gesture is one of the few gestures which is not obvious but Microsoft explains it quite clear during start-up of the system. A swipe gesture is not as one would expect. To swipe to other content a buttons needs to be rolled over. If the hand is on rollover status, arrows indicate on which direction a movement of the hand will perform a change of the content. The usage of this way to perform a swipe gesture makes the system look quite slow. To see where the users position or hands are, a virtual avatar is displayed in the background of the interface. Every time a gesture is made, an icon displays it. During playing the games new interactions and gestures are possible, for example jump and movement of the hole body.
I think Microsoft Kinect Interface is quite a good example. There are many good points in it and they didn‘t use to many gestures to control the system. This makes it easy for a wide range of people to use. A drawback I see, is the missing click function. Not having this and only relay on time based activates makes this system feel slow.

Easy Authoring for the Microsoft Kinect with Open Exhibits
The software [13] from Open Exhibits provides simple solution for gesture and flash based application. In their demo they showed different interactions using one or two hands. In one example they controlled a 360 degrees image using simple gestures. One hand is used to pan, two hands are used to zoom in and out. In another example they controlled Google Maps. The interaction and gestures for it are the same.
What I really like at this project is, that they provide an easy to use gesture set. Like the Gesturespace project the gestures are not complicated to learn and people will pick it up quite easily.

Controlling PowerPoint Presentations With Kinect
Rafael Augusto Bassan has created a Microsoft Kinect controlled application [15] to control PowerPoint. Simple gestures will change the slides. The only gesture he used was a swipe gesture. This makes it easy for everybody to control.

Gesture-based Fine Manipulation of a Surgical Tool using Kinect
The project [14] is a prototype for a gestural based surgical tool. It uses gestures to control a robot. This could be a way how in the future surgeons can be performed over distance. The current state of the project is not yet as good that it could be used for a real surgeon. But I think it clearly shows the way how health care can be in the future. The gestures they used in this project are mostly logical.

If the users want to grab something he has just to close the hand like we would do in real life. Using obvious gestures like that will make it easy for new user to adapt.

Kinemote Project - Kinect controlls Boxee
This project [17] uses a very basic gesture set to control a media centre. All gestures can be performed using only one hand. The system seems to be really fast. With a simple movement gesture in every direction the menu can be used. There is a click gesture included to activate a button. The sound level is controlled using up and down gestures.
This project is a good example how an easy interface with a Kinect control can be developed. Because it uses only one hand it can be easily understand by a wide range of people. Compared to the official Microsoft Kinect controlled Xbox interface it seems to be very fast because they used click events instead of a time based button click.

[fig 2.3] Kinect controlled Boxee Media Centre

Moscow interactive shop window with gesture controls
VIVID Interactive produced an interactive shop window [16]. They used two basic gestures, swipe with one hand and pinch and spread with two hands. For pressing buttons they used the same system like Microsoft‘s Xbox. Rolling over a button and wait till a certain time is over to dispatch a click. In their example it seems very fast. One problem I see with such systems is that the content does not get as much attention similar to the Beijing City Planning Exhibition. People are more interested in the system than the content.

2.2 NATURAL USER INTERFACES

Natural User Interfaces are not natural
Currently it‘s all about Natural User Interfaces. Cheap technology makes it possible to easily track gestures, body movements and speech. But behind all these buzzwords there is still a need for a good conceptual model and clear feedback. Graphically driven user interfaces (GUI) are easily learned through exploration. All possible options are visible and lead the user through the functionality. In Natural User Interface this is not always true. For example the same gesture may mean

something else in a different culture. Even though most common gestures like pinching and dragging are well known in different cultures there is still a problem with things like yes or no. Using a Natural User Interface with gestures must be learned and cannot easily be discovered. Physical gestures have other problems, using the hole body as an input device can be difficult for handicapped people.
Gestural systems are not different from any other form of interaction design. They need to be designed on a solid conceptual model and provide an easy navigation through the application.

Natural Interfaces will definitely play an important part in the future but it will need some time for us to understand how to deploy them.
„Are natural user interface natural? No, But they will be useful.“ Dan Norman [18]

I agree with this paper. Some papers I read about gesture design are just too much focused on technology. Sometimes it seems that for some engineers it‘s not about the usefulness rather than the possibilities. I think for designers it‘s very important to think about what makes sense and how people will use it.

Microsoft is Imagining a NUI future
Microsoft published on their blog a post [19] about their prediction for the future of natural user interfaces. Technology becomes more natural and intuitive. It‘s not only about multi-touch and speech sensors and technology. Future systems will combine different technologies and contextual awareness, 3D simulation and anticipatory learning. A future with an almost invisible technology and an easy interaction with such a system. Not only in the game industry will it play a major part, also in technology and health care will natural interfaces change a lot. One question about future development always comes up when predicting a futuristic scenario: “Is there a need, is the market ready for it, will it be embraced?“ In the field of natural user interfaces the answer is yes. Polls, ordered by Microsoft showed a huge interested in such technologies.

If we compare this blog post to the paper of Don Norman (Natural User Interfaces are not Natural) I think we can say that both papers predict a more natural user interface future. While Microsoft is more focused on the technology and feasabilty, Don Norman predicts it a bit more abstract and critical.

2.3 GESTURES

In this section I would like to show the most common gestures currently used by systems. There are a few gestures which are very common and already so established that we already use them intuitively.

Tap or point to open, select or activate
Most touch based applications use the tap to send click events. It is used to open a function, select an item or activate it. Most touch screen mobile phone use this as one of the most used gesture. But if you look at controller free applications like Microsoft Kinect this function is hardly used yet. „Pointing is the most natural gesture for selection.“ [20]

Drag and Drop
From GUIs on personal computers we know drag and drop functions. In a natural user interface such a function can be a very clear gestures as it can be directly transformed in how we move objects in real life.

Pinch to shrink and spread to enlarge
Since Apples iPhone and iPod Touch got really popular nearly everybody knows that the pinch or spread of fingers or hands gestures can change the size of an object. It became one of the most popular gesture without a direct real life counterpart.

Wave to activate
Waving is a simple gesture and has already a wide usage area. Not only is it needed to activate the user tracking on Microsoft‘s Kinect [21], it‘s also very common in public restrooms for the water tap, paper spender or the toilet flush.

2.4 ACCESSIBILITY IN GESTURE CONTROLLED APPLICATIONS

While designing a gestural interface we always need to consider people with physical disabilities and handicapped people. When we design an application mainly based on hand gestures, we need to think about how people with limited handmovement possibilities can also use the system. It is important that such systems use a small number of gestures, all of which should be easy to perform. But not only will a gestural interface be harder for certain people to use, it may also be easier if a person has problems performing the small movements to controll a mouse or a keyboard.

Further reading:
[22] Dan Saffer, Designing Gestural Interface 978-0-596-51839-4 Page 44

2.5 2D VS. 3D – A FEW THOUGHTS

During my research I came across the question if I should build a 2D or 3D interface for my application. Here a few thoughts I had.

Advantages of a 2D interface
The 2 dimensional applications are very common. Most of the graphical user interfaces have been designed in 2D. Users can deal with such systems using common input devices like a mouse or a keyboard.

Disadvantage
If a spatial input is used but the interface remains flat, it can be confusing for users. A transmitted thinking is required.

Advantages of a 3D interface
If a 3 dimensional representation of a user interface is used, users will more likely

use 3 dimensional gestures. To support the intuitive action of the user, spatial input should be used for a 3D interface.

Disadvantage
Is an interface designed in 3D and controlled by 3D gestures it will be relatively quickly tiring. 3D interfaces are often slower to reach a goal.

Further reading
[23] http://www.useit.com/alertbox/981115.html

2.6 INTERACTIONS IN A DIGITAL SYSTEM

When we think about interactions in digital systems we can divide it in three areas:

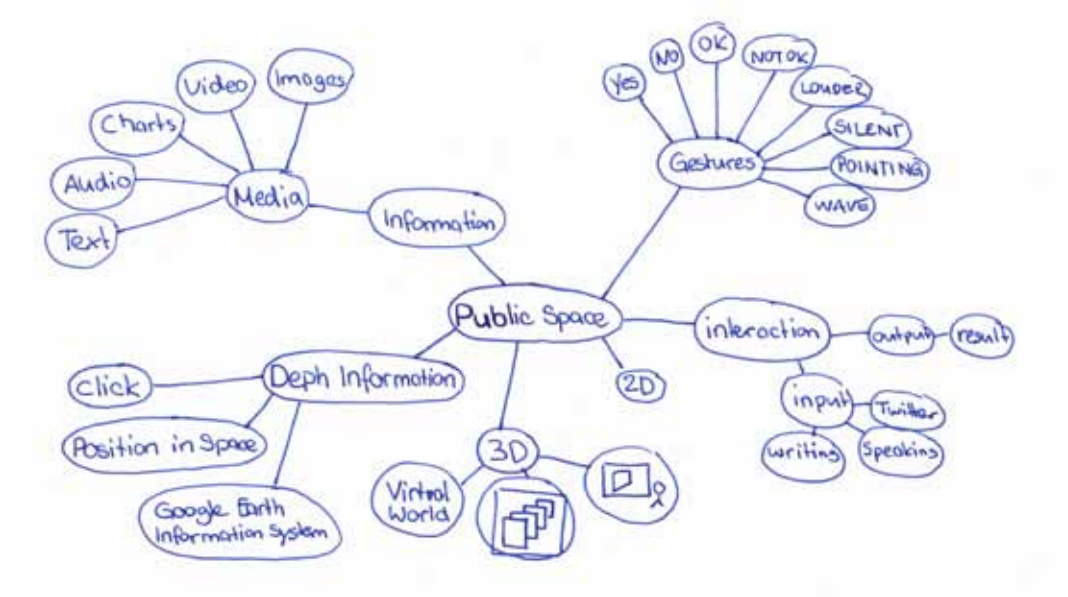
Digital Manipulation
Whenever we press a button, drag a scrollbar or move an object in our graphical user interface we manipulate a digital system. Our language involves different patterns like single click, double-click, press and move, release and roll over. All these patterns are performed by a mouse, keyboard or a similar device.

Gestures in 2D
Most touchscreens and modern trackpads allow gestures to manipulate the software. Since Apple released the iPod Touch and iPhone we got familiar with simple gestures with our fingers, such as flicking album covers with one finger or zooming and scrolling with two fingers.

Gestures in 3D
After Nintendo launched the Wii controller many people got used to interact with gestures in a 3D space. New gestures like shaking, turning or spinning were introduced. With the launch of Microsoft's Kinect gestures with the hole body became popular and accessible to a general audience. Currently such systems are mainly developed for gaming, exhibitions or experiments.

Further readining:
[24] Bachelor Thesis TWYE Fabian Kuhn Page 16-18

2.7 BASIC CONCEPT



[fig. 2.7] During my research process I decided to focus on a public space. I was thinking about what media I could use and what gestures might be interesting to design a dialog between a system and a user.

2.8 TECHNOLOGIES OF INTERACTIVE SHOP WINDOWS

Interactive shop windows use different technologies. Currently the most common are touchscreens. Many examples us this technology because it is already well established. Newer touch-screens use multi-touch which improves the user experience. Using a depth sensing camera or multi camera tracking setup is the latest trend in interactive shop windows. Shoppers will no longer need to touch anything and can use their hands or body to control the information displayed on the shop window. New technologies allow multiple users and 3D gesture tracking. With such a system in place window shopper can look at products from any angle using simple gestures. Whenever there is a user and the system knows what the user is looking at, it can track this information. Using this information in an analytics system can give valuable information of which product is looked at most and for how long. This technology would allow to take a picture of each person who looks at a product and store this information together with the products the person looked at (eventhough under the current law in Switzerland this would be prohibited).

Further reading [25]

http://www.sciencedaily.com/releases/2011/01/110114155245.htm

http://www.gizmag.com/3d-interactive-shop-window-displays-in-the-works/17617/

2.9 POSSIBLE IN-WINDOW PURCHASE

When we design the next generation of shop windows its important to think about the additional values. Not only can such a system create an entertaining buzz, but it can also drive sales. If we add the ability for the customers to purchase products directly from the window, even when the shop itself is closed. To establish an easy connection between the shopping window and an online store we have a few possibilities.

Order form
Having an order form directly integrated in the system can make it easy for people to order a product. There will be no additional device needed to order a product.

Video Order
Shoppers will record their adress on video using a camera and a microphone built into the shopping window. This way no additional device is needed for the shoppers.

Order using SMS
Nearly everybody owns a mobile phone. Beeing able to use text message from a mobile phone is a convenient way to order a product.

QR Code
The QR (Quick Response) Tag, was developed by a Japanese company in 1994. Its a 2 dimensional code to store information. Most smart phones have the possibility to read QR codes. Using a QR code in the description of the product makes it easy for the user to order it online. One advantage of such a system is that the order address or payment option not directly will be handled in the shopping windows which makes the order process more secure and private.

QR-Code which contains the URL: www.michaelfretz.com [fig. 2.9]

Google Wallet (NFC)
With Google launching a mobile payment system based on NFC Chip payment we will soon get the possibility to pay all over the world with our mobile phones. This system will allow to pay products through the window directly from the street.

2.10 CONCLUSION BACKGROUND RESEARCH

During my research with gesture based applications I found that many applications are difficult to use. But all analyzed projects had a few interesting parts in them. One major lack in gesture based applications is that we do not have a gesture standard yet. There are only a few common gesture which have quite established in currently used systems . If we focus on application which will be available in public space and easy to use we have to use this gestures or find a way to display our new gesture in a very easy way.

The use of touch-free interaction with an application in public space seems a good solution for my bachelor project. The research showed that in this field already many different systems got established. Some of them had a complicated multi camera setup wile others used a depth sensing camera setup. Using a depth sensing system will make it easier to calibrate and use.
In my bachelor project I will build an easy to use, Kinect controlled application, that uses an easy to learn gesture set.

Questions I would like to answer during this project:

- When does it make sense to use a gesture and what gestures are easy to learn?
- What gesture will normal users use for a common tasks?
- What gestures can be used in public space?

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