Muru in Wonderland: An Immersive Video Tour with Gameful Character Interaction for Children

Sung-A Jang
Korea Culture Technology Institute
Gwangju, Korea
sjang@gist.ac.kr

Kwang Hee Ko
Dept. of Mechatronics
Gwangju Institute of Science & Technology, Gwangju, Korea
khkoh@gist.ac.kr

Kyouseok Baik
Korea Culture Technology Institute
Gwangju, Korea
qseok@qist.ac.kr

Abstract
Most video-based virtual reality (VR) content currently available or in production are designed for viewing only [6]. In this paper, we present Muru in Wonderland, an interactive VR experience for children that combines 360-degree real-world footage of places in Gwangju with real-time 3D interaction with a virtual character. Participants are lured into a game of hide and seek, and encouraged to find and grab or poke Muru with their hands. The playful and robust character interaction is designed to draw children into the world the character inhabits and encourage spatial exploration. It is structured in the form of a game to make the video content more engaging for children. We examine the effectiveness of our creative approach and share insights we gained through an exhibition of our work.

DIS '16 Companion, June 04-08, 2016, Brisbane, QLD, Australia
ACM 978-1-4503-4315-2/16/06.
http://dx.doi.org/10.1145/2908805.2909417

Author Keywords
Immersive video; gestural interaction; virtual reality; play; gamification.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

Introduction
This year is hailed to be when virtual reality (VR) finally sets off and becomes a part of our everyday fabric [1]. Consumer-ready head-mounted displays (HMDs) are expected to make VR accessible to the broader public. Smartphones are readily transformed into VR goggles, which can be used to view 360-degree videos on Youtube. Content providers are ambitiously developing immersive videos for emerging VR platforms, which allow entirely new ways of experiencing video-based

Figure 1: Muru in Wonderland in action. In this scene, Muru sits on top of the clock tower and grows big enough to fill the screen when continually poked at.

Figure 2: The flattened cartoon-like rendering (left) blends more naturally with the video imagery than a classic 3D rendering of the model (right).

Figure 3: Screenshot of skeletal hand model in action.

content. In most VR videos currently available or being made, however, the audience's interaction is limited to changing perspectives with head movement [5]. The audience is rarely given the chance to engage with what they are seeing in more meaningful ways.

Our system uniquely combines real-time virtual character interaction with a panoramic video journey in VR to create a hybrid environment where real-world and virtual elements converge. Immersive video allows users to freely direct their gaze and explore sites in a natural, intuitive way [4] that enhances the "real sense of being there [7]." Its gameful interaction design invites children to become an active part of the space and fully immersed in the world the character inhabits. "Gameful" design in this paper refers to the "use of game design elements in non-gaming contexts" [3] to create a more creatively engaging and satisfying tour experience.

Preliminary observations strongly suggest that introducing playful interactivity into immersive video tours for VR enriches the experience and makes it more creatively stimulating for children. Children of ages 8 and up generally showed an immediate understanding and intuitive command in exploring and interacting with the virtual environment. The simplest type of character interactions were often sufficient for generating excitement and commanding their attention.

Previous work that used immersive video to explore real-world environments were primarily focused on realistic presentation and documentation, and interactivity was generally confined to providing a means of navigation [7] or access to further information [4]. Our initial explorations in creating interactive, immersive video tours for VR shows promising creative potential for further development.

Muru in Wonderland: The Prototype

The Muru in Wonderland project began as an expansion of an earlier work that featured 360-degree moving footage from various sites in Gwangju with narration to provide a walking tour of the city. The work was made for Gear VR and presented as an immersive cultural VR tour of the city for foreigners. Exhibition of the work attracted great attention, which inspired us to adapt its material into an interactive video tour for children.

Muru in Wonderland aspires to take its audience on an entrancing journey to a magical place. Particular attention was paid to the storytelling and interactive features to create an immersive video tour that would appeal to children and engage their imagination. An anthropomorphic virtual character named Muru is introduced into the scenes to playfully engage the children and draw them into its world. Interactivity is considered vital for making the children feel like a part of the scenes and sustaining their focus [6]. Scenes from seven different sites are woven together by the narration, which provides context and guides the interaction. The narration was combined with natural background sounds that were recorded on location to enhance the sense of space [4] in the final video, which is approximately 1.5 minutes long.

Character & Interaction Design

Muru is designed to be a fun-loving, approachable character that represents the face of Gwangju (Figure 2). The character is based on river otters that inhabit the Gwangju Lake. Interactions with the character are designed to pique the children's curiosity and

Figure 4: Leap Motion VR set-up.

Figure 5: Hand tracking works best when hands are a comfortable distance away from the headset and mounted sensor [2]. The sensor's expansive range enables the tracking of all hands within a full arm's length that come into the headset's view [2].

Figure 6: A girl reaches out with both hands to catch the jumping Muru.

encourage spatial exploration of the scenes. Hand movement-based interactions are used to support natural and intuitive play and enable children to physically connect with the space [6]. A skeletal hand model representing the user's hands appears whenever the hands come into the motion sensor's view and trackable range (Figure 3). The virtual hands provide a sense of bearing for users and a means of navigating and interacting with the virtual space. The skeletal model was chosen for its simple, minimalist design that is broadly applicable to hands of all shapes and colors.

Interactions are structured in the form of a game, in which users are sent on a chase for the elusive Muru. Users are challenged in each scene to first find Muru then physically interact with it using their hands. When users reach with their hands to either grab or poke Muru, the otter playfully reacts and usually escapes their grasp in various ways. The level of interaction required gradually rises in difficulty and complexity with each successive scene. Its game-like design is intended to motivate participation and make the interactions more fun and rewarding. Interaction scenarios are carefully integrated into the video to make Muru appear as an integral part of every scene. The interactive character functions as an entry point to the virtual world, and connects the user's physical sense of presence to the video-based virtual space.

Implementation

In the basic set-up, the user wears a HMD with a motion sensor mounted to the front for hand tracking (Figure 4, 5). The Rift's external camera is fixed onto the monitor facing the user to effectively track head movement. The hardware consists of a state-of-the-art HMD (Oculus Rift Development Kit v.2) for immersive VR, a motion sensor (Leap Motion Controller) for accurate hand tracking and gesture recognition, and a high-performance computer for heavy-duty rendering and high frame rates. The software was built with Unity3D v.5.2.1 and integrates real-time hand-character interaction and corresponding character animation with the video view.

Exhibition & Discussion

Hundreds of children were able to experience the prototype during its three-day exhibition (Figure 1, 7, 8). The prototype was a success in drawing interest and actively engaging the participants. The experience was best suited for children ages 8 and up who were generally capable of withstanding the weight of the HMD and had large enough hands for robust hand tracking. With proper guidance, most children exhibited instant familiarity and intuitive command of the hand-based interaction. Simple hand-based interaction with the character kept the children fully engaged and entertained throughout, and many returned to play it for a second time. While adult participants generally enjoyed the experience as well, they were not as focused on constantly interacting with Muru and were more likely to leisurely look around to enjoy the view.

Interactivity was observed to heighten the sense of immersion for children and give them a sense of drive and direction. Whereas most adults were content to comfortably sit and play with their hands, many children were bursting with energy and did not hesitate to expand their sphere of action. This was also evidently due to the fact that children often had to extend their physical reach to get to Muru. Some even jumped up from their chairs and walked back and forth to chase the character.

Figure 6: Muru jumps and disappears into thin air when the user's hands reach out to grab it. It instantly appears again mid-air to drop a new location.

Figure 7: Muru runs away from the user's grasp to hide behind the house, then peeks out to tease the user.

Figure 8: Parents and kids stand in line to experience Muru in Wonderland.

The gameful interactive features of the work often had the effect of becoming the children's singular focus. Most children stood in line with their parents expecting to play a "game," and were impatient for their turn. Despite the absence of scores to measure their performance, the children were completely immersed and persistent in chasing Muru. Siblings and friends naturally competed against each other and measured their performance by how adept they were in navigating the space and engaging the character. The weight of the HMD, however, in addition to its obtuse design and potential heat, made it generally difficult for children under 5 or 6 to wear. The hand sensor's limited range and tracking capacity also constricted the sphere and speed of movement.

Conclusion

Muru in Wonderland transformed an immersive video tour into a rich interactive experience for children by introducing a virtual character in its scenes that children could physically touch and playfully engage with their hands. Its gameful design proved to be effective in motivating children to fully engage with the video-based content and make new discoveries. Preliminary observations suggest that interactive, immersive video for VR has potential to expand ways of experiencing video-based content and also create novel experiences that support creative engagement and further fuse the physical with the virtual.

It would be informative to conduct a user study to determine if participants felt a deeper connection with the places they explored and interacted with Muru. It would also be beneficial to explore ways of achieving a balance between content appreciation and playful interaction in future works.

Acknowledgements

This research is supported by Korean Ministry of Culture, Sports and Tourism (MCST) in Culture Technology (CT) R&D and Mgmt. Support Project.

References

1. Rory Cellan-Jones. 2016: the year when VR goes from virtual to reality. 2016. Retrieved Jan 20, 2016 from http://www.bbc.com/news/technology-35205783
2. Alex Colgan. 12 FAQs about the VR Developer Mount. Retrieved Feb 2, 2016 from http://blog.leapmotion.com/12-faqs-vr-developer-mount
3. Sebastian Deterding, Dan Dixon, Rilla Khaled, and Lennart Nacke. 2011. From game design elements to gamefulness: defining gamification. In *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*, 9-15.
4. Karol Kwiatek and Martin Woolner. 2009. Embedding interactive storytelling within still and video panoramas for cultural heritage sites. In *Proceedings of 15th International Conference on Virtual Systems and Multimedia*, 197-202.
5. Megan Logan. The headset cometh: A virtual reality content primer. 2015. Retrieved Jan 6, 2016 from https://gigaom.com/2015/12/31/the-headset-cometh-a-virtual-reality-content-primer
6. Holger Regenbrecht and Thomas Schubert. 2002. Real and illusory interactions enhance presence in virtual environments. *Presence: Teleoperators and virtual environments* 11, 4: 425-434.
7. Matthew Uyttendaele, Antonio Criminisi, Sing Bing Kang, Simon Winder, Richard Szeliski, and Richard Hartley. 2004. *Image-based interactive exploration of real-world environments. Computer Graphics and Applications, IEEE* 24, 3: 52-63.