VR Planet: Interface for Meta-View and Feet Interaction of VR Contents

Kevin Fan,* Liwei Chan, Daiya Kato, Kouta Minamizawa, and Masahiko Inami
Keio University, The University of Tokyo

Figure 1: *a) 360 video projected as planet, b) stepping on planet view to trigger light, c) audience interact through projected planet, d) walk to different planets to view immersions*

Keywords: planet view, stereographic projection, feet interaction, VR projection

Concepts: •**Human-centered computing** → **Interaction techniques; Visualization;**

1 Introduction

The emergence of head-mount-displays(HMDs) have enabled us to experience virtual environments in an immersive mean. At the same time, omnidirectional cameras which capture real-life environments in all 360-degree angles in either still image or motion video are also getting attention. Using HMDs, we can view those captured omnidirectional images in immersion, as though we are actually ”being there”. However, as a requirement for immersion, our view of these omnidirectional images in the HMD is usually presented as first-person-view and limited by our natural field of view (FOV), i.e. we only see a fraction of the environment which we are facing, while the rest of the 360-degree environment is hidden from our view. This is even more problematic in telexistence situations where the scene is live so setting a default facing direction for the HMD is impratical. We can often observe people, while wearing HMDs, turn their heads frantically trying to locate interesting occurrences in the omnidirectional environment they are viewing.

Viewing only a fraction of the environment according to our head orientation is a requirement for immersion, but hinders our VR experience. We therefore believe there should be interfaces which allow us to easily view the full VR environment. We propose a ”planet” view for visualizing an meta-view of the environment that a user is immersed in (Figure 1a). Equirectangular images taken from a omnidirectional camera can be transformed into ”planets”. The planets are then placed at users' feet and becomes visible when look down. The planets capture the full omnidirectional scene so users can easily obtain a whole view of the environment, even those that are behind them. As these planets are around the user's feet, we further suggest natural feet-interaction with the planets to enhance our experience.

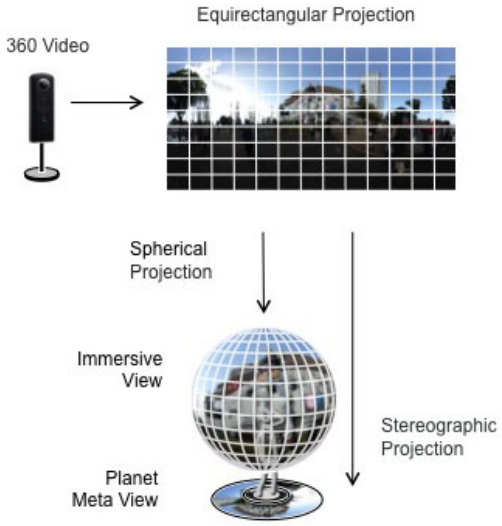

Figure 2: *Projection methods of both immersive and planet view from 360 omnidirection video*

2 Implementation

Traditionally, omnidirectional images are captured in a rectangular form, formally known as equirectangular projection. When to be viewed in virtual reality (VR), these equirectangular images are mapped to a sphere, with the user's viewpoint situated at the center of sphere, to provide a fully immersive view. However, as aforementioned, we could be missing interesting events in VR using only spherical projection, due to the limited FOV of VR content. Alternate visualization methods were thus explored in order to show

*e-mail:kevinfan@kmd.keio.ac.jp

SIGGRAPH '16 VR Village, July 24-28, 2016, Anaheim, CA,
ISBN: 978-1-4503-4377-0/16/07
DOI: http://dx.doi.org/10.1145/2929490.2931001

more information beyond our natural FOV. In a VR context, we could increase our FOV by presenting the full 360 degree equirectangular images in the HMD [Ardouin et al. 2012], while situations different than VR also benefits from alternate visualization methods of equirectangular images [Mulloni et al. 2012; Fong 2014]

To solve the problem of limited view in VR while still adhere to immersion, we propose the use of "planet" view that capture the full omnidirectional scene of the environment to be presented at our feet, so users can easily obtain a complete view, including areas behind them. In our system, we apply stereographic transformation to the omnidirectional images to create a 2D plane representation of the spherical view. The resulting "planet" is a circular meta-view of the environment with center located to users' feet to provide a clear spatial mapping to the spherical view (Figure 2). Users can thus, while in immersive spherical view, glance down to locate events that may be hidden behind them, and look up in the according direction to view again in immersion.

An interaction method brought about by these VR planets located at our feet is therefore embodied feet interaction. Using simple mechanism of tracking our feet with Kinect and visualizing our limb in VR, we can enhance our experience in VR with VR planets. For example, physically turning while in immersive VR to view scenes behind a user could be problematic as that could disorient the user's direction in physical environment. Rather, with feet interaction we could swipe the planets to rotate both the planet and the immersive spherical view to view different directions without physically turning. We implemented three examples of feet interaction: (1) using feet to rotate the planet which in turn rotates the spherical view, (2) erasing the planet with feet and (3) walking between multiple planets to transition between the environment that user is immersed in. A merit of feet interaction is that it provides hands free and intuition in certain interactions, as demonstrated in Step World-in-Minature where users can step on projected environment widgets on the floor to move around the environment [LaViola Jr et al. 2001]. We therefore envision that our experience in VR could benefit from planet view and feet interaction which lightens the burden of hand interaction.

3 Visualization

The planet view, when combined with the traditional immersive spherical view, gives three kinds of visualizations. In our system, we transition between these visualizations using feet interaction.

Immerive + Planet view: is a hybrid view which integrates the planet view with the immersive view by placing the planet at the user's feet. The user normally sees the immersive view and can look around just as in normal omnidirectional VR experience. As the user looks down, instead of seeing the floor as that in a usual VR experience, the user would see the planet view of the whole environment.

Full Immersive: is useful in situations where the full omnidirectional video should be viewed in immersion, including floor directions, as in the case of aerial 360 videos. While in "Immersive + Planet" view, users can utilize feet interaction by swiping to erase the planet on the floor, similar as to how one would erase floor graffitis.

Planets view is visualized as only showing planets situated. While in "Immersive + Planet" view, as users look in the direction where other planets are placed across the virtual environment, the immersive sphere would gradually blend out to hint the presence of other planets. Then, as users walk out of the planet they were standing on, their view would be transitioned to Planets view where they could walk to different planets to trigger different immersions.

4 Application and User Experience

Adding a planet view brings more potential to applications and interactions with omnidirectional videos. Here we give three examples.

We could capture the omnidirectional image of the live environment that we are physically situated in and transform to a planet view. By integrating with video-see-through HMD and house appliances, we could enhance our interaction with these appliances. For example, instead of reaching for remotes, we can look down at the planet view and utilize our feet to step on appliances we want to trigger (Figure 1b).

VR experience, while immersive to the user, often leave the audience to be "left out" as most of the time they could only watch from a monitor of what the user is experiencing. Projecting virtual environments to the physical environment could enhance audience experience [Saraiji et al. 2015]. By having a projection of the planet view in the physical environment, audience could perceive the kind of 360 degree environment that the user is situated in. Audience could also interact with the user; for example, using feet to swipe the physically projected planet to rotate the sphere in user's virtual environment (Figure 1c).

Planet view gives a perception of users situating in a environment with many portals. Users could utilize embodied walking to different planets to be immersed in different environments (Figure 1d). By providing omnidirectional videos of different locations and placing their planets according to a physical map, we could create the experience of literally walking from Seattle to London, as an example. For the demonstration, we will provide planets of different locations as well as recorded spots and streaming omnidirectional video from a telepresence robot in the SIGGRAPH venue.

Acknowledgements

This work was supported by NTT Media Intelligence Laboratories.

References

ARDOUIN, J., LÉCUYER, A., MARCHAL, M., RIANT, C., AND MARCHAND, E. 2012. Flyviz: a novel display device to provide humans with 360 vision by coupling catadioptric camera with hmd. In *Proceedings of the 18th ACM symposium on Virtual reality software and technology*, ACM, 41–44.

FONG, C. 2014. An indoor alternative to stereographic spherical panoramas. In *Proceedings of Bridges 2014: Mathematics, Music, Art, Architecture, Culture*, Tessellations Publishing, 103–110.

LAVIOLA JR, J. J., FELIZ, D. A., KEEFE, D. F., AND ZELEZNIK, R. C. 2001. Hands-free multi-scale navigation in virtual environments. In *Proceedings of the 2001 symposium on Interactive 3D graphics*, ACM, 9–15.

MULLONI, A., SEICHTER, H., DÜNSER, A., BAUDISCH, P., AND SCHMALSTIEG, D. 2012. 360 panoramic overviews for location-based services. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM, New York, NY, USA, CHI '12, 2565–2568.

SARAIJI, M., FERNANDO, C. L., MINAMIZAWA, K., AND TACHI, S. 2015. Mutual hand representation for telexistence robots using projected virtual hands. In *Proceedings of the 6th Augmented Human International Conference*, ACM, 221–222.