Adjustable Halo – An Experimental Augmented Reality Art Installation

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ARea 14 workshop on Interaction and User Experience Design for Future Mixed Reality Spaces. May 12, 2014, Oulu, Finland.

Abstract
Adjustable Halo is an experimental interactive art installation that uses a camera, a projector and a gesture-based Leap Motion controller to achieve a mixed reality experience. The installation was set up in an art exhibition, where approximately 1500 users interacted with it. This paper discusses the technical implementation details of the installation and the success of the experiment when it comes to mixing augmented reality and contemporary art.

Author Keywords
Augmented Reality; Mixed Reality; Projected AR; Gesture-Based Control; Interactive Art

ACM Classification Keywords
H.5.1. Information interfaces and presentation (e.g., HCI): Multimedia Information Systems

Introduction
Adjustable Halo is an experimental interactive art installation that uses a camera, a projector and a gesture-based Leap Motion controller [1] to achieve a mixed reality experience. The idea for the art installation was sparked in a demonstration session, where several gesture-controlled applications were presented.

Experimentation

"When you start doing things with your hands, you're in direct contact with matter. This time you're not manipulating anything concrete, but a digital illusion. You are a magician, a wizard or an angel. Use your gestures to move the halo, levitate it for a while.

The installation studies interaction and the experience of seeing oneself. […] The occurrence that you are controlling is a dreamlike magical experience. The installation wants to challenge you. It experiments and larks. In art, content and form are entwined and they cannot be observed separately. The observer has an effect on the observed, while being observed."

-Ollipekka Kangas, freely translated into English [4]

Figure 1. A picture of the installation in use with visualization of the user interface. The Leap Motion controller is hidden inside the golden chalice. The webcam used for video input can be seen under the projected video screen. [3]

The idea of the installation is to create the illusion of controlling a weightless, floating halo by moving your hand. This is made possible by capturing video of the installation space with a webcam, adding 3D model data to the video and then displaying the processed video.

The manipulable object was chosen to be a halo because of several reasons. It is a geometrically simple object, meaning that it can be easily textured and rendered with a computer. Yet the object carries a deeper meaning. It is an ancient symbol of deity and holiness in many religions. It is also a part of popular culture and can be used in a humorous way. [2]

The installation was first set up in an art exhibition by the artist Ollipekka Kangas. The exhibition lasted for two months and was held in Galleria Berner, next to (and during) the Turku Christmas market at the old Great Square. This meant that the exhibition had more families visiting it compared to typical art exhibitions. A picture from the exhibition can be seen in Figure 1.

The "Gorilla Arm" Problem

The term "gorilla arm" is an old term that became known as the first touchscreens appeared to markets in the early 1980s. It describes a problem with vertical touchscreens: holding one's arms in the air for extended periods of time is very fatiguing and also becomes painful over time. Like the jargon file describes: "*[…] the operator looks like a gorilla while using the touch screen and feels like one afterwards.*" [10]

Even though the term originally became known for describing problems of touch-screens, it can – and should – be applied to controllers like Leap Motion as well. Leap Motion has the exact same problem as vertical touchscreens: to use it, you have to support your hand(s) in air and doing that for extended periods of time is very exhaustive. This severely limits the usage of the Leap Motion controller.

Gesture-Based Control

One of the most challenging areas of Augmented Reality (AR) research is the exploration of suitable user interface methods [5, 6]. AR does not offer much to the field of desktop computing. That is why developers of AR applications have to expand their view of input methods beyond the traditional mouse and keyboard setups. Mobile AR applications are usually automatically set for input with large touch screens and integrated cameras, but new input methods need to be developed for any other AR applications. Interacting with public displays is another well-known research topic on this field that struggles with the same challenges [7, 8]. The Leap Motion controller offers a new approach to both of these problems.

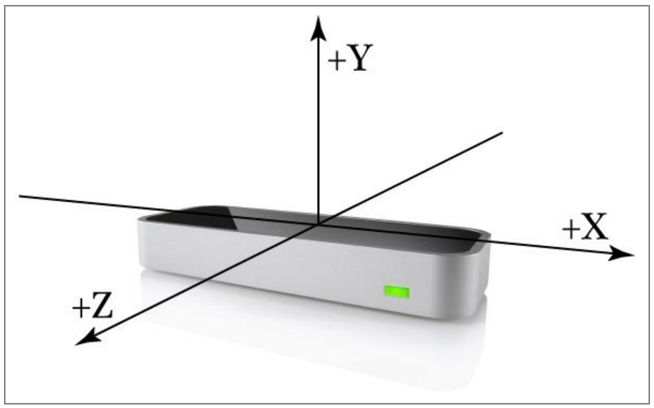

Figure 2. The Leap Motion controller, with added markers for directions in the controller's space. [9]

The basic idea of the controller is to sense the natural movement of hands in three-dimensional space and then translate that movement into data that can be used to control applications. The controller and its coordinate system can be seen in Figure 2. The compact size of the controller is the primary reason why Leap Motion was chosen. The size makes the controller very easy to hide inside another object in an exhibition.

The guiding principle of user interface design was that the functions should be easily embraced by inexperienced users. Human-controller interaction methods were tested through trial and error in several different scenarios. The most intuitive way was found to be when the position of user's hand in the controller's three-dimensional space is directly mapped to the position of the halo in the application while the rotation of one's hand is mapped to the rotation of the halo. In other words, when the halo follows the motion path of the user's hand.

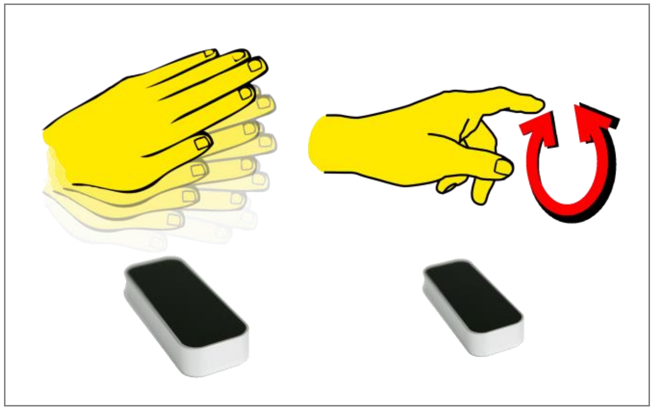

Figure 3. A picture of the instructions that were provided to users.

An additional feature was also added to change the size of the halo by either clockwise or counter-clockwise circular movement of the user's finger. There was no need to implement more features for the installation's purposes, as a more complex control scheme was only found to make the application less intuitive to use. The simplicity of the interface provided that controlling the application could be easily embraced without written instructions, albeit a small picture containing visual hints was still presented next to the controller as shown in Figure 3.

Implementation

Hardware

The hardware setup for the installation consists of a webcam, a Leap Motion controller, a projector and a computer. The webcam is used to feed live video into the application, the Leap Motion controller is used as the input device and the projector is used as the display device. The three components are connected to a computer that runs the application.

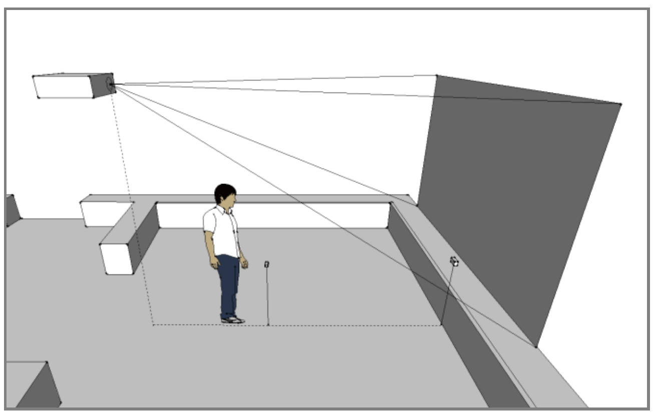

Figure 4. An illustration of the main components of the installation in the art exhibition space.

The distance between the projector and the screen was 3.5 meters, which meant that the screen had a diameter of approximately 140 inches. The Leap Motion controller was situated approximately halfway between the projector and the screen. Both the Leap Motion controller and the webcam stood at waist level (approximately 85 cm from the ground). An illustration of the installation in the art gallery can be seen in Figure 4.

Software

The software for the installation was built using Unity3D. Unity3D was selected because of the availability and flexibility of the platform: Leap Motion SDK (Software Development Kit) directly supports Unity3D [11] and combining 3D model data with live webcam video is a straightforward task in Unity3D. Most of the development time of the application was spent tweaking the user experience, i.e. how smoothly and responsively the user's gestures were transformed into the motion of the halo. Special attention was also paid to make the software as reliable as possible to minimize downtime due to maintenance.

Conclusions & Discussion

Feedback from the audience was written to a visitors' book and reactions were observed on-site. Incoming guests quickly discovered how to interact with the installation. Control of the device was not experienced as too troublesome by older users, while younger guests tended to be more curious and excited about the possibilities of interacting with the halo. Feedback given by the audience (orally or in the visitor's book) was unilaterally positive. According to the exhibition staff, the installation worked flawlessly and without any downtime through the whole exhibition. Approximately 1500 exhibition guests interacted with the installation.

The setup where a webcam fed live video that was processed and displayed with a projector was found to work very well in an art exhibition setting, enabling a visually impressive setup.

As for the motion controller, we found that Leap Motion was an almost ideal way to control an application that's set up in a public area. This was mostly due to the fact that users of the controller do not need to hold anything in hand to be able to use the controller. In addition, gesture control eliminates the need to consider hygiene aspects since the device is not in direct physical contact with the users. Special care needs to be taken to make sure that the control scheme is designed to be simple enough so that non-technophiles – i.e. older people – can still quickly adopt the "futuristic" gesture-based controls.

Acknowledgements

We thank the SensiLAB program for providing the hardware for the exhibition and for providing extensive assistance in setting up the installation. [12]

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