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Poster

A Projection-Based Augmented Reality Setup for Blended Museum Experiences

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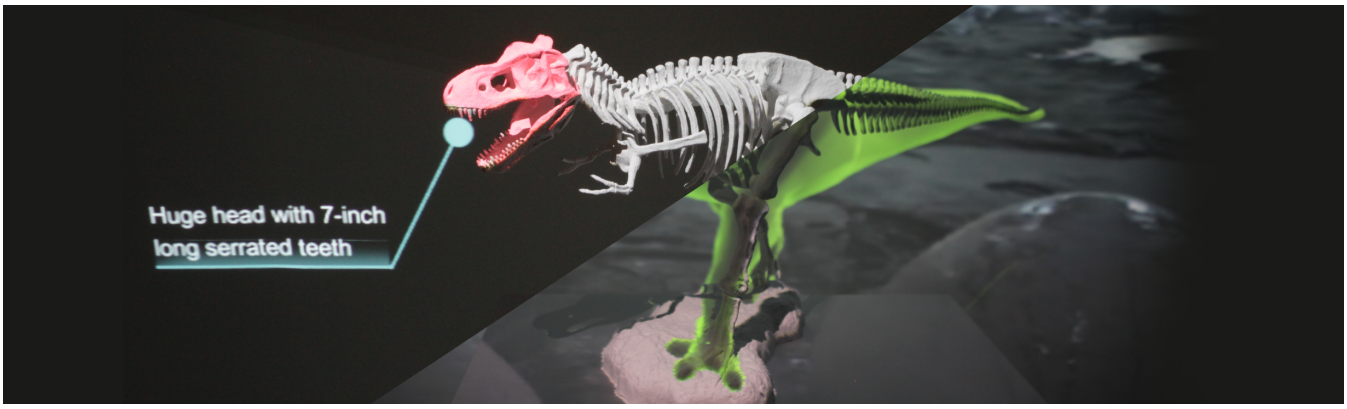

Figure 1: *Two views of a physical skeleton that is augmented with virtual information (captured without post processing).*

Abstract

Most traditional museums still rely on physical artifacts since their authenticity and uniqueness foster an emotional engagement with the objects themselves and the stories they are supposed to tell the visitor. However, the context of the exhibition space makes it difficult to vividly present information that are closely related to the origin of the artifact. In this regard, we propose a 3D projection-based augmented reality setup, which keeps the focus on a physical exhibit and at the same time allows visitors to seamlessly switch to virtual representations of the exhibit's original appearance and context.

CCS Concepts

•***Human-centered computing*** → ***Mixed / augmented reality;*** •***Applied computing*** → *Interactive learning environments;*

1. Introduction

While our world gets more virtual every day, there are fields where real objects still take on an essential role. Several surveys conducted by Reach Advisors revealed that meaningful experiences in museums are predominantly connected to original objects [Wil15]. An explanation of this outcome is the people's wish for authenticity as the digital revolution proceeds. While current technology allows creation of continuously improving multisensory experiences by providing visual, auditory and even haptic feedback, the emotional connection between the visitor and an exhibit gets lost. From an emotional point of view, a real stone brought from the moon will always exceed its virtual replica, even when they are indistinguishable. On the other hand, collections that only rely on original objects suffer from certain limitations. By nature, museums show objects that usually have their origin in a different time and a different place. By conveying the exhibit to the museum and its visitors, the link between the real object and its context is destroyed. Virtual information could reestablish those links by adding contextual information to the object.

On a whole, visitors still want to be able to experience the real exhibit with all its material qualities, however, they could also benefit from other views that show additional information or even overlay the physical object completely. Projection-based augmented reality environments, sometimes also referred to as spatial augmented reality (SAR) environments, could cope with these requirements as they allow the transition between different stages of the reality-virtuality continuum [BR05].

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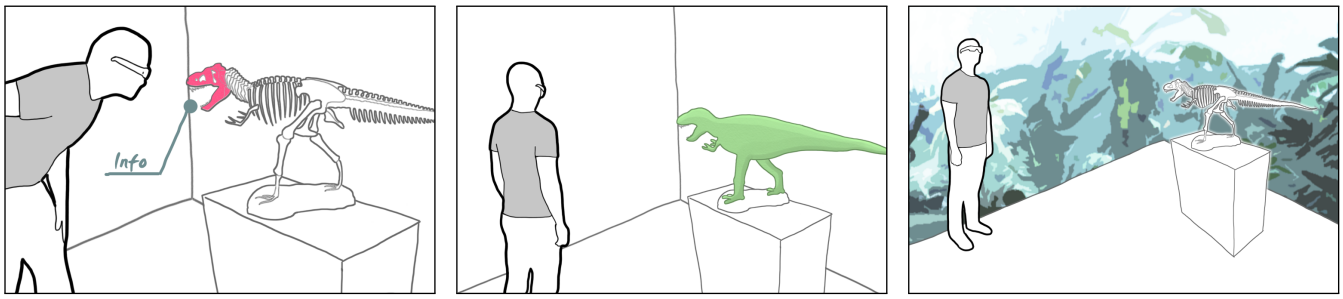

(a) (b) (c)

Figure 2: *Illustration of three different views of the same exhibit, with virtual overlays showing (a) details of the exhibit, (b) the original appearance of the exhibit, and (b) the original context of the exhibit.*

2. Setup

Starting point for our SAR environment is a low-cost CAVE, which includes three walls and the floor as projection surfaces (see Figure 3). We used a drywall installation to build a room that measures $3.15 \times 4.2 \times 2.36m$. Since only customary materials were used to build and paint the CAVE, a suitable sized room could also serve as the basis. The CAVE is equipped with four off-the-shelf Optoma projectors that are mounted on the ceiling. In order to reduce shadows to a minimum, the wall projectors are placed at a distance of around $0.8m$ in front of the walls. As our intention was to achieve perspectively correct stereoscopic projections that appear to surround the real exhibit, a tracking system was installed to measure the user's head pose. While we used a marker-based ARTTRACK2 system by A.R.T. for our setup, recently released consumer hardware as the HTC Vive tracker would be another affordable option.

Inside the final CAVE, one or multiple exhibits can be placed. Using the floor projector to illuminate the exhibits from above increases the probability of casting shadows that interfere with the projection. To avoid such shadows and increase the pixel density, we use a fifth projector that is mounted on a swiveling arm. After an initial calibration of this projector with the CAVE, the projector's pose can be tracked by the same system used for head tracking. Since the projector is not fixed to a specific position, it can be individually adapted for specific installations.

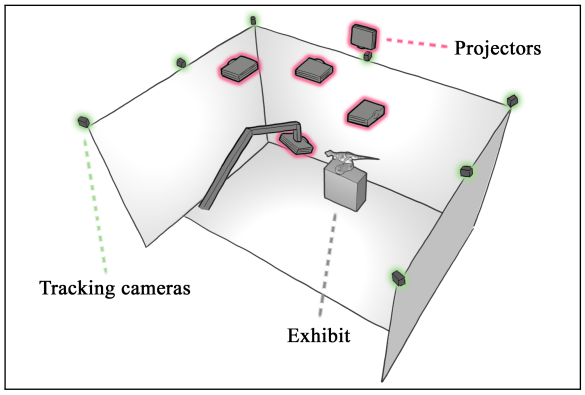

Figure 3: *SAR environment with five projectors.*

3. The Blended Museum - A Pilot Application

The pilot test of the described setup was a simulation of an exhibition scenario, with an artificial dinosaur skeleton serving as the central exhibit (see Figure 1). We collected qualitative feedback of multiple visitor groups with different background such as pupils, culture enthusiasts, and computer science students. While a few visitors mentioned the decreased immersion of the system in comparison to head-mounted display applications, the majority of users felt positive about the experience. In particular, the strong connection between the user, the virtual information and the real exhibit as well as the low threshold to enter the system were well received. Although the current demo is a single-user setup, visitors appreciated to be not isolated from their companions.

4. Future Work

In future projects, we will focus on the development of collaborative interaction concepts that allow natural transitions between different views, with regard to the special characteristics of museums. The basis for such concepts could be provided by proxemic interactions as shown in Figure 2. Ballendat et al. [BMG10] suggest different dimensions of proxemic relationships such as position, orientation, movement and identity of the user. The user's distance to the exhibit as well as his orientation and movement can provide indications on the visitor's intention and his current focus. Furthermore, different categories of museum visitors were identified in previous studies, with each group having its own unique needs and visitor patterns [Fal16]. A consideration of identity allows an individual customization of the shown content according to these categories.

References

[BMG10] BALLENDAT T., MARQUARDT N., GREENBERG S.: Proxemic Interaction: Designing for a Proximity and Orientation-Aware Environment. In *ACM International Conference on Interactive Tabletops and Surfaces* (2010), pp. 121–130. 2

[BR05] BIMBER O., RASKAR R.: *Spatial augmented reality: merging real and virtual worlds*, vol. 6. AK Peters Wellesley, MA, 2005. 1

[Fal16] FALK J. H.: *Identity and the Museum Visitor Experience*. Routledge, 2016. 2

[Wil15] WILKENING S.: Beginning to measure meaning in museum experiences. *ASTC Dimensions 17*, 3 (2015). 1