Bauhaus-Universität Weimar
Faculty of Media
Degree Program Computer Science and Media

Can't touch this - A Prototype for Public Pointing Interaction

Master Thesis

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Affidavit

Affidavit

I hereby declare that this master thesis has been written only by the undersigned and without any assistance from third parties. Furthermore, I confirm that no sources have been used in the preparation of this thesis other than those indicated in the thesis itself, as well as that the thesis has not yet been handled in neither in this nor in equal form at any other official commission.

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Michael Pannier

Abbrevations

RFID   Radio-Frequency Identification

FSD   Functional Specification Document

MIT   Massachusetts Institute of Technology

SDMS   Spacial Data-Management System

WYSIWYG "What you see is what you get"

GUI   Graphical User Interface

SUI   Single-User Interface

MUI   Multi-User Interface

HCI   Human Computer-Interaction

MVT   Museumsverband Thüringen

1 Abstract

Museums tend to be perceived as old fashioned. At least, that is what some people assume and therefore not even consider having a look for themselves. Nevertheless, there are many modern and open minded ones, which are willing to experiment with new possibilities, to get rid of their dusted reputation and to evolve.

So, I was called to do exactly that. – Implement a novel informatory interaction system for a museum of pre- and protohistoric history, where precious artifacts are locked up behind thick glass. The challenge was not only to develop a working prototype, but also make it intuitive, low maintenance and robust enough for everyday use. The system I developed employs the natural behavior of visitors. It detects potential users and enables them to interact with the system via pointing-gestures. Moreover, it can easily been set up and altered by museum personnel.

2 Introduction

In the beginning, there only was a raw concept of collaboration with a local museum to develop an innovative museum installation. The installation would be interactive and based on in- and output modalities that actually make sense in a museum. Therefore, visitors and staff should be observed and interviewed. Further, it was planned to use Microsoft Gadgeteer-hardware[1] as embedded components of tangible devices. I looked out for suitable museums in Weimar and found some interested ones. Later, I narrowed them down to a single one, which had the most fitting properties and attitude. Together, we conceived some ideas for possible installations. Not all of them were applicable or to far off my expertise. Nevertheless, there were two concepts, we were very interested in and excited about.

The first concept, *"Interaction with Tangibles"*, was directly addressing the visitors' haptic perception. A number of reproductions could be placed outside the showcase. Each somehow interactive tangible could then be manipulated or placed on a pedestal to gain information about its corresponding exhibit. Here, certain exhibits could have been photogrammetically scanned in three dimensions. After that, the digital model could be scaled to a handy size and otherwisely modified. Ultimately, the tangible could be printed or casted. Such an object could then be enhanced by using Radio-Frequency Identification (RFID)-technology[2]. In order to make it interactive, it would be fitted with such a RFID-tag. There is a RFID-module for Gadgeteer, which would have allowed identification of each tangible. The corresponding information could then be provided by any medium compatible with Gadgeteer.

A completely opposing approach was based on an assumption of natural behavior of

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1   Microsoft Gadgeteer is a modular system of various hardware-components distrubuted by GHI Electronics. It resembles Arduino- and other microcontrollers.
2   RFID-transponders or -tags do not require any batteries, are cheap and robust. In addition, their range is very limited, which allows several tags on one tangible.

visitors. After a meeting at the museum, a second concept of *"Interaction by Pointing"* emerged. Later the underlying assumption was confirmed by the observation of visitors' behavior around showcases. Whereupon, visitors do not only talk about exhibits, but they also point at certain exhibits during interaction with each other. Therefore, a device should be build or utilized to point into the showcase and select a certain exhibit. Additional information of it would then be displayed in an appropriate manner.

These concepts were fairly comprehensible, but their exact technical realizations were not this clear, yet. Throughout further investigations, the work turned from testing various modes of input to a more technical approach. Both ways of input are fairly special and revealed different challenges along the way.

Throughout the following chapters I documented my proceedings during the development of the aforementioned system. Chapter 3 gives basic information about the fields of study, which are included in my work. Thus, there is a brief outline about the progression of technologies employed by museums, users behavior around public interfaces and with tangibles. In addition, a brief overview of virtual reality-techniques is given.

Afterwards, I describe my goals for the development of this system. Before I come to explain the schematics and evaluation of my implementations, I give a short review of my partnering process. Thus, chapter 4 deals with finding the fitting museum for a collaboration.

Conception explains the whole development-process of the system's schematics and functionality. It begins with possible system designs and explains their possibilities and constraints. In the end of chapter 5, the final concept is shown along with necessary obligations such as an Functional Specification Document (FSD) and the contract between me, the university and the museum.

Chapter 6 addresses the implementation of the system's functionality. Therefore, all libraries and softwares are explained in more detail.

Experimental lab-installations and the final museum-installation are described in chapter 7. Therefore, measurements, hardware specifications, and other influential criteria are presented in detail.

The final installation is evaluated in chapter 8, where visitors were observed and interviewed before and after alterations by the system. Chapter 9 then deals with the discussion of the evaluation's findings.

In the end, I thought about future work, which could improve, extend, and follow my sys-

tem. In chapter 10, I would also like to mention reactions and suggestions I encountered along my work.

3 Background and Motivation

Over time public places became more and more enriched with all kinds of technology. Nowadays, on nearly every corner something is beeping or blinking and buttons, leavers and knobs make us - their potential users - interact with our environment. This trend does not spare anyone or anything. Even traditionally calm and sophisticated places open up to the possibilities of contemporary technologies.

3.1 Museums

Museums, much like libraries, are foremost seen as a place of knowledge and its preservation. Hence, visitors behave in a very reserved manner. Whilst applying for libraries, museums are willing to involve people instead of merely providing information. Many Museums therefor employ guides, who give tours and tell visitors about the exhibits. In addition to their factual knowledge, they also provide interesting anecdotes and other exciting information needed to bond with a certain topic. Apart of instructive and teaching staff, museums have tried many other ways to involve their visitors. One of those is employing technology. With time technology evolved, and so did technological augmentations in museums.

The name "museum" comes from the ancient greek's "Museion". It describes an, in honor of a muse, sanctified place [Mus14a]. Basically, museums are collections of arts and science or at least parts of them on display. In modern history, those collections were of an artistic nature and mostly private. Later, scientific and otherwise cultural museums were established for the general public.

One of the first high-tech installation of the modern age was the *Diorama*. In 1821,

Louis Jacque Mandé Daguerre[1] and the painter Charles Marie Bouton partnered up to develop this spectacle. It is an elaborate combination of painting and lighting [Woo93]. Through ingenious lighting, the paintings became vivid. This way, a diorama could simulate the moods of a whole day within minutes. Thus, it might be seen as an early predecessor of the cinema. Even today, although in much smaller size, dioramas are still thematised [Sch14].

The first interactive displays appeared at the *Urania* in Berlin around 1889, when they introduces visitor-activated models and a scientific theater. In 1907 the *Deutsches Museum* in Munich also began experimenting with film and mechanical models, which were operated by visitors [McL93]. Later, other museums all over the world followed. Since then the

> [...] wider museological community's understanding of nature and purpose of interactiveness

has taken shape.

> This understanding almost invariably involves:
>
> 1. The presence of some technological medium.
>
> 2. A physical exhibit which is added to the main display.
>
> 3. A device which the visitor can operate, involving physical activity. [Wit08]

As electronics and microchips evolved, computers became popular and affordable. The technological equipment of museums grew with what was available and new kinds of devices and installations appeared. Today, nearly every museum has a certain guide system such as an audio guide. It either leads visitors through the museum on a predefined course or a visitor can choose the track according to a given code for each included exhibit. In 2004, Chou et al. compared different museum guide systems in various categories, which were considered necessary to provide a user-friendly and informative experience. Expositors, tape machines, CD-players and a PDA were judged. The PDA was most versatile and easy to use system [CWH+04] (*see Figure*). The described system had the portability of an audio guide, but due to position recognition the PDA would

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1 Daguerre is a scene painter and stage designer by trade. He also is the inventor of the first photographic process called daguerreotypy

always present the current exhibit. The system could replace common audio guides and immobile information terminals all together. In addition, it still was able to give predefined tours depending on the user's interests.

Yet another chapter was opened, when the internet and wireless communication were introduced. Museums began to also maintain websites. Burgard et al. went a step further, included robotics and build an autonomous tour-guide robot called *RHINO*. It was able to navigate through the museum freely and without bumping into visitors. On demand, RHINO worked as an information terminal for present visitors and it could be used as a tour-guide as well, because it had a simple build-in web interface. Thus, the museum's contents where simultaneously used by the website and the robotic tour-guide. RHINO was deployed at the *Deutsches Museum Bonn* in 1998.

In 2002, a group from the *University of Limmerick* made a survey in *Hunt Museum*. The museum is owned and run by the Hunt-family. Its tradition is to involve the visitors since its early days. Therefor, they had so-called *cabinets of curiosity* [Cio02], special compartments within the exhibition, where additional exhibits were hidden. For example, a curious visitor had to open drawers in order to find a collection of plates. Via this exploration, the visitors became involved. Inspired by their observations, Ciolfi et al. implemented a completely new and interactive part of the exhibition in 2005 [Cio05]. Two new rooms were introduced. First, there was the *study room* with three interactive devices for getting further information about certain exhibits. They were disguised as a chest, a painting and a desk. The second room, the *room of opinion*, was plain white with plinths, on which visitors could record their interpretations of the intended function of certain exhibits. In order to manage all the data, a third and hidden room was used to host all the data-servers.

The *medien.welten*-exhibition at *Technisches Museum Wien* was not only showcasing technical devices from all eras and genres of modern media, it also invited visitors to make use of some. As Hornecker et al. described, throughout the exhibition users were given opportunities to produce their own medial content. The interfaces ranged from an abacus over a telegraph to a whole rebuild of a news-studio from an Austrian TV-channel. Visitors could not only use the devices, but store some of their produced contents in a *digital backpack* [Hor06]. This way, visitors did not only have an exciting experience, but also something to remember it by later.

3.2 Interfaces and Interaction

The only connecting link between user and system is the interface. It dictates the way of interaction and, therefore, whether the whole systems works or not. A ground breaking system is worth nothing without proper interaction between its operator and it. This presents the need for suitable kinds of input and feedback. Thus, Ben Shneiderman once introduced his *eight golden rules of interface design*:

1. Strive for consistency.

2. Enable frequent users to use shortcuts.

3. Offer informative feedback.

4. Design dialogs to yield closure.

5. Offer error prevention and simple error handling.

6. Permit easy reversal of actions.

7. Support internal locus of control.

8. Reduce short-term memory load. [Shn98]

Following this guideline should yield a well operable interface. However, there still might be particular difficulties for specialized or novel systems. Especially public user-interfaces bring new factors, which are not explicitly included in Shneiderman's rules. How should an interface behave,

- in order to invite users?

- on a user's first encounter?

- if there are multiple users?

The ideal interface should be as intuitive and naturally to use as possible. This requirement was already addressed in 1980 by Richard A. Bolt. He described the *Media Room* at Massachusetts Institute of Technology (MIT) as an office with a chair, a wall-sized screen and other analogue or electronic installations. The room's equipment allowed the user to navigate through the *Spacial Data-Management System (SDMS)* called *Dataland.* The user would sit down and had several input-devices at its disposal. One of them was

a small device that could measure its position and orientation in space. The device was used to calculate where on the big screen the user was pointing. In combination with simple voice-commands the user was able to create and manipulate geometrical primitives [Bol80].

Since then, this seemingly futuristic furnishing could not be established as a common way of interaction. Keyboard and Mouse are still the most widely used input-devices. Meanwhile, touchscreens and voice-recognition are closing the gap though. The principle of "What you see is what you get" (WYSIWYG)[1] became of ever greater importance. Many interfaces are designed with Shneiderman's rules and usability in mind. Developments in Human Computer-Interaction (HCI) seem promising. More intuitive devices and interfaces are developed and tested thoroughly.

There are basically two types of interfaces. A Single-User Interface (SUI) is designed to be operated by only one user, whereas a Multi-User Interface (MUI) can be operated by a group of users at once. However, there is no strict distinction between the two. People might look over a SUI's user's shoulder and give instructions, or a lone person could operate a MUI on its own. Another factor that influences how people use an interface is the occasion. Public interfaces, such as a kiosk system at a cinema or for photo-developing provide a GUI on a touchscreen. Those systems are intended to be used by a single user, but might also be confronted with groups. Azad et al. investigated how groups behave around such kiosks. Most groups approached the interface asynchronously. Meaning, one member is interacting with the system, while the others watch. As time passes, the rest of the group might get more active due to *intra-group communication*. They further observed, that

> there is a semantic, profound difference between pointing and touching. Users who point are communicating ideas within a social group and may not want the technology to treat it as input. [ARHL11]

Moreover, inter-group communication is also of great importance. Shyness or frustration may inhibit an individual or group from interacting with a system. Other, strange people

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1 WYSIWYG first came up in the 1970s, when the first office-programs appeared. Due to different resolution-densities of displays and printers, it was necessary to show correct relations of letters and page. Later on, the term was synonymously used for Graphical User Interface (GUI)-elements.

can ease the use, when the act as an example or explain their actions to those shy or frustrated [HF14].

Interfaces can not only be categorized by their intended demographics. Input- and output-devices dictate the kind of interaction. As mentioned earlier, keyboard and mouse are being replaced with novel technologies. Touchscreens and voice recognition have become an established device as well. Moreover, all kinds of novel approaches towards interaction are made and demanded for novel possibilities in technology.

Eingabemethoden - Novel Interaction Techniques

- Tangible interaction [UIJ05]

- VR-interaction [AA13]

- Interactive Museum Exhibits [FB00]

3.3 Goal

Annotations

- **Why?**
  "Unfortunately, current user interfaces often lack adequate support for 3D interactions: 2D desktop systems are limited in cases where natural interaction with 3D content is required, and 3D user interfaces consisting of stereoscopic projections and tracked input devices are rarely adopted by ordinary users. The success, both in research and commercial applications, of recent touch-based interfaces raise an interesting possibility. Can the immediacy, control, and expressiveness of recent touch-based natural interfaces be applied to 3D problems?" [SKK$^+$13]

- **What?**
  "Freehand Selection Gesture Pointing" [RO13]
  "SMSlingshot DIY" [FHZ13]
  "Shared Encounters" [FH12]

4 Partnering process

The very first step after having the idea of introducing a new way for information to be retrieved in public places, was to find a partner to realize it with. In order to find the most promising and possible cooperation, decision properties would have to be defined and considered for each institution before partnering with any of them. Afterward, a suitable exhibit, and an agreement on a design for the installation would be found.

4.1 Requirement analysis

To determine the ideal partner for a cooperation, a mutual beneficial system of needs and demand had to be established. Therefor, each party's needs and offerings were identified. As Table 4.1 shows, three major criteria were determined. Possible cooperations would be composed on those criteria. In addition, special characteristics would be considered as well.

	Museum	**Me**
Needs	Improvement / Innovation	Access to a public space with exhibits and visitors
	New group of visitors	Authentic content
	Publicity / Awareness	Potential test subjects
Offerings	A public space	Technological expertise
	Factual expertise	Development and testing
	Resources	Motivation

Table 4.1: Needs and Demand.

Museums want to get people interested in their respective topics. Thus, reaching more people and raising awareness is one of their main interests. A good way to attract new groups of visitors is to offer something unique and innovative. Although there are

companies offering services like guide- or information-systems, they are either cosmetic, expensive or high-maintenance. On the other hand, a museum has valuable offerings. Usually, they have a budget for renovation and improvements. The staff is highly skilled and experienced concerning the exhibits and visitors' behavior around them. Finally, a museum offers a public space, where a system can be tested under natural conditions.

The Bauhaus-Universität or rather its chair of HCI and I wanted the final system to work in a real-life environment, but not as a lab-study alone. Hence, we needed access to a public place in order to reach a broad variety of people. Those would be unbiased toward the nature of interaction and content as well. Meanwhile, we could provide our knowledge of interaction design and the suitability of contemplable technologies. And lastly, I was highly motivated to develop a working system.

After finding a cooperation partner, a FSD would be made, which includes the system's properties ordered by necessity. In addition, a contract between all parties would be drawn up to register each party's contributions and obligations.

4.2 Potential partner museums

According to Museumsverband Thüringen (MVT) [Mus14b], there are a lot of museums in and around Weimar. More than 50 are listed within a distance of a few kilometers. Table 4.2 only shows museums registered at the MVT and the three towns with the most of them. Other towns have between one and six registered museums. Further, it is most likely that there are more museums than those in this list. It provides a good point to start from, though.

Town	Museums
Weimar	26
Erfurt	12
Jena	12

Table 4.2: Museums in and around Weimar.

Regarding the high amount of museums in Weimar alone, it seemed logical to start looking for a suitable cooperation partner right here. Since 26 museums are too many to investigate thoroughly, a preselection had to be made. In the first step, the focus

was on flexibility. This meant, only a small administrative apparatus could guarantee fast decisions and less organizational meetings with boards and other decision makers. Hence, all the *Klassikstiftung*'s museums were crossed of the list, narrowing it down to only 10 remaining candidates. Next, and after some further research, museums with less interesting topics or inconvenient concepts were withdrawn. This included the tiny *umbrella museum* and *Weimar Haus*, a place glutted with animatronics. Afterward, the list of candidates was down to five (see Table 4.3). A personal visit to each of these museums was indispensable now.

Museum
Deutsches Bienenmuseum
Kirms-Krakow-Haus
Museum für Ur- und Frühgeschichte Thüringens
Palais Schradt
Pavillon Presse

Table 4.3: Remaining cooperation candidates.

Gathering impressions in person was a process of three stages. In the first stage, I would visit a museum and note its technical and pedagogical equipment, directly followed by the next stage. The first, informal introduction to some of the staff was more or less a chat about my ambitions and the respective persons' attitude towards them. The final stage was a formal introduction-meeting between my professor, me and the administrative staff of each museum, that had expressed serious interest. This serious interest wasn't shown by the Kirms-Krakow-Haus and the Pavillon Presse. Hence, the aforementioned meeting only took place at the Deutsche Bienenmuseum, Museum für Ur- und Frühgeschichte Thüringens and Palais Schardt. We introduced ourselves at each venue, because a discussion about what might be done was more efficient directly on site.

4.3 Decision for a partner museum

A formal introduction-meeting went as follows. First, I explained some of my previous projects, related installations in other museums and the general intent of the professor's chair. Next, the staff explained their museum's concept and which subject area they

would like to emphasize. After that, we discussed potential concepts. Those ranged from augmentations of existing exhibits to completely new installations.

Deutsches Bienenmuseum   The museum is run by the beekeepers association of Thuringia. The staff we encountered were very skilled with the craft of beekeeping, but less professional concerning museum education and design. They listened to my remarks and we had an inspiring discussion about potential topics and their feasibility. Unfortunately, the assosiation's chairman and us could not agree on a project. Also, because bees hibernate, attendances are seasonal and also fluctuant. Hence, the Deuschte Bienenmuseum was out of the picture.

Palais Schardt   This venue is owned by a family, which exhibits multiple collections of art and crafts as well as the building itself. In addition, they operate a cafe and use the adjacent hall for events. The husband is a restorer by trade and gives talks about the building and its historic significance, while his wife handles planning and the cafe. Events are regular and the cafe supplies casual customers and visitors. Both were very interested in a cooperation and had some ideas for installations. But the monument protection of the building and minor financial issues complicated feasibility. Therefor, Palais Schardt also had to go.

Museum für Ur- und Frühgeschichte Thüringens   Since the state office for preservation of historical monuments and archaeoligy of Thuringia is the bearer of the museum, all personnel is very competent at their field of work. In addition, the museum employs special staff, that maintains the exhibition, gives tours and is present for arising topical questions during opening hours. Classes of 5th and 6th grade visit regularly for field trips as well as visitors from all age groups. The exhibition was already altered by several media installations. Moreover, the director was very ambitious from the first meeting and had several ideas, of which exhibits to emphasize.

Summarizing, the Deutsche Bienenmuseum and Palais Schardt were deemed less interesting and lacking feasability. The Museum für Ur- und Frühgeschichte was chosen to be the cooperation partner, because it checked the most boxes of the previous Requirement Analysis (see Chapter 4.1), while the others lagged at least once in the *Needs*- or

Offerings-category. It was the most professional and ambitious candidate with promising resources and conditions.

5 Conception

After the *Museum für Ur- und Frühgeschichte Thürigens* was chosen as a partner, all previous ideas had to be analyzed more thoroughly with feasibility in mind. Thus, impractical and too complex or too simple ideas were eliminated in two rounds of review. At first, vague ideas were either improved or discarded. Hence, a screen displaying only information about a fossilized fireplace was eliminated. The idea of a system for digitizing stone carvings was considered too complex to realize and therefor discarded as well. Afterward, some of the museum's staff and I looked at the contents, that could be provided for the remaining candidates. This left us with two remaining possibilities, that were promising enough from an educational and a technical standpoint. The first one was the reproduction of the *Fürstengrab von Haßleben*, which contains replicas and original findings from a 1700 year old grave of a teutonic princess. A close second was a workshop, which should have shown how archeologists and preparateurs work behind the scenes of a museum. Here, the latter consisted of too many single parts and a lot of questions remained unanswered.

According to the aforementioned review, the Fürstengrab von Haßleben was most promising and therefore chosen in the end. It contains many special relics from ordinary, teutonic pottery to rare, roman coins and jewelry. This apparent eclecticism is, what makes the grave so special though. It is a sublime showcase for thriving trade and cultural exchange between Teutons and Romans as far east as Thuringia. Further, it proves how Teutons began adapting roman traditions, such as burials. In order to emphasize this insight, an interactive system was to be developed.

5.1 System design

The final system was developed and tested by me, while the museum-staff will be responsible for future maintenance. Some visitors might not have proper technical experiences

to operate a contemporary interface. Consequently, it was crucial to design the system with that in mind. It had to be operable by absolute lay persons, who have no prior experience concerning information technologies. Hence, the interface had to be intuitive. Three major points had to be considered.

First, established and common input devices, such as a mouse and keyboard, had to be replaced by something different. In order to be intuitive, the interaction was designed to capture and use the natural behavior of visitors. Outputs, on the other hand, had to be as discreet and as conservative as possible to not disturb or interfere with the exhibition. Thus, invasive technologies such as speakers and animatronics were excluded from the beginning. This consideration only left visual and haptic channels for output. The third point was, that daily operations at the museum were not to be compromised. So, it was not possible to develop the prototype inside the Haßleben-showcase itself and a full-size mockup had to be build somewhere else. Therefore, I measured the showcase and organized for a room, in which the mockup could be placed for the prototypes implementation and testing[1].

5.2 Constraints

Annotations

- Technical

- From the museums perspective

  - Size

  - Cost

  - Inclusion

- Limitations of hard- and software

- Capabilities of a single programmer (me)

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1   For further description of the lab-setup see chapter 7.1

5.3 Final concept

Annotations

- 'Pflichtenheft'-criteria
    - Must
        - *
    - Should
        - *
    - Could
        - *
    - See appendix
- Contract
    - MUFT, BUW and me
    - Avoid misconceptions
    - Commitments / Obligations
    - Responsibilities
    - Boundaries
    - Legal stuff
    - See appendix

5.4 Testing

Annotations

- Test of pointing accuracy

  1. One centered Point I

     – Only Pointing

     – *Images and sketches*

     – *Data and Statistics*

     – results and conlusion

     – See appendix

  2. One centered Point II

     – Pointing, Aiming and Combined

     – *Images and sketches*

     – *Data and Statistics*

     – results and conlusion

     – See appendix

  3. Four Points on each corner of the plane

     – Classification of combined values

     – *Images and sketches*

     – *Data and Statistics*

     – results and conlusion

     – See appendix

- Development of algorithms for eye-hand mismatch (elbow/hand + head/hand)

  – Description of Eye-Hand Mismatch [ref]

- *Sketches of classification*

- Test of algorithm's accuracy

  - Target = '90 percent of all values within a 10cm radius of mean value'

  - Differentiation between real and virtual point

  - Necessity of 1:1-mapping of real and virtual point

6 Implementation

The IMI-system consists of two main parts. First, the hardware part involves the physical tracking and computing of its data in the background. Second, the software part, which includes the IMI-libraries and IMI-softwares utilizing them, provides the **UI!** (**UI!**)s.

6.1 Interactive Museum Installation - Libraries

Annotations

- 'What are the libraries?'
    - Overview
    - Structure of Exhibition and Exhibits
- 'What does each one do?'
    - Modularity
    - Config-files (XML)
    - Particular methods (Lotfußpunkte, Ebenenschnittpunkt, DataLogger etc.)

6.2 Interactive Museum Installation - Administration-software

Annotations

- 'What is the administration-software?'
    - Define and edit exhibitions
        * ExhibitionPlane

  - ∗ Define, load and remove Exhibits

  - ∗ Define and change UserPosition

  - ∗ Edit dwelltimes

  - ∗ Load Background(s)

 – Define and edit exhibits

  - ∗ Define and change Position

  - ∗ Load and remove Images

  - ∗ Write and load Description (up to 310 charcters)

- 'What does it do?'

 – *Sequences*

 – Paper-mockup

 – Create (re-)loadable Config-files

6.3 Interactive Museum Installation - Presentation-software

Annotations

- 'What is the presentation-software?'

 – Display information of previously defined interactive exhibits

 – Overview-map of ExhibitionPlane

 – Feedback of exhibits' positions and pointing position

 – Description (Readability, Sehwinkel) and Images as slide show

- 'What does it do?'

 – Check for Exhibition

 – Pre-calculate Lookup for exhibit-selection (saves processing power)

– Recognize visitors

– Identify user by predefined UserPosition

6.4 Interactive Museum Installation - Presentation-remote

Annotations

- 'What is the presentation-remote?'

    – Microsoft Gadgeteer-Device

    – Bluetooth / WiFi-connection to PC

    – For lecturers in order to explain exhibits themselves

- 'What does it do?'

    – Automatically connect to Presentation-software

    – Toggle Presentation-software's blindness

6.5 Interactive Museum Installation - Statistics-tool

Annotations

- 'What is the statistics-tool and what does it do?'

    – Small tool to evaluate logged user-data

    – Statistics, such as average length of stay/session, exhibits chosen and how many transitions

7 Setups and Hardware

Three installations were build. One lab-setup for development, one makeshift setup was placed in the faculties lobby, and the final one was installed inside the showcase in Museum für Ur- und Frühgeschichte Thüringens. The various setups differed more or less in dimensions and were run with different hardwares. Early tests were conducted with the lab-setup. The lobby-setup was used for a stress-test during an open door-event at the faculty, whereas the final evaluation took place in the museum. Then, only the presentation-software was tested.

7.1 Lab-setup

A special lab had to be found and equipped with all necessary Hardware. The Hardware was lend to me by multiple sources of the faculty, while the museum's carpenter made a pedestal consisting of a surface and feet. The surface is made out of four 9mm-press boards. The feet seemed to unstable and thus were replaced with one desk rack for each board.

7.2 Lobby-setup

After some technical difficulties with the museum-setup, the first test under aggravated conditions was conducted during *Summæry*[1]. Therefore, I build a makeshift setup in the facultie's lobby. It consisted of three tables forming the exhibition plane and a bar table, on which the computer and a tripod with the sensor on top were positioned. There were

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1   Summæry is an open door-event at the faculty of media, where all chairs present their work throughout the faculty-buildings.

three targets - a candy bar, a stack of coins, and a stack of fliers - lying on the plane
(*see Figure*).

7.3 Final museum-setup

- Automatic boot at 8:30am [Bios]

- Runnging

- Logfiles for each *Session-Event*

    - Start Session: User in interaction zone (Exhibition.UserPosition +/- Threshold from SessionHandler := 250mm)

    - New Target: User pointing at a target

    - Target Selected: Dwelltime (Exhibition.SelectionTime := 700ms) starts slide show for selected target

    - End Session: User leaves interaction zone

- Automatic shutdown at 4:45pm [Software]

8 Evaluation

Annotations

- Pre- and postcondition of exhibition
- Survey of visitors' behavior prior to system's installation and afterwards
  - Interaction between visitors
  - Interaction with display
  - **LOS!** (**LOS!**)
  - Interviews
  - Evaluation-Forms

9 Discussuion

Annotations

- Conclusions

  - Comparison to Conception

  - Comparison to 'Pflichtenheft' see *Ref: Appendix*

- Anecdotes

  - Very short short-time memory $\rightarrow$ Instruction-sticker

  - Misconception of screen an a simple video and no interaction

  - Inhibitional factors (shyness, frustration, being watched)

10 Future Work

Annotations

- My work in relation to situation described in chapters 2 and **??**

- Outlook of possible further developments or optimizations of the system

    - Multi-user

    - Mobile devices

    - Audio

    - 3-dimensional positioning of objects and users

    - different possibilities of feedback

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