

Bauhaus-Universität Weimar
Faculty of Media
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Can't touch this - A Prototype for Public Pointing Interaction

Master Thesis

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Abbreviations

1 Abstract

Annotations

- Exciting summary
- Create interest

Old version

Three dimensional (3D) graphics are a common sight in modern media, while two dimensional techniques are widely used for interaction. In virtual reality, several 3D devices are used to navigate and manipulate the virtual contents. Nevertheless, they are often not easy to use or error prone. At the same time, home entertainment systems (i.e. Kinect) can be operated with simple hand gestures. Hence, a novel interaction prototype has been developed as an interactive museum information (IMI)-system. Here, users are tracked with an ASUS Xtion-motion sensor. Gestures can be analyzed using the OpenNI framework. By simply pointing at it, a user then describes ones interest in a specific exhibit and the software will provide further information regarding the exhibit. The IMI-System is a low cost and maintenance system. Thus, the museum's staff defines and edits the objects of interest and the corresponding information themselves.

2 Introduction

Annotations

- Short overview, about what has been build
- Summary
- System of libraries for pointing interaction
- Information system (Information On Demand)
- 'Uncharted territory' → technical focus
- Template solution / 'just a proof of concept'
- Motivation
- Working within the confines of museums respectively public installations

3 Related Work

Annotations

- Backgrounds
 - Historical
 - Technical
- Application areas
- Not to much detail
- Only in respect to the thesis' topic

3.1 Museums

Annotations

- Historical evolution
 - Museums are believed to be old fashioned
 - Mostly willing to experiment (Examples)
 - * Dioramas
 - * ...
 - * Animatronics
 - * Robotics

Old version

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

It may have started with simple mechanics, which moved some models, and later included basic electronics, which illuminated particular exhibits. Microchips and computers became more and more popular and affordable. So, the next step was immanent. There were info-terminals (...) Yet another chapter was opened, when the internet and wireless communication were introduced. Burgard et al. build an autonomous tour-guide robot called RHINO. It was able to navigate through the museum freely without bumping into visitors. RHINO could be used as a tour-guide for present visitors as well as for visitors on the internet, for it had a simple build-in and a web interface [Bur98]. RHINO was deployed at the “Deutsches Museum Bonn” in 1998.

In 2002, a group from the University of Limerick made a survey in the Hunt Museum. The museum is owned and run by the Hunt family, whose tradition it was from the beginning to involve the visitors. Therefore, they had so-called cabinets of curiosity [Cio02], special compartments within the exhibition, where additional exhibits were hidden. For example, one 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. Two new rooms were introduced. First, there was a 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 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 [Cio05].

Something about [Hor06].

3.2 Public single-user interfaces

Annotations

- Human behavior concerning public interfaces
 - self-service at train-stations
 - public interfaces, such as Tobias Fischer's *SMS-Schleuder für Fassaden*
 - Intuitive usage vs. inhibition

3.3 Tangible Interfaces

Annotations

- Technologies for input / interaction
- Hands-free
- Gestural interaction (Kinect)

3.4 Virtual Reality

Annotations

- Input
 - Metaphors and devices
 - * Navigation and selection in 3d space
 - * Possibilities
 - * Difficulties
 - * Constraints

4 Museums

Annotations

- Project process: Partnering
- Preselection of possible partners
- Criteria
 - Proximity
 - Flexibility
 - Open-mindedness
 - Attractiveness of theme
- 'Supply and demand'

4.1 Requirement analysis

Annotations

- 'What do we have to offer?'
- 'What do we need?'
- 'What should the museum be offering?'
- 'What does the museum want?' *better: need*

4.2 Further investigation

Annotations

- Visit preselected museums
- Getting an Overview → (Im)Possibilities
- Establish a first contact

4.3 Determination

Annotations

- Official introduction at the museum
 - Personal
 - Present requirements see 4.1
- Brainstorming
 - Museum-staff: 'Emphases'
 - Me: 'Possible solutions'

Old version

In order to finding a museum to cooperate with several steps had to be made. They included getting an overview of all museums in Weimar, finding several candidates for that cooperation, scouting those candidates and getting in contact with the most promising of them, and, finally, discussing possible concepts within their exhibitions.

The first step was to find out about all the museums in Weimar and close by. So I looked them up on the website of Museumsverband Thüringen [...], where there is a list of all members with links to further information. This list included museums in Weimar, Jena and Erfurt. Some were run privately, others by a foundation or a club, and a few by a public owner. Since there was a total of fifty museums and half of them in Weimar alone, there had to be a preselection.

Hence, as the following step, only museums in Weimar were chosen. In addition, the museums run by Klassikstiftung were taken out of consideration, for the foundation seemingly being too big and too inflexible concerning innovation in their historic premises. Some very small museums were struck off the list as well. This left four candidates remaining. They were Pavillon Presse, Pallaiss Schardt, Bienenmuseum and Museum für Ur- und Frühgeschichte Thüringens.

The next step was to get some first hand experience of each of the aforementioned museums. So, I went to visit all of them. During the visit I took notes and pictures of the exhibitions. Afterward, I talked to some staff members, explained what I was about to do, and arranged an appointment for an official introduction later on.

The first visit was to the Bienenmuseum. It is run by a club of beekeepers and displays exhibits of beekeeping throughout the ages and several cultures. The exhibition is mainly conventional with vitrines and open exhibits. Moreover, they offer workshops, in which attendees learn more about bees in general, 'making' honey and even dipping our pouring candles.

Pallaiss Schardt was the second visit. It is the historical home of the Schardt family, a very influential family at the court of Sachsen-Weimar. This place is owned by the Brinkmann family and run aside a cafe with traditional pastries from that particular era. Mr. Brinkmann is giving tours around the premisses and explains the building's significance in close contact to historical events. In addition, the saloon and other rooms can be rented for festivities.

Right next to Pallaiss Schardt is Pavillon Presse. It used to be a printery and now accommodates printing presses and equipment from all ages. The museum is privately run by a foundation and volunteers. This museum was struck off the list immediately after the visit, for being too capricious to work with.

The final visit was to the Museum für Ur- und Frühgeschichte Thüringens. There, artifacts from fossils, which are millions of years old, to medieval times are exhibited. The museum was overhauled in 1999 and thus, has a modern touch already. It is owned and run by the Thüringisches Landesamt für Denkmalpflege und Archäologie.

After those field trips, I fashioned a presentation, in which I would introduce myself and previous projects I participated in. Later on in the meeting, I would show pictures of the museums in Limmerick and Vienna and explained the work, which had been done there. Finally, I prepared a short presentation of the Microsoft Gadgeteer-system and some of its capabilities. Following my presentation, the attending museum-staff, my

professor and I discussed possible deployment scenarios. During the brainstorming the museum-officials named exhibits, which could or rather should receive more attention, whilst me and my professor suggested fitting solutions or explained further technological possibilities.

At Palais Schardt, the owners were very interested in technology, but they could not imagine how and where to make use of it. The best thing we could come up with was a guided tour. Thus, I was invited to one of their soirees with classical music and a tour of the house, in order to making up my own mind. Although it was very interesting, nothing ground-breaking arose.

At Museum für Ur- und Frühgeschichte, the director was very fascinated by the demo and immediately came up with several exhibits, which seemed fitting to him. Yet, his optimism had to be reined a little. Some of the tasks he had in mind were unfortunately not realizable with the tool I have in hand.

At Bienenmuseum, there were two main topics. First, social interaction of bees. For instance, bees dance to communicate the direction of plenty resources. Second, bees' perception of their environment. Bees see in another spectrum than we do and they can smell a lot better than us. In the end of our meeting, we were discussing about a virtual bee hive. This installation would be able to simulate the behavior of a bee colony according to some certain inputs, which could be made by visitors.

The final decisions were made after working out several key criteria for the best possible cooperation. Those were common criteria every museum could or could not meet and special criteria, which could also tip the scales. Three common criteria were identified. First of all, the amount and age of visitors was very important. Since the prototype had to be evaluated, a sufficient number of potential test subjects with a certain grade of affinity for technology would be needed. Second and not much less important, was the size and quality of the staff. If there was no expert of the museum's subject, who was able to work together with me, the project would be a fail. The third criteria was plainly budget. At some point, additional electronics and/or other equipment would be necessary. The special criteria more or less had an influence on the aforementioned main criteria. For example, monument protection, seasons, and motivation were some of them. First, Bienenmuseum had to go, because the club's chairman was not very fond of our discussions. Furthermore, the staff was not particularly professional and seemed to run the museum more as a hobby. The fact, that the museum has a large variety of visitors was a big plus, which was neutralized with the other fact, that bees are seasonal,

and so are the according numbers of visitors. This makes an evaluation rather difficult, for not providing a constant number of test subjects.

Finally, Pallais Schardt was struck from the list. Although, its owner was a restorer by trade, very approachable, and there were lots of events at the cafe, it had some corresponding cons as well. The building and its historic role was very interesting, yet is a landmark. Thus, it must not be altered in any form, which might prove hard later on. The many people visiting the cafe are mostly 50 years and older. Hence, their abilities to understand and use technology as intended could be too much a risk during evaluation. Sadly, it is just a cafe and not a museum.

The last item on the list is the Museum für Ur- und Frühgeschichte Thüringens. The major con was the planned exhibition, which leaves not much space for alterations. But, it is controlled by regional authorities. Hence, there is a budget for innovation projects. Moreover, the staff at the museum is interested in innovation and highly qualified in their field of expertise.

5 Conception

Annotations

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5.1 System design

Annotations

- User perspective
 - Visitor
 - Curator / staff
- System view
- Development of ideas according to the plan
 - Method of elimination
 - Feasibility
 - * Effort
 - * Cost

5.2 Design options

Annotations

- Possibilities of hard- and software
- Capabilities of a single programmer (me)

5.3 Constraints

Annotations

- Technical
- From the museums perspective
 - Size
 - Cost
 - Inclusion
- Limitations of hard- and software
- Capabilities of a single programmer (me)

5.4 Final concept

Annotations

- 'Pflichtenheft'-criteria
 - Must
 - Should
 - Could
- Contract between MUFT, BUW and me

5.5 Testing

Annotations

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

Annotations

- Explanation of functionalities
- Diagrams
 - Classes
 - Sequences
- Sketches

6.1 Interactive Museum Installation - Libraries

Annotations

- 'What are the libraries?'
- 'What does each one do?'

6.2 Interactive Museum Installation - Administration-software

Annotations

- 'What is the administration-software?'
- 'What does it do?'

6.3 Interactive Museum Installation - Presentation-software

Annotations

- 'What is the presentation-software?'
- 'What does it do?'

6.4 Interactive Museum Installation - Presentation-remote

Annotations

- 'What is the presentation-remote?'
- 'What does it do?'

6.5 Interactive Museum Installation - Statistics-tool

Annotations

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

7 Installation

Annotations

- Current State
 - Comparing Lab- and Summaery-setup
 - Documentation of system's installation

7.1 Lab-setup

Something about the Lab- and Summaery-setups...

7.2 Final museum-setup

Something about the final setup in the museum...

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
 - Length of stay (LOS)
 - Interview
 - Evaluation-Form

9 Discussuion

Annotations

- Conclusions
 - Comparison to Conception
 - Comparison to 'Pflichtenheft'

10 Future Work

Annotations

- My work in relation to situation described in chapters 2 and 3
- 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

Bibliography

- [BR05] Mihir Bellare and Phillip Rogaway. Introduction to modern cryptography. In *UCSD CSE 207 Course Notes*, 2005.
- [BR06] Mihir Bellare and Phillip Rogaway. The security of triple encryption and a framework for code-based game-playing proofs. In *EUROCRYPT*, pages 409–426, 2006.
- [Tan11] Till Tantau. The one-time pad algorithm - the simplest and most secure way to keep secrets. In *Algorithms Unplugged*, pages 141–146. 2011.

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.

Michael Pannier