VENTANA

Interactive Shop Window

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ABSTRACT

Today, retail stores are finding themselves in a fierce competition with e-commerce stores. By bringing the latest technologies to these physical locations, Ventana is trying to provide a solution to this problem. Installed in the shop‘s window, Ventana enables passing potential customers to interact with a digital representation of the store‘s inventory. Now, well informed, the customer is more likely to enter the shop.

Ventana is designed to allow the presentation of any kind of information. It could be used to present fashion, jewelery or a restaurants menu. For our purposes Ventana is showing two products thematizing the US city New York. By the mere presence in front of the window a user can navigate and interactively experience the digital space.

The non-stop availability of the stores inventory breaks the boundaries between the digital and the real world and has the potential to attract many more customers. And as touch-less sensors become more affordable we will see many more applications of this kind, which will open up a range of completely new possibilities. Kinect, for example, would allow us to determine a customers body size and use it as a filter on the inventory and thus tailoring the information to the users needs.

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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. Never-the-less, 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:

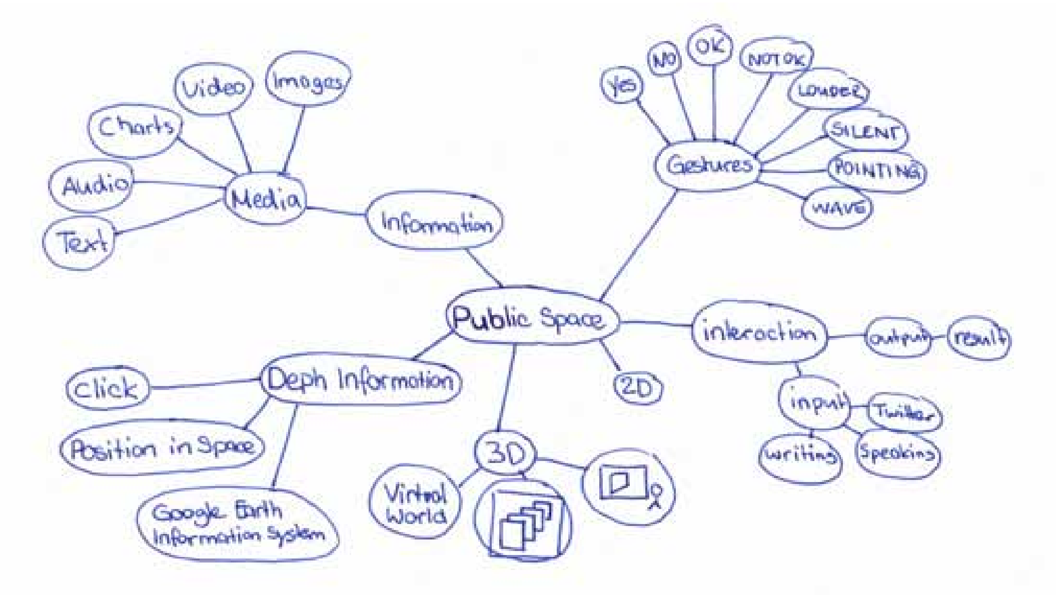
Digital Manipulation
Whenever we press a button, drag a scrollbar or move an object in our graphical user interface we manipulate a digital system. Our language involves different patterns like single click, double-click, press and move, release and roll over. All these patterns are performed by a mouse,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

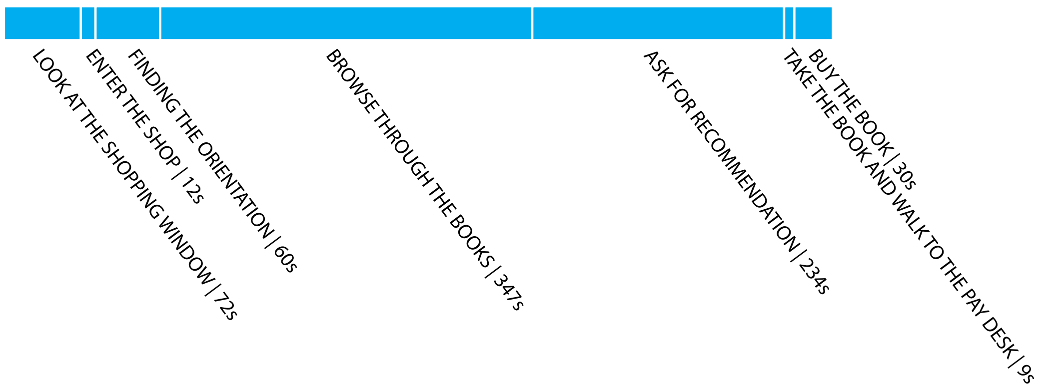
3 CONTEXT INQUIRY

Through the method of observing, interviewing and user centred gesture design I looked at gestures. What gestures could be used to interact with an application? What gesture would make sense when interacting with a digital system. What gesture are acceptable in public space? How would people use an interactive shop window and what gestures to interact with it? What would the user rate as acceptable in public space? How do people behave in front of shop window and what are the key attractor that pedestrians stop and look at shop windows? What is important for shop window designers?

Through observing and interviewing different professionals and pedestrians I tried to find out what is important for them and what they expect from a shop window.

3.1 SHOPPING SEQUENCE

In my research I looked at peoples shopping behaviour. As a use case I used a book store. I was investigating how shoppers behave and how much time they spend on certain taks in a shop. To do this I followed a person and stopped the time on how long each task takes. This is not a representive statistic as only one person was observed. [fig. 3.1]



3.2 DAILY GESTURES TO CONTROL APPLICATIONS

Our gesture lexicon has many different gestures for different situations. Some of these gestures are the same all over the world, some are totally different depending on the cultural background of the user.

In a few example I want to show different gestures and what they mean for our culture here in Switzerland. These examples are all gestures that could be used to control an application.

Gesture: YES

[fig. 3.2.1] If someone shakes the head up and down it means that this person agrees to something.

Gesture: NO

[fig. 3.2.2] If someone shakes the head left to right and right to left it means that this person disagrees to something.

Gesture: OK

[fig. 3.2.3] Putting a thumb up is interpreted in Switzerland as a positive feedback.

Gesture: NOT OK

[fig. 3.2.4] Pointing down a thumb is interpreted as not OK in Switzerland. Often this gesture is performed with a small movement.

Gesture: SILENT

[fig. 3.2.5] A raised finger crossing over the lips will be intepreded as a gesture to demand silence. Often combined with a “sschh” sound.

Gesture: LOUDER

[fig. 3.2.6] Cupping the hand behind the ear is an indication that the user would like the volume to be increased.

Gesture: WAVING

[fig. 3.2.7] Waving one hand is used to say good bye and sometimes to welcome someone.

Gesture: POINTING

[fig. 3.2.8] Pointing is the most natural gesture and is used to demonstrate a selection.

3.3 RESEARCH INTERACTIVE SHOP WINDOWS

Since the 19th century when shop windows became popular window shopping evolved into a common phenomena in our culture. It is inexpensive, engaging and enjoyable. Window shopper walk from window to window in a shopping district or shopping-mall to pass time, get inspired, compare products, etc. Not always is the window shopper actually interested in buying something. However the shop owner has a big interest in captivating the customer and engage them to spend money in his store.

The latest trend in shop window design is interaction. Technologies such as touch screens or camera tracked movements with projections are used to engage shoppers to stop at the window. Future trends will lead to window shopping with an actual purchase.

Here are a two examples of interactive shop windows

Iwindow Interactiv shopping window [fig 3.3.1]

Eye-Click [fig 3.3.2]

3.4 BEHAVIOUR OF PEOPLE IN FRONT OF SHOP WINDOWS

How do people behave in front of a shop‘s window? How do people stand there and what are they actually doing? And is it possible for us to distinguish a window shopper without interest to buy something from one that we might be able to entice to do so?

To get answers to these question I went to the Bahnhofstrasse in Zurich and observed and photographed pedestrians walking through the shopping street. Many people of different ages were walking along the windows. Some very slow, others very busy. A small number of stops at certain windows to look at them. While the shoppers looked at the window, they were only focusing on it. They didn’t move when other people passed them. Usually they stood still or pointed at certain objects if somebody was with them. Also if a shop offered outside display items people would often take it in their hands. It also seemed that this may have engaged them to enter the store.

One important part for the attraction of a shop‘s window is it‘s location. At places where people wait, many look closely in the windows. Such places are next to a tram station or next to a pedestrian crossing. More remote shops get less attraction.

[fig 3.4.1] Colors and design is an important part for a shop window to attract people.

[fig 3.4.2] If a shopping window has a unique design then people are more likely to spend more time in front of it.

[fig 3.4.3] Shop Windows with a creative approach attract curious customers.

[fig 3.4.4] Looking at the windows while talking on the phone is very common.

[fig 3.4.5] People spend more time in front of the store if they can actually touch the product. In this case people read in the books in front of a book store.

[fig 3.4.6] Some people just stand in front of the shop window without moving.

3.5 ACCEPTABLE GESTURES IN PUBLIC SPACE

Using gestures to control a digital system in public can be very uncomfortable for many people. Especially if the gestures involve huge movements. Because gestures mean different things depending on the situation or location a person is in, I want to only focus on gestures for users in front of the shop window.

To see what gestures are acceptable in a public space, I let a person perform certain gestures in front of a shop window in a busy street. I wanted to know what action were fine for her and what she thought were not acceptable gestures for a public space. In the test there was no interactive system that actually reacted to her gestures. However the test focused on the defining the users comfort level with body movements in public spaces. From my observations I created the theory that users are more likely to use the system in the public space if they have a certain comfort level while moving around. My thought is also that acting in front of a system that delivers actual feedback would rise the comfort level tremendously.

[fig. 3.5.1] Many shop window reflect the sunlight. Its a common gesture for window shopper to raise the hand to the forhead and go very close to the window to see more of its content.

[fig. 3.5.2] Window shopper often strole along the windows until something catches their attention...

... and then they have a closer look.
[fig. 3.5.3]

[fig. 3.5.4] Pointing at something is a normal thing to do if one person wants to show something to another person.

[fig. 3.5.5]

[fig. 3.5.6] Waving one or two arms in front of a shop window is rather uncommon and people felt silly doing it. However with an interactive system in place, this gesture feels more natural as seen on http://www.youtube.com/watch?v=RX1aCvtevCM

[fig. 3.5.7]

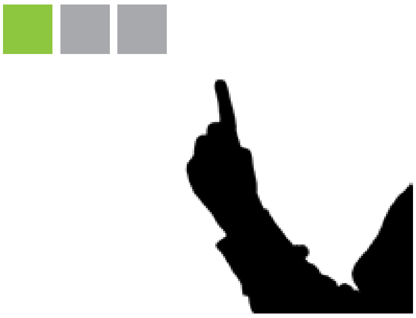
3.6 WHAT GESTURE CAN BE PERFORMED IN PUBLIC

I created a three color rating system to analyse a small set of gestures. Answering questions like: what hand or finger position would people use or how much would they move their bodies in a public place, resulted in a rating from green to red for each gesture.

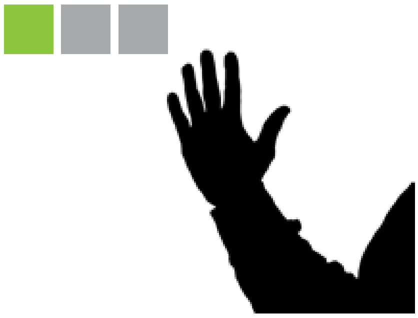
Green: Totally acceptable and fine to use and perform in public space

Orange: OK, but it depends on the situation. Mostly only OK if an interactive system is controlled with it.

Red: Not OK. People do not like to perform it because it‘s offensive or makes them look silly

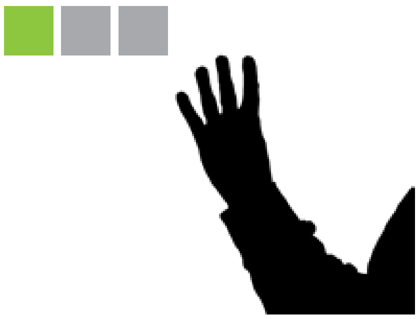


Indexfinger up
Common gesture to display
that one has an idea [fig. 3.6.1]



Hand up
Gesture to display „stop“
[fig. 3.6.2]

Wave with hand
Performed to say „hello“
or „good bye“ [fig. 3.6.3]

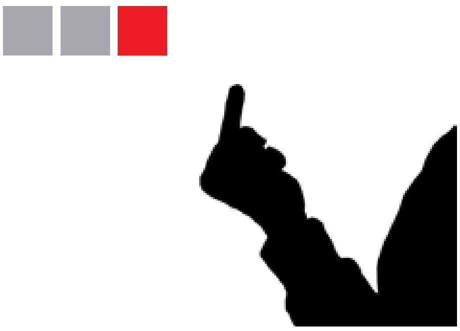


4 fingers up
Mostly used to display the
number 4 [fig. 3.6.4]

Thumb and little finger up
Gesture which could be offensive for certain people [fig. 3.6.5]

Index finger and little finger up
Common gesture in the rock scene to display respect [fig. 3.6.6]

Index finger, thumb and little finger up
Common gesture in the rock scene to display respect [fig. 3.6.7]



Middlefinger up
Gesture to display dislike of someone. Very offensive [fig. 3.6.8]

Fist
Context depending gesture. Can display violance or grabbing something [fig. 3.6.9]

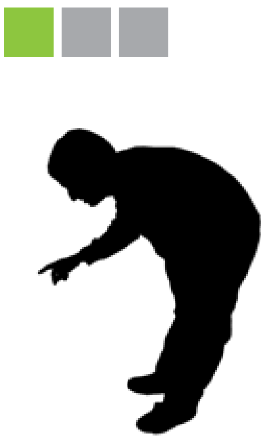
Pointing with Index finger
Performed to show something to someone. If used to talk about a person it can be offensive [fig. 3.6.10]

One Foot
Performed wile walk-ing, playing, dancing [fig. 3.6.11]

One Foot
Performed wile walk-ing, playing, dancing [fig. 3.6.12]

Spinning
Performed wile danc-ing, games. It can feel silly for certain people in public space [fig. 3.6.13]

Jumping
Jumping will feel silly for most people in pub-lic space [fig. 3.6.14]



Pointing (close)
Pointing at something close to a person is a common gesture in public space especially in shopping windows [fig. 3.6.15]

Pointing (up)
Pointing at an object is a common gesture [fig. 3.6.16]

Waving with two hands
Big gestures can make a person look silly [fig. 3.6.17]

4 TECHNICAL SOLUTIONS

When building an interactive system it's important to look at the technologies available. What would be a perfect setup to build a prototype for an interactive system. What are the advantages and disadvantage of the different solutions? In this chapter I explain the technologies I used and why. I explain the basic functions of the prototype and the technology behind it.

4.1 COMPUTER VISION

Before building my prototype I decided to do some tests in different programming languages and techniques. I did tests three different environments:

- **Processing and OpenCV**
- **Processing with SimpleOpenNI**
- **Actionscript 3 with Kinect, OpenNi and NodeJS.**

All techniques I tested are documented with video and can be found on my blog: http://ba.michaelfretz.com/2011/03/24/techniques-in-computer-vision/

OpenCV in Processing
OpenCV is an open source computer vision library developed by Intel. I used the processing edition from http://ubaa.net/shared/processing/opencv/
OpenCV for Processing is a good tool to develop a working prototype in a short time. The problem with the Processing edition from OpenCV is, that it requires a lot of performance. I uploaded two videos on my blog (http://ba.michaelfretz.com/2011/03/24/techniques-in-computer-vision/) to show the difference between different resolution.

OpenCV and Processing 320 x 240
This resolution works quite good and the performance of the program works fine.

OpenCV and Processing 640 x 480
If we double the resolution the framerate drops rapidly and developing a smooth program is hardly possible.

Advantage:
- Human recognition initializes automatically.
- Tracking starts very fast
- easy to use

Disadvantage:
- performance is not very good

SimpleOpenNI in Processing
Using SimpleOpenNI is a rapid way to access most OpenNI und NITE features. As soon as the detection is done the program will run smooth and will not require to much performance. There are two different solutions to work with SimpleOpenNI. One is using the NITE function. Usually activated by waving, the other is the Skeleton provided with OpenNI.

Kinect Handtracking using SimpleOpenNI and Processing
Advantage:
- very accurate

Disadvantage
- needs a special calibration wave gesture to get control

Facetracking using Kinect and SimpleOpenNI.
Advantage:
- very stable in position tracking
- different points of interest easily trackable (head, arms, hands…)

Disadvantage
- needs a special and strange calibration gesture to get control

Actionscript 3 with Kinect, OpenNi and NodeJS.
Using Actionscript 3 and Kinect together with Node.JS works quite good. The tracking is fast and very accurate. Flash make the visual aspect very easy to control.

Advantage:
- very accurate

Disadvantage
- needs a special and strange calibration gesture to get control

4.2 PROCESSING AND SIMPLE OPEN NI

[fig 4.2]

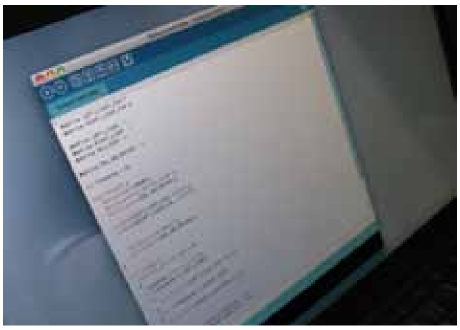
For my final prototype I used SimpleOpenNI [26] and Processing for the user- and hand tracking. using the Microsoft Kinect camera. Because I used Flash to display all Information on the screen I used the Server class from processing. The only values I send to the flash are the hand position and the center of mass of the closest user. These two values can easily be accessed through SimpleOpenNI.

4.3 ACTIONSCRIPT 3

[fig 4.3]

The design of my shop window theme should be easy to change and quick in development time. Hence, I used Adobe Flash to achive this goal. The application is built in Actionscript 3 and is set up as an MVC based application. A socket server receives the values from the processing and passes them on to Flash where the values are handled by an appcontroller. The combination of pure Actionscript 3 coded in the Adobe Flash Builder Enviroment and the Flash IDE gave me the possibility to design quick prototypes and test them thouroughly before I had the final graphics.

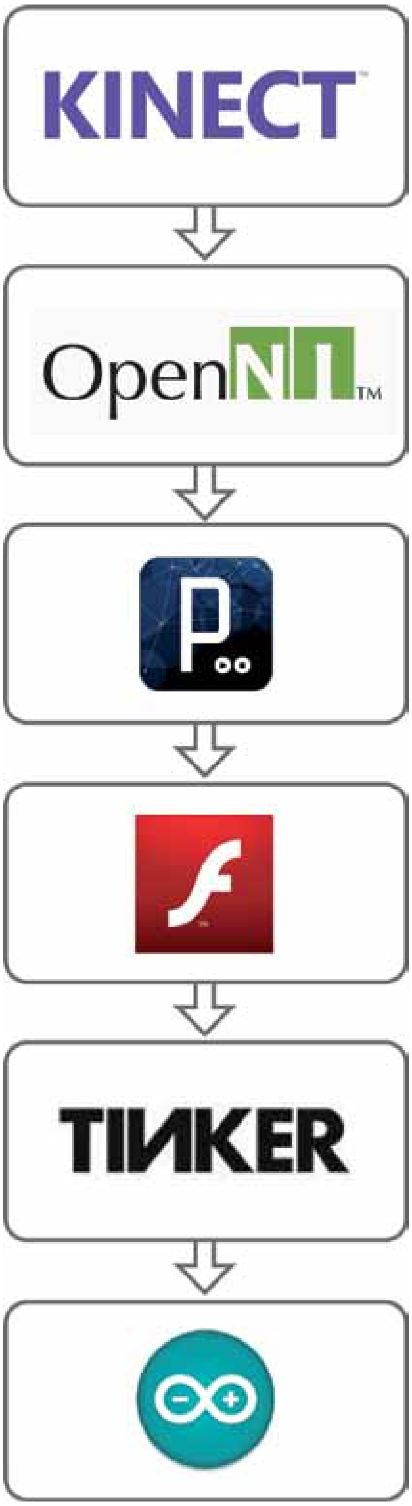
4.4 ARDUINO AND ELECTRONICS



[fig 4.4]

For my prototype I displayed two products. Both of them are related to one scene which will be projected to the screen. To make the connection between the product more visual I used light. The light will higlight the product of the active screen.
To achieve this functionality I used Arduino and two relays. On the code side I used the serial listener which listens to the Tinker socketserver that controls switching the lights on and off.

4.5 FLOW CHART



[fig 4.5]

Microsoft Kinect captures the scene with it's sensors.

OpenNI analyses the data and SimpleOpenNI wrappes the data for usage in Processing.

Processing applies business logic to the data and provides it through it's internal socket server.

Flash receives the data packet from the socket server and changes the UI based on the received values.

Depending on the values Tinker receives data from flash to either turn on or off the spotlight

Told by the Tinker socket server Arduino switches relays to either an on or off position.

4.6 SOUND

Sound in the prototype can help increase the fun factor while using the application. Certain hot spots in the different scenes play sound when the user activates them. Every scene has a theme background noise to increase the connection between the visual theme and the real world.
All sound are from www.freesounds.org

4.7 CONCLUSION

The setup I choose to build the technical prototype helped me to develop quickly a running prototype and test the different functions. Having a technology like Adobe Flash for the visual and audio part made it easy to design and develop the prototype at the same time. Using processing together with the SimpleOpenNI wrapper made reading the values from Microsoft Kinect a very easy solutions. Using the micro-controller Arduino to control the light is an easy way to bring digital content in a connection with a physical attractor.

5 PROTOTYPE

To prove my concept I built a prototype. In this chapter I will introduce the different steps during this process. I will show the possible interactions with the shop window and explain my thoughts on the design of the different screens.

5.1 PROJECTOR AND KINECT TESTING

Before I could create the exhibition design, I had to know how large the projected image can be and what the distance of the projector from the screen will be. I tested it with two different projectors. A short-distance projector and a normal projector.
It turned out that the use of a short distance projector is the better solution because this makes the construction easier and the size of the image is bigger. Unfortunately, the color quality of the short distance projector is not as good.

Next, I conducted tests to see how well Microsoft Kinect is playing with the projection. It was mainly about whether the tracking still works when set up directly in the projected area. After that I checked the angle of the camera to identify more possible positions of it.

The findings of this tests were that the Kinect and the projector cover the same area, which results in a much easier setup. Also tracking through a projected area didn't seemed to be a problem.

[fig 5.1] First tests with projector and Microsoft Kinect

5.2 EXHIBITION SETUP SKETCHES

Here are my exhibition setup plans. The idea is to build a box which should look like a shop window. The reason I build such a construction is that I do not have the possibility to display it during the exhibition in a real shop window.

[fig. 5.2]

5.3 3D RENDERINGS FOR THE EXHIBITION SETUP

The idea would be to line the interior with dark fabric.
Thanks to Florian Wille for designing this 3D Renderings.

[fig 5.3.1]

[fig 5.3.2]

5.4 INTERACTIONS WITH THE SHOP WINDOW

Using a Microsoft Kinect sensor, Ventana recognizes a person's presence in front of the window. Immediately it greets it's opponent with an audio-visual feedback. The user is now aware that a communication is established. Simply by raising and waving the hand, the user is now able to navigate and explore the contents inside Ventana. The interaction patterns are purposely kept simple and straight forward. Thus, the user learns to fully interact with Ventana in very little time.

Nobody in front of the shopping window
The screen is in indle mode virtually empty. This emptyness changes dramatically when a person enteres the camera sight. Through this massive difference on the screen it will attract the pedestrian and direct their gaze in the direction of the shop window.

Walking into frame
If pedestrians into the frame of the camera, the foremost person is identified as the active person. A parallax effect displays the movements of the person in front of the screen.
At the position of a certain product, the scene of the background changes to a theme that fits the product.

Stopping
If a person stops moving in front of the shop window, a indicator teaches the user how to start interacting with the application through waving.

Wave
Performing a wave gesture activates a cursor which can be moved using the hand and moving it in front of the screen.

Hand movements
After the cursor has been activated, it can be moved around freely on the screen. As long as the cursor is active, the scene can not be changed until the cursor is released or a certain hot spot is activated.

Active hot spots
Running the cursor over a hot spot area will display a playfull animation or a product information. These actions are also supported with audio events.

[fig 5.4]

Size of the user
The system will be able to use the physical size of the user to change the user interface and displayed information to their needs. For example if a child is in front of the shop window special information and child related animations could be shown. As seen in graphic [fig 5.4] This feature is in the current state of the prototype not implemented.

Singel User
The current prototype is built for a single user. The system recognizes which person in front of the sensor is the closest and automatically gives control to that person.

Multi User
The concept allows multi-user interaction.

5.5 SHOPPING WINDOWS NEED A THEME

During the research part I talked to Sasha Wohlgemuth from Jelmoli about shop windows. One important aspect, he told me, was that a shop window only has the reason to bring the people into the shop. To accomplish this difficult task, a shop window needs to display a message and a lifestyle. This theme of the shop window will also be used in the shop it self to make the connection between the shopping window and the shop. Emotions are very important. If the shop window can reach a persons attention, he or she is more likely to enter the shop.

Here is an example of the current Jelmoli theme: MY STYLE IS…. New York
Its a good example to show less information and products but still reach the shoppers attention. [fig. 5.5.1]

[fig. 5.5.2]

[fig. 5.5.3]

5.6 THEME: NEW YORK

For my bachelor project I built an interactive shop window with the theme “New York”. I choose this theme because I think its a challenging topic and I do have a direct comparison to the shopping window from Jelmoli.
My shop window will not be related to the one from Jelmoli and I do not get support, requirements or guidelines from Jelmoli.

One thing I wanted to achieve with this shop window is to bring New York closer to the person in front of it. To achieve this I will use different technologies. It is important to me that I will attract the user. When shoppers pass by they should stop and start playing with it. The setup should be very playful and therefore target a younger audience.

5.7 THEME DESIGN

When designing the application I tried to bring in an abstract layer. People should still easily discover that the theme is “New York” but it should not look like a photo. Therefore I designed it in a cartoon like way. I tried to use typical aspects from New York when working with the graphics. Using photos as a draft and reassemble them to a new art work helped to keep the New York touch but added a surreal visual value. Changes between the scenes are displayed through an animation. The animation has an important part because this is the point when most users get attracted by the shop window.

The interactive shop window prototype uses two scenes: Central Park and City.

Scene: City
The City scene displays the fast living and uprising business life. Everything is loud and fast.
Buildings in the city are tall and grey. Only a few famous buildings are added to build the connection to the trend city New York. Everybody knows the city and its very famous attraction like the state of liberty or the empire state building. Therefore I added this two famous constructions to the design to make it easy readable for the visitor to see what the theme is about. But New York is not only famous for this two constructions, New York is a major player in the movie industry like in the movie King Kong. Therefore I used King Kong as a fun attractor for the shop window visitor.
The bag displayed in the shop window is a bag specially designed for business lady's. To display more information about the bag I used the famous "ONE WAY" street signs and replaced its content with the new bag information. Using such a connection helps the user understand that the theme is "New York" but also brings in the connection between the bag and the theme.
As an addition to this visual aspects and features I added sound. Having sound as a background noise as well as having sound for playful features supports the theme even more.

[fig. 5.7.1]

Scene: Central Park

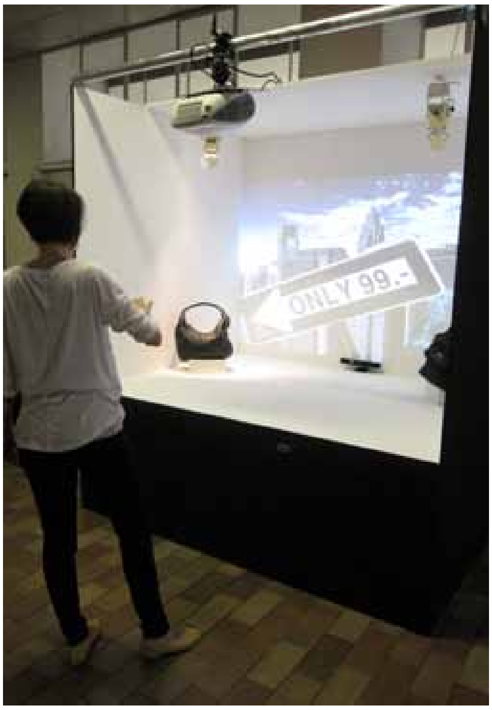
The Central Park scene is, in contrast to the City scene, more quite and nature related. The Central Park in New York is another very important part for this city. Many people use it to relax from their stressful and hectic life. They go out for a run or play sports or have a picnic with friends. In my design I tried to bring in this relaxing and playful aspect. I used butterflies to follow the active hand, a squirrel running around and added girls having a picnic. All of it supported by background sounds from a park. A man which walks into the scene displays that there is a wave gesture required to gain more possibilities to control the interactive shop window. With such a direct message it's easy for users to understand how to get an additional interaction layer.

[fig. 5.7.2]

5.8 FINAL PROTOTYPE PICTURES

[fig. 5.8.1]

[fig. 5.8.2]



[fig. 5.8.3]


[fig. 5.8.4]


[fig. 5.8.5]

6 EVALUATION

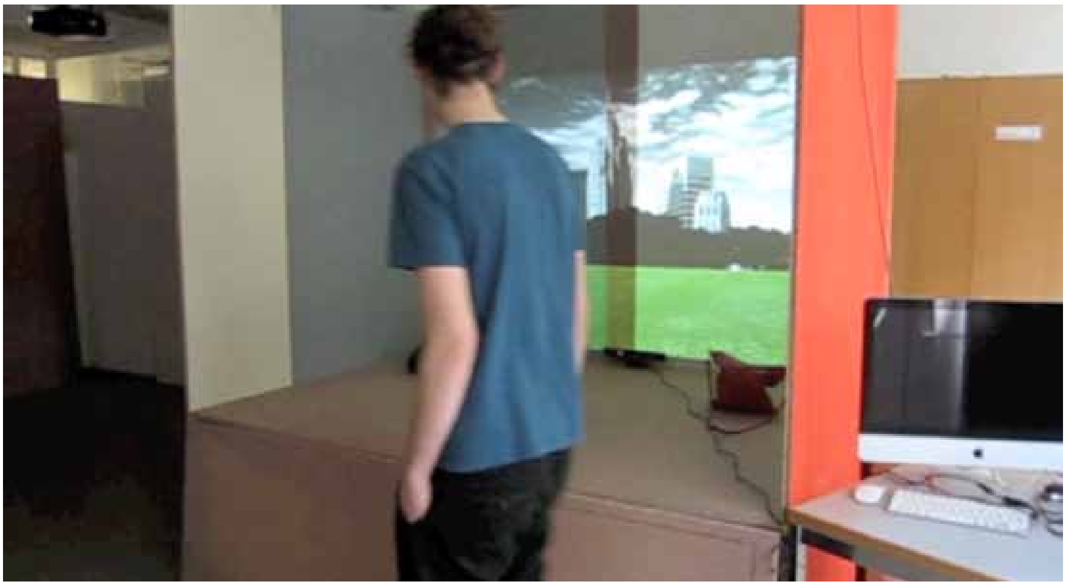
After I finished the first working prototype, I started with user tests. None of the test users were informed about the subject but all of them have recognized the subject of “New York“.
With the user tests I wanted to find out if people understand the functionality of the interactive shop window. Could they understand how to interact with the application? I asked them what they would change and what was difficult for them to do.

6.1.1 USER TESTS SCENARIO 1

Setup
For the first user tests I asked 3 people to try the interactive shop window at a very early stage. Each of the user was only informed that the installation is a shop window. Neither the possibilities of interaction nor functionality are known. The users had to discover everything by them self. The users didn’t have a time limit or a goal to reach. Time spend in front of the prototype was between 29 seconds up to 1min.

Result
All users could see the parallax effect, however, they could not recognize the additional features once they activated the controller.

Conclusion
A simple and fun way to make the user wave to the application needs to be added. Also the bags are not recognize as part of the installation. Adding lights to selectively illuminate the bags will hopefully solve this problem. The time spend in front of the shop window was very low. This value will increase when the user knows more about the functionality.



[fig. 6.1.1]

6.1.2 USER TESTS SCENARIO 2

Setup
In the second user test round I asked 5 participant.

All users knows what they could do in front of the shopping window. They knows that with a simple wave gesture he can get several ways to interact with the screen and can quickly explore the various scenes. I had to tell them this information because by the time I did this test I did not have a visual feedback to show them this information. The users didn't have a time limit or a goal to reach. Time spend in front of the prototype was between 1min up to 5min.

Result
In some cases, the wave gesture was still not clearly recognizable. Once the users had control, they moved around on the entire surface with their hands. Most users stand still when doing that. Problems have occurred when users were in the middle. Then no scene appeared. Many users point to the non-active product. Some users were disappointed that there were only three small interaction in each scene. A major problem was the placement of the hotspots. Some of these were too low and could not easily be reached by the user.

Conclusion
The products must be clearly associated with the scene. The active areas need to be better placed. No empty spot in the middle of the shop window. Since the users knows how to interact with the application they played for a longer time with it. The empty part between the two screens need to removed.

[fig. 6.1.2]

6.1.3 USER TEST SCENARIO 3

Setup
In the 3th user test scenario I asked 4 users. Most of the participant have worked and played with Kinect before but they didn't know what they can do with the interactive shop window. The light to display the product was installed and a wave gesture is symbolized by screen. The users didn't have a time limit or a goal to reach. Time spend in front of the prototype was between approximately 3 min up to 6min.

Result
Because the user knows that a wave gesture can give him more control he was quickly able to discover the virtual theme.

Conclusion
Parts of the design need to be redesigned. Wave gesture displayed through a visual feedback was a great help to understand what gesture needs to be performed to get more control. The light for the active bag was a great help and made it easier to understand the concept of two scenes for two products.

[fig. 6.1.3]

6.2 INTERACTIVE SHOP WINDOW VERSUS TRADITIONAL SHOP WINDOW

In a direct comparison between traditional shop windows and interactive shop windows we can find for both possibilities interesting parts. Through the use of an interactive shop window we can add a new target group. On the other hand we also loose the more traditional oriented customer.

Having an interactive shop window in place we are more likely to get the customers attraction. We have the possibility to add additional information in a small area. Wile having a limitation on space in a traditional shop window we can use digital content without limitation and therefore display much more information or products than with a traditional shop window. New shopping channels can be activated too. For example sale through the shop window when the shop hours are closed.

On the down side we have more external influence for example sunlight which disturbs the screen projection or camera tracking. Some people might get easy overcharged with new systems and we do not have a common gesture set and usability standard which would help them.

6.3 REDUCING THE GESTURE SET

Ventana was designed to be used without any learning time. Therefore I had to use a gesture set which had to be reduced to only a few possibles. It should be easy for nearly everybody to use.

Currently there are two possible ways to control the application.One is the bare presence and one is hand pointing gesture. It was an important aspect for me to make sure that the users do not feel silly when using the shop window in public space. Having a reduced gesture set makes it easy for people to learn how to control the system.

6.4 FINAL PROTOTYPE

Ventana is designed to allow the presentation of any kind of information. It could be used to present fashion, jewelery or even a restaurants menu. Ventana can be installed in any shop window.

For our purposes Ventana is showing two products thematizing the US city New York. By the mere presence in front of the window a user can navigate and interactively experience the digital space.

Through the use of inexpensive technology it is affordable for a wide varaity of shops. It can be used for very small interaction with the shop windows content up to very complex games and e-commerce solutions.

6.5 ADDED VALUE / FUTURE

The non-stop availability of the stores inventory breaks the boundaries between the digital and the real world and has the potential of attracting many more customers.

While traditional shop windows only had the change to display one theme and a few products we can use in interactive shop windows a huge inventory and amount of information in a small area. With touch-less sensors becoming much more affordable and therefore an extended reach we now have completely new possibilities.

In the future we will see systems which will determine a customers body size and use it as a filter on the inventory and tailor the information to the users needs. That could mean that kids get children related content and their parents more adult related information.

The system will know if a user is far a way or close to the shop window and therefor display different content.

In the future shop windows will determine if only one person is in front of the shop window or if there are many people passing by.

Combining digital media with a real live store will allow store users to extend their inventory tremendously and break through the physical locations limitations. When shops start to activate new shopping channels for example sales through the shop window when the shop hours are closed a new point of sale can be established.

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8 PHOTOS

fig. 2.1 persoanl photo, Michael Fretz, Beijing China
fig. 2.2 http://www.nextension.com/eth-library/gesturespace2/
fig. 2.3 http://www.geeky-gadgets.com/kinemote-uses-kinect-to-control-boxee-using-hand-gestures-2010-12-24/
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fig. 3.3.1 http://blog.clickz.com/Elle%201.jpg
fig. 3.3.2 http://www.signageinfo.com/2010/08/eyeclick-unveils-new-interactive-window-technology/
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fig. 3.4.4 persoanl photo, Michael Fretz
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fig. 3.4.6 persoanl photo, Michael Fretz
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