TELARSCOPE: A GAMEBASED TOURISTIC AUGMENTED REALITY TELESCOPE

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Keywords: Augmented Reality Telescope, Gamebased Tourism, Interaction and Exploration.

Abstract: TelARscope is a gamebased touristic augmented reality telescope. Its interaction and exploration concept is sufficient for a heterogeneous user group such as tourists. It enables not only to watch augmented content overlayed at all times statically but also to explore it completely interactively. We evaluated the telescope with 91 real tourists.

1 AUGMENTED REALITY IN TOURISM

Augmented Reality is often used in tourism. In (Fraser et al., 2004), a mixed reality system in a museum was discussed and analyzed. It is concluded that 'digital components can effectively deliver information which enriches subsequent hands-on exploration'. In (Schnädelbach et al., 2001), a tripod system was used to explore a historical site. Another project for exhibitions is (Hindmarsh et al., 2002). The first Augmented Reality telescope was the AR-Ocular XC-01 by Fraunhofer IGD (Lutz et al., 2004). GeoScope was developed at the Leibniz University of Hannover in 2006 (Brenner et al., 2006). The difference is that they used a touchscreen display. It presents geographic information to a large audience without prior knowledge or instructions. Another telescope is Timescope by ART+COM in Berlin. Users are able to watch historical material recorded at the focused location. A modified variant of Timescope is the Jurascope at the Museum of Natural History in Berlin. It enables the visitor to follow the virtual transformation of a dinosaur skeleton into a 'living' animal (Juraskope, 2007). 'One Rock' is a very informative project about Augmented Reality telescopes in public places (Reeves et al., 2005). It was developed and installed for two months during an exhibition on a large rock in Morecambe Bay. If it was pointed at a nearby bottle, a prefabricated video of microorganisms living on the rock was presented. Visitors are put under the illusion that they are zooming into the bottle to watch the microorganisms. The system was evaluated by user observations.

Augmented Reality telescopes have been used successfully in the past. These systems integrate everything needed to build a stationary Augmented Reality system. None of these projects used gamebased interaction and exploration concepts to allow an interactive exploration of the surrounding areas.

Figure 1: Usage of telARscope.

2 TELARSCOPE

Tourists explore new environments every day all over the world. How can their touristic experience be enriched and how can applications add value to their sightseeing tours? How can they be entertained in a way that improves the touristic experience and does not disturb but allow them to learn something in an intrinsically motivating way? The touristic setting only allows intrinsic motivation. Extrinsic motivation doesn't work (Stier and Grüntjens, 2011). Tourists

Grüntjens D., Arndt D., Beschorner J., Dietterle J., Epe J., Kobold P., Stüttem T. and Müller S..
TELARSCOPE: A GAMEBASED TOURISTIC AUGMENTED REALITY TELESCOPE.
DOI: 10.5220/0003827304970500
In *Proceedings of the International Conference on Computer Graphics Theory and Applications* (GRAPP-2012), pages 497-500
ISBN: 978-989-8565-02-0

want to have free time during their holidays. They do not want to work nor to learn: 'Regarding the latter, experiential processes, such as imagining, daydreams, and emotions, play an important role in vacation choice behavior' (Goossens, 2000). This lead us to gamebased interaction and exploration concepts. These concepts motivate users intrinsically and allow a positive experience in a short time period.

TelARscope is a gamebased outdoor Augmented Reality telescope exhibited at the national garden show in Koblenz 2011 which had 3.5 million visitors. It is shown in figure 1. It faces many interesting historical places: Historical bridges, a prussian fortress - Fortress Ehrenbreitstein - and some other remarkable locations. It was presented to visitors from different countries, with different spoken languages and various ages. It is designed to add value to the touristic experience by allowing an exciting exploration of the area and showing some historical interesting locations. The hardware was developed by Trivisio GmbH, Trier. The software component was developed by University of Koblenz-Landau.

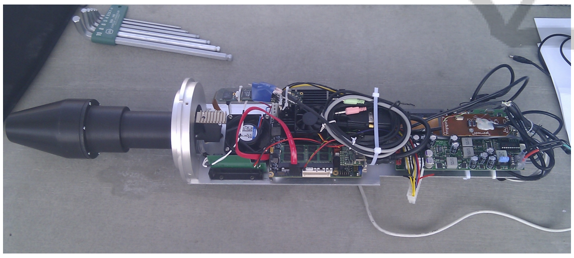

Figure 2: The hardware of the system.

The hardware of the telescope is encapsulated in a cartridge installed into the telescope's main tube. It consists of three components: a computer in mini ITX format, a display and a camera. The telescope seems to be a normal touristic telescope. But if a user looks through it, she or he will be surprised by seeing an image presented on the display with added information from the computer. The whole computer system is encapsulated in a cartridge which can be removed easily in the case of necessary maintenances on the system. The computer consists of an Intel Celeron T3100 @1.97 Ghz, a Geforce 9400 mobile graphics card, a 60 GB SSD and 4 GB RAM. There are two rotary encoders built in to track horizontal and vertical movements of the telescope with 8192 encoding levels. The installed camera is a Pointgrey Firefly @61 fps with a resolution of 640x480. In the front part of the cartridge, an active cooler is integrated. For maintenance purposes we installed a UMTS stick to be able to connect to the telescope via VNC. The telescope is enabled to broadcast its state via email. A cover at the side of the telescope can be removed to gain access to a USB connector. A keyboard and a mouse can be used to maintain the telescope. The hardware is shown in figure 2.

3 APPLICATION

We assumed that the average visitor uses telARscope for about 30 seconds. An application for such a big exhibition requires for it to work without any spoken or written language. We couldn't describe the age of the users any closer. The noisy environment implies that we couldn't use any audio output. Our application should be interesting every time. Users leave the telescope in its actual position and a new user must be able to use it with full functionality at every time. It ought to work if the user is using it for a few seconds only, but it should also enable long time exploration.

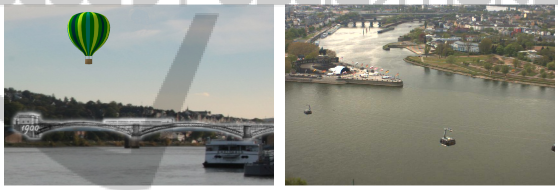

Figure 3: Left side: An overlay station. Right side: A beamer station.

There are several gamebased stations. Each is a point of interest. There are overlay stations and beamer stations (figure 3). In overlay stations, an image of the past overlays the reality. Beamer stations beam users to another viewpoint (figure 3). This is completely innovative. All stations are shown in table 1.

Users should be able to interact with the environment by merely moving the telescope but they should also be able to interact actively with the system. We didn't want to present the digital contents all the time. The two buttons on top of the telescope could be used for interaction but the user should be able to interact without any additional input devices, as there was a high possibility of users not detecting the buttons. The first button enables or disables a station. The second button is a gimmick: It throws flowers into the landscape.

Similar applications often use simple pointers. In an augmented reality environment a lot of immersion is by using icons. We wanted to create an environment where users get help to find the objects to interact with but could also just use the telescope as a

Table 1: All stations of the application.

Name	Type	Content if selected
Fortress	Overlay	Image of 1789.
Castle Philippsburg	Overlay	Image of the now destroyed castle.
Ape	Overlay	The ape throws bananas at the user.
Ship bridge	Overlay	A now destroyed ship bridge.
Train bridge	Overlay	Old train bridge.
Tram	Overlay	A tram existent in the past.
Balloon 1	Beamer	The fortress in a bird's eye view.
Balloon 2	Beamer	View from the bridge below the ballon
Webcam	Beamer	A webcam image
Statue	Beamer	Koblenz in the past.

plain one. Users should be able to use the telescope without understanding the interaction concept in every detail. Therefore, an intelligent pointer was designed for gamebased exploration: Hints show where something can be explored and if a user activates it, augmented contents appear. The curiosity of people is piqued and there is fun exploring everything and interacting with the contents. Instead of icons, vibrant auras hint at interactive content and a cluster of floating petals accompanying the user replaces a classic pointer (see figure 4). Hovering over an aura for several seconds causes the petal cluster to change its appearance from a loose drifting to a more defined formation in the shape of the logo of the national garden show. The content beneath is executed. When some content is active, the petal cluster is faded to invisibility to prevent blocking sights and returns to full opacity when the user leaves the current aura. Alongside its selection mechanic the petal cluster is designed as entertaining content itself. It draws the initial attention and gives the first hint that something is odd. It follows the users movements and can be spread out and pushed around.

We developed WatchGART (WatchGuard for ARTelescopes) to watch the state of the main application. In case of an application crash, it can restart the application. If it isn't successful, a status email is sent. In this case, one can connect via internet to the telescope. A MemoryFile class serves as an interface for the communication between the main application and WatchGART. After the system is booted, WatchGART is started automatically. After the initialization, an 'Out of order' image is displayed in fullscreen mode. The telescope's main application will be started by WatchGART in front of this.

Figure 4: Auras around selectable objects ant the intelligent pointer.

4 EVALUATION

We evaluated the whole system with 91 real tourists with an average age of 35.86 years. There was no special evaluation setting. The average user group size was 2.57 persons consisting of 0.64 children, 0.64 adolescents and 1.29 adults. The average time of use was 33.8 seconds. All questions should be rated by the participants in a range from 1 ('completely agree') to 5 ('completely disagree') with the possibility to leave a question unanswered. The knowledge of Koblenz was average (2.81 from 5, sd: 1.76). Most users were interested in history (average: 1.98, sd: 1.02) but didn't know much about the specific history of Koblenz (average: 3.78, sd: 1.27). The interest in technological inventions and new developments was high (1.66, sd: 0.87), as well as the interest in new compuer developments (average 2.21, sd: 1.29). Figure 5 shows the stations explored by the users. The most explored stations are concentrated in the area telARscope faces at. Users moved the telescope less thán expected. Fortress Ehrenbreitstein is the tallest and most present building in this area.

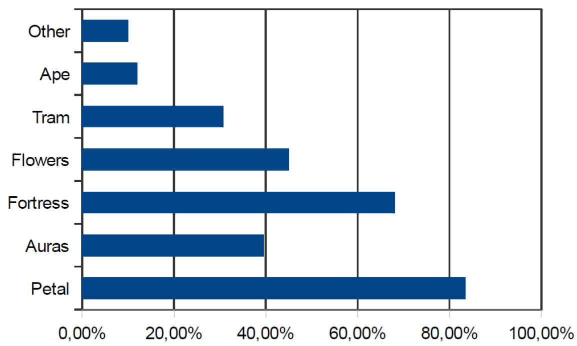

Figure 5: Stations explored by the users.

We evaluated the telARscope's concept, interaction, innovation, comfort and social interaction. The overall score is shown in figure 6. Users found the overall concept apart from the knowledge transfer good (average: 1.99, sd: 0.088). The knowledge transfer was rated average (average: 2.68, sd: 0.82). The innovation of telARscope was considered good too (average: 1.63, sd: 0.21). The overall concept of telARscope worked. The system was fun, interesting and innovative. If such a system should provide knowledge transfer, there should be an explicit concept for it.

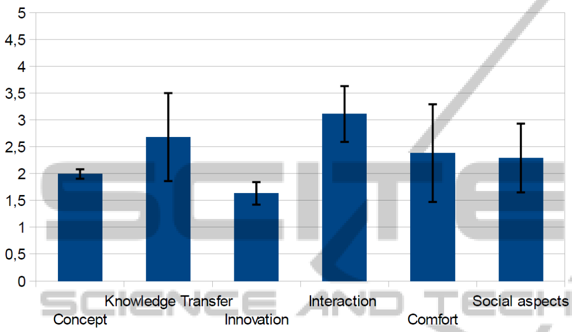

Figure 6: The overall score of the evaluation with standard deviations.

Most people didn't understand the interaction concept in every detail (average: 3.11, sd: 0.52). Due to the heterogeneous user groups, the standard deviation is high. The average time of use (33.8 seconds) is too short to explore the interaction concept completely. If users don't explore the interaction concept in every detail, telARscope still works as if there was static augmented reality content. The interaction concept works with every type of usage, it allows tourists to explore everything interactively in detail or merely to explore the stations in a short time.

The comfort of telARscope was rated good (average: 2.38, sd: 0.91). There is no optimal height for a telescope. A block of wood has been installed in front of telARscope so that children could step on it. Because of this, children moved telARscope even less because they had to move the wooden block too. It is very hard to use telARscope's lense because one has to look straight through it to see the installed monitor.

The social aspects of telARscope have been rated good (average: 2.29, sd of 0.64). People interacted socially by speaking about it with their companions and discussed about it. This adds value to the touristical experience too.

5 PROSPECTS

The idea and concept were very much appreciated by the users. We are going to advance our gamebased interaction and exploration system by tuning our parameters and by designing, implementing and reevaluating new interaction concepts. In the develeopment process, we developed an SDK. We are going to advance it with authoring opportunities. New concepts could be implemented more easily and less time consuming. We are going to be able to test more interaction and exploration concepts to find out which gamebased concepts work best. We are going to design and implement approaches to enable gamebased knowledge transfer on telARscope.

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