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Shy Tech Floating Tablet Computers for Interaction with XR in Museums

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Abstract

Tablet computers like the iPad are user-friendly and reliable interaction devices for displaying XR content in museums. Although they are lacking the stereo view of a VR headset, they also avoid the hygiene, optics and usability challenges of head mounted displays in public spaces.

In our paper we describe methods to improve the shortcomings of these devices: Placement, presentation and distracting branding. Our solution is a combination of a physical hanging system and custom designed acrylic cases disguising the hardware. In our example of an exhibition about a baroque architect the result is a series of floating baroque picture frames which users are grabbing and rotating to view into the XR scenes.

1. Introduction and Background

Presentation hardware for using in museums must be robust and user-friendly. At the same time, it should allow easy software development and provide sufficient hardware performance to run the software for several years. Furthermore, the devices should feature a restricted kiosk mode to prevent abuse and focus on the main application.

Current tablet computers meet these requirements. But not every museum wants to be an advertising platform for Microsoft and Apple, exhibiting the iconic logo and form factor in their spaces. And even more important is the fact that users are associate the form factor of the devices with their actual function watching videos, browsing websites and reading books. While the idea of XR storytelling in museum is to provide a kind of magic looking glass into virtual worlds from the past or the future.

With our approach we want to improve the shortcomings of current tablet computers and provide a concept for some simple enhancements resulting in a new device class (see figure 1).

We will describe the mechanics for a floating placement instead of a stand or a dock and show the disguising with acrylic to hide the actual device class and its distracting branding.

This concept we have applied in several museum exhibitions over the last years. In this paper we'll describe the in an exhibition about a baroque architect where the result is a series of floating baroque picture frames which users are grabbing and rotating in order to view into the XR scenes of the architect's working space, his tools and one of the castles bult by him.

Tablet computers have been playing a role in cultural heritage applications since the early days of surface computer development.

Figure 1: *Backside of the disguised tablet with an acrylicbaroque frame*

We could look back to larger scale surface computing like Bill Buxton's ActiveDesk or Dietz and Leigh's DiamondTouch [DL01].

However, in 2005 the technique became widely available by Jeff Han's [Han05] simple, inexpensive, and scalable technique for multi-touch sensing on rear-projected interactive surfaces based on frustrated total internal reflection LEDs. In the same year Kaltenbrunner et. al. [KBBC05] presented their reacTable including a simple protocol designed for table-top tangible user interfaces and later network enabled tablet computers.

Before the iPhone and the iPad Microsoft's UMPCs provided a glimpse of what will be possible with mobile touch devices in the next years. Within the project iTacitus [ZSBP07] the team developed AR interaction prototypes for cultural heritage sites

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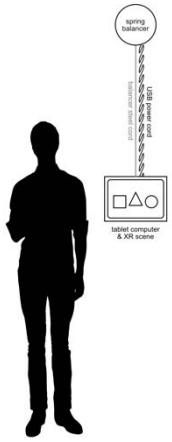

Figure 2: *Schematic drawing of the setup*

Figure 3: *User holding the acrylic case and touching the screen.*

with the so called slate PCs. Sauter et. al. [Sau08] described how to interact with these novel media devices in public spaces like museums.

Thanks to the these and other comprehensive preparatory work, today tablet computers like Apples iPads [IP224] and Microsoft Surface [MS2] are common visualization and interaction devices in museums.

2. Methodology

In the following sections we are describing our approach to enhance tablet computers in museums, the parts of our setup (see figure 2) and their functions in detail.

2.1. Shy tech

The term shy tech was in coined the in automotive user interface (UI) technology. Heijboer et al [HSTG19] introduced an interaction model which represented activities like climate control and multimedia access in the car physically by linking different tangible control elements. We are using this approach to disguise the device's original use and create a floating baroque picture frame which users are using as kind of magic looking glass into virtual worlds from the past or the future.

2.2. Tablet computers

Thanks to their simple to set up restrictive kiosk mode we chose Apple's iPads as tablet computers for our applications. With these we are able to lock the device's usage to a single application and prevent abuse my users other than application's intention.

In our projects we used different models from 9 to 12'9 inches displays and both regular and pro devices depending on the application and its performance requirements.

2.3. Spring balancer

The actual application of spring balancers lies in the industry and workshops. Cordless screwdrivers and other heavy tools are held in suspension to make work more ergonomic. The spring is adjusted to the weight of the tool so that it is held suspended in the air until the worker grabs and uses it. After it is released again it reaches back to its originate position (see figure 2).

We are using the spring balancers to let the tablet computer appear to be floating in the air waiting for the museum visitor for interacting with it. The spring is adjusted to the weight of the tablet and its case. It's resting position is defined by the height of the users: From smaller children and wheelchair users to regular sized humans. Due to the optimization of the spring to the applications weight, its resistance while pulling it down is minimal.

In our applications we used high quality balancers by FEIN Power Tools, Inc. [BL2]

2.4. Acrylic cases

The intention of our acrylic cases is to disguise the tablet computers industrial design and to fit into the storytelling of the museum exhibition. In our example we chose an abstract variant of a baroque picture frame. The material of our choice was acrylic sheets which we can cut with a laser cutter.

There are three layers of acrylic sheets: The front layer is 3mm thick with a cutout for the tablets display. The 3mm back layer with a cutout for the dissipation of the tablet's heat. The layer inbetween adapts to the depths of the respective tablet computer with a cut out channel for the USB-C power chord.

All three layers are kept together with M4 steel screws on the top and bottom of the frame. The screw in the top center also functions as mounting for the spring balancer's steel wire.

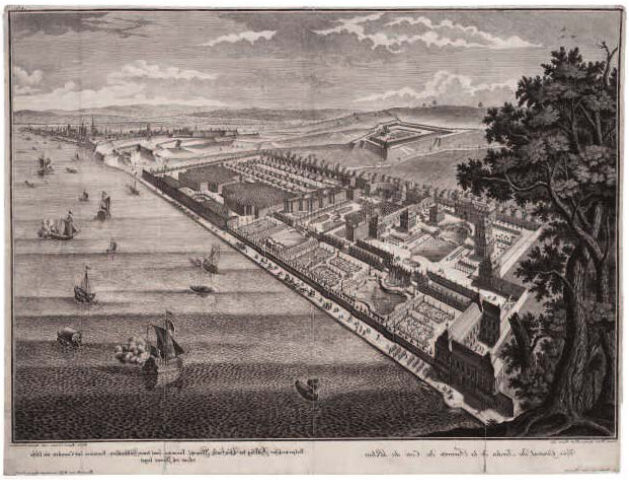

Figure 4: *The Mainz Favorite castle and gardens.*

Figure 5: *An interactive AR view through a baroque frame into the Mainz Favorite castle and gardens.*

Figure 6: *3D reconstruction of Haus Boderam's Room of the Arts from historic photographs.*

2.5. Results and discussion

The Mainz Favorite (see figure 4) surpasses the fate of the other Maximilian von Welsch's gardens: not only have the gardens disappeared, the grounds have been completely altered and crossed by a railroad line, but the palace buildings and fountains were also demolished during the siege of 1793, so that no trace remains of their original location.

This total loss of this complex is even more regrettable as the views created in 1723/24 by the Viennese architectural draughtsman and engraver Salomon Kleiner (1700-1761) have preserved the imposing overall impression of the complex.

Our team has dedicated itself to the challenge of using modern technology to recreate the pleasure palace of the Electors of Mainz for visitors to experience in the Welsch Year 2021. The aim was to convey and educate about innovative technologies and methods as tools for successful digitalization in medium-sized companies. The basic didactic concept for the Favorite is based on the interplay of innovative forms of knowledge transfer with the technical possibilities of the 21st century. The prerequisite for this was the production of a simplified architectural model of the palace and gardens using 3D printing. In a second step, this model can be explored interactively using modern augmented reality technology (see figure 5). An iPad serves as a kind of interactive picture frame, which locates the digital information on the model and thus connects the virtual space with the physical one.

For example, the views of the Favorite from Salomon Kleiner's copperplate engravings adorn the facades as digital image information and fill the footpaths in the extensive garden architecture with life. Viewers can use the AR application to find out the background to Welsch's magnificent Baroque work of art. However, the 3D reconstruction of the palace complex can not only be experienced visually, it is also designed as a tactile model with Braille, thus making a contribution to the topic of inclusion through technology.

The "Haus zum Boderam" stood on the north side of Mainz market square opposite the north side of the cathedral and was destroyed in the Second World War. Maximilian von Welsch lived there for 30 years until his death in 1745.

Only a few photographs from the 1940s exist of the "Room of the Arts" with its fireplace, alcoves and wall panels with grotesque decorations.

We have developed a three-dimensional reconstruction in order to be able to perceive the room in its original quality in the exhibition (see figure 6). Using machine learning and manual corrections in Blender, we were able to create three sides of the room with the details of the wall panels.

Visitors view the reconstruction of the Raum der Künste using an iPad integrated into a baroque frame, which hangs weightlessly in the room on a spring balancer. This allows them to move around

Figure 7: *An interactive AR view into Haus Boderam's Room of the Arts exploring the wall panels.*

the room and learn more about the details of the wall panels (see figure 7).

We developed the mentioned applications with Unity3D [UR2] using the AR Foundation [AR2] tracking capabilities. The 3D models of the Favorite was modeled in Blender and print on a large-format BigRep [LF2] 3D printer.

3. Conclusions

We documented our approach of using the shy tech method on tablet computers to hide their technological appearance in favor of a story compatible view for cultural heritage museum applications. In our example we disguised an iPad as an interactive floating baroque frame telling the stories of the architect Maximilian von Welsch. Like his buildings, parks and work environments.

This approach is a blueprint to disguise and hide technology in cultural heritage applications to improve storytelling. It can be transferred to other device classes like smart phones and XR headsets and other application areas.

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