Exploring Exhibits: Interactive Methods for Enriching Cultural Heritage Items

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Abstract
The amount of information that is available for each object in museums is unlimited. Curators choose the most appropriate chunks of information when creating exhibitions with regards to the storyline. However, these chunks do not necessarily fit the desires and expectations of visitors due to the heterogeneity of this group. Another challenge curators face is that some parts of exhibits may have been destroyed or lost their coloring. To tackle these challenges, we present two concepts that allow to explore the exhibits in detail. These concepts are called *Point. Explore. Learn.* and *Interactive Torch*. Both concepts allow visitors to explore parts of the exhibits or background information that are from particular interest for them.

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Introduction

One main challenge in designing exhibitions is selecting the information about the object that fits into the exhibition's context [7]. In many cases, the amount of information is too large to communicate to visitors in a classical way using signs and displays. Therefore, the information needs to be adopted to the likes and dislikes of visitors. Some visitors, for example, are interested in information about the former owner whereas others are interested in the fabrication process. Another challenge curators are faced with is that many exhibits are partly destroyed, lost their coloring, or are taken out of their context. However, these information are mostly interesting and highly relevant for visitors. An ancient cave painting, for example, is often partly broken and the colors bleached out. Our approach to tackle these challenges is to create interactive exhibits that allow visitors exploring them and, thereby, revealing information with regards to the visitors likes and dislikes. The cave painting, for instance, can be recolored and the missing parts (digitally) reconstructed.

Interactive installations in museums have been explored in a variety of projects in order to increase users' engagement. However, the focus mostly lies on using touch enabled surfaces. Grammenos et al. [4] present a digital catalog, called Panoptes. Visitors can browse through the various exhibits that are displayed on a touch screen. Furthermore, they develop *Polyapton*, a wall sized display showing an ancient greek painting. Visitors can explore this painting to gain background information. Additionally, they can use a physical magnifying glass to digitally magnify content. Exploring the secrets of museums in terms of their storage facilities is investigated by O'shea in the *Out of Bounds* installation[1]. Visitors use a torch that allows looking through a wall and giving insights into how it looks there. The *PaperView* system of Grammenos et al. [3] projects context sensitive information on regular sheets of paper. Depending on where the papers are placed, additional context-dependent details are projected onto this paper. The *Unbuilt Ruins* installation by Sparacino et al. allows users to explore large building or ruins by interacting with a projected groundplan [9]. As soon as users interact with the plan by placing a tangible on it, four $3x3\,m$ projections show how the building would look like when the users would stand at this position. Hornecker [5] explores how visitors interact with a multi-touch table located in the Berlin Museum of Natural History. She shows that although most visitors enjoyed the interactive installation, the actual gain of knowledge was very limited. Users seem to be more concerned with the handling of the table than the actual content that was displayed. Sensors are explored as more sophisticated interaction techniques (e.g., waving) by Campos et al. in [2]. However, since prototyping has become easier [6], we see that many new prototypes may find their way into exhibitions.

In contrast, we focus on exploratory interaction techniques that use more natural interaction techniques. In this paper, we introduce two different concepts to explore exhibits in the museum concept. First, the *Point. Explore. Learn.* concept that tracks the users finger when pointing at the exhibits and reveals information depending on the pointing position (e.g., the original coloring). Second, the *Interactive Torch* concept that uses a physical torch revealing background information by digitally illuminating specific parts of the exhibit. Both concepts strive to allow the user to get further information about an exhibit of interest by interacting with it in a playful way.

[1] Out of Bounds - www.chrisoshea.org/out-of-bounds

Figure 1: By pointing at an exhibit, the user is able to explore the part pointing at in more detail.

Figure 2: A 3D Model of the object is used to calculate the point of intersection.

Point. Explore. Learn.

The *Point. Explore. Learn.* concept tracks the user's finger while pointing at an exhibit. Thus, people can explore an exhibit by simply pointing at it (cf., Figure 1). This concept can be used to enrich the exhibit in a variety of ways. We elaborate three different approaches of enriching objects with this concept.

Point & Zoom
The finger acts as a virtual camera navigating through the scene. On a screen next to the object, a high resolution image or virtual model of the object is shown. The user can change the perspective by pointing at different parts of the object. By moving the finger a little bit towards the exhibit, the user can zoom-in to see more details and, likewise, zoom-out by moving the finger further away.

Reconstruct
If, for instance, the original object is damaged and partly broken, the original coloring is interesting for visitors. In this approach, the virtual model reflects the original shape with the original coloring and texture of the object. This way, visitors can imagine how the exhibit used to look like at specific parts depending on where they are pointing at. Furthermore, if the object's original location is of particular interest, the surroundings of the object are shown how they used to be. A sculpture, for instance, can be embedded into a digital model of the temple where it was located.

Explore
In order to explore the exhibit in deep, additional information can be displayed on the screen or projected right onto the exhibit (e.g., the original coloring of the exhibit) depending on where the user points at. Finger gestures provide another mean of interaction. For instance, by tapping the user could switch through different modes (e.g., different reconstruction alternatives). This allows curators to provide different alternatives to those visitors that are interested without overloading the exhibition space for visitors simply enjoying the exhibition

Prototype
We developed a first prototype of the *Point. Explore. Learn.* concept. As a tool for tracking the user's finger, we use a Leap Motion[2] controller. The Leap Motion is a device that tracks the position of the fingertip and the orientation of all fingers of a user's hand. Even though all finger are traceable, the current prototype only supports a single finger to avoid ambiguity and provides the virtual position and direction a user is pointing at. We use these virtual coordinates to calculate the point of intersection between the virtual pointing and a virtual model of the exhibit (cf., Figure 2) by applying a ray casting approach. Thus, the prototype calculates the position at which the user is pointing at the virtual model. Then, we use this specific position of the model to apply the approaches to the right spot of the real world exhibit and to set the parameters of the virtual camera. In order to render the model of the exhibit, we use the MOGRE 3D framework[3].

In our prototype, we use a 3D model of the Abu Simbel rock temple in southern Egypt as a use-case (cf., Figure 2). A small replica of this temple serves as the exhibit and a 3D model that contains a reconstruction of destroyed parts is used as a model.

Interactive Torch

The *Interactive Torch* concept allows museum visitors to explore exhibits using an interaction device in the form

[2] https://www.leapmotion.com/
[3] http://www.ogre3d.org/

Figure 3: A visitor is using the torch to select a specific category he or she is interested in.

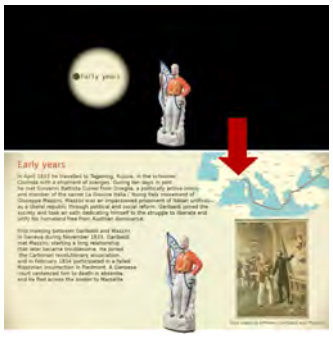

Figure 4: As soon as the visitor selects a category, further information is displayed.

factor of a torch (cf., Figure 3). This device tracks the area the user is pointing at on a display. By switching the device on, the area is digitally illuminated. The form-factor of a torch encourages visitors to use it as an exploratory tool and help to reduce the technical hurdles. We developed two approaches that are used to provide the user with further information.

Looking Back in History
Especially cultural heritage sites such as caves or bunkers have lost parts of their history (e.g., cave paintings or the furniture in bunkers). By applying the *Looking Back in History* approach, these parts can be visualized again as soon as the user points at the specific position. This can be done by using projection of the torch's spotlight. In contrast to a normal torch, the spotlight does not only illuminate the environment but also projects the content on the surfaces (e.g., the painting on the cave's wall).

Explore Background Information
Many exhibits such as sculptures nowadays shown in museums have a huge history that contains information from different categories. For instance, information about the sculpture regarding the artist, the places the sculpture was built and traveled over time, or about the purpose of the sculpture can be shown. To achieve this, the categories of interest are shown next to the object (cf., Figure 4, top). As soon as the user switches on the torch while pointing at one of the categories, the respective information is shown (cf., Figure 4, bottom).

Prototype
We built a first prototype of the *Interactive Torch*. The system consists of a visualization, the torch itself, and a server. We use either a display or projection to visualize the information. On the bottom of the visualization, two Infrared-LEDs are placed. These LEDs can be traced by the Wii controller[4] that is built inside of the torch. The controller sends the position of the LEDs to the server that uses this position to calculate the position the user is pointing at. The server manages the visualization and switches the displayed content with regards to the pointing position.

As a use-case, we use the history of Giuseppe Garibaldi, a famous Italian guerilla fighter. We collected information about his live, death, marriage, and the wars he was fighting in that were shown as soon as the user points at the specific caption (cf., Figure 4).

Conclusion and Future Work

In this paper, we present two concepts for exploring exhibits in museums or other cultural heritage sites, namely, *Point. Explore. Learn.* and *Interactive Torch*. These concepts help to explore exhibits in a rather playful and exploratory way. The *Point. Explore. Learn.* allows visitors who want to know how items have looked like in the past to explore the original form of the exhibit. On the other hand, the *Interactive Torch* is designed to allow visitors to chose which categories of information they want. Visitors who are rather interested in the artist can focus on this information whereas visitors interested in the purpose of the exhibit (e.g., ancient tools) can gain these information, too.

For each general concept, we defined more practical approaches to realize the concept and developed one prototype for each of them. These prototypes are fully functional and we will test them in a field study in a museum in the near future. We strive to gain information about how visitors like the exploratory interaction style as

[4] http://www.nintendo.com/wii/what-is-wii/#/controls

well as how visitors interact with the prototypes. Furthermore, we are interested in how these tools help to increase the memorability of the specific objects. As related work from other domains suggest (cf., [1, 8]), the memorability can be increased by interacting with content.

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