An Artistic Provocation to Explore Effects and Opportunities of Virtual Surreal Spaces

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**Abstract**

The concept of *surreal virtual space* is used in this paper to describe a space which looks realistic but is impossible to exist in reality. For this project, we developed a 3D virtual space using Google Cardboard and an Android mobile device. Referring to the 2D drawing, “Relativity,” of M.C. Escher, the virtual space was designed to have multi-directional but connected stairs. This work was exhibited with other artworks at a gallery for a period of three weeks. Despite some minor sensory confusion, all audiences experienced a degree of place illusion, enjoyment and a sense of self-awareness even though the virtual environment did not provide a visual representation of the audience’s own body. For future work, we plan to investigate the advantages of these effects and apply them to everyday non-virtual environments.

**Author Keywords**  
Artistic provocation; Virtual surreal space; Sensory confusion.

**ACM Classification Keywords**  
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.
Introduction
Current studies on virtual spaces aim mostly at achieving an immersive experience by mimicking the real world. Not only they use visual images, but also multi-modalities such as auditory and haptic feedback. However, as Salter [12] explained, virtual space can provide a unique novel experience that only a virtual environment can provide, capable of more than just simulating the real world. One type of a possible new experience in virtual space is the distortion of reality, in which components are assembled in an unconventional way. Existing studies on distortion in virtual reality, however, are limited to understanding the phenomenon of unintended distortion or leveraging the discrepancy between what users feel in physical space and what they see in the virtual. There also have been games [1,3] and artworks [2] using surreal illogical spaces, but they do not focus on exploring how distorted architectural virtual space can affect the senses of an audience.

In this study, we show an artistic provocation that provides a space made of an unusual composition of ordinary components, which seems real but cannot possibly exist in a physical environment. We constructed a 3D virtual reality environment characterized by loops of multi-directional stairs with an outer space background. Our application was exhibited at a gallery where we received live feedback from the audience. The audience experienced immersion and self-awareness in the space, even with confusions caused by experiencing visual feedback without the actual act of walking. We propose that this user’s ability to adapt to unfamiliar and distorted space is interesting and worthy of study. We plan to investigate the advantages of these effects and apply them to daily non-virtual settings.

Related works
A world, which looks similar to the real world but has noticeable differences, can be described as a surreal or distorted reality. Sometimes this is unintentionally caused by limitations in the implementation of virtual reality [6,10], but in some cases it is intentionally used [7,8] for a certain purpose. As a case of unintended distortion, the research by Interrante et al. [6] dealt with the understanding of egocentric distance perception when participants experience the exact virtual replica of the environment they occupy. Ogawa et al. [10] compared the difference in perceived size when seeing virtual objects and a virtual hand. These unintended distortions are considered problems to overcome.

On the other hand, intentional discrepancies between physical and virtual environments have been applied in relation to a user’s body. In the case of Kolkman’s work [7], which manipulates the relationship between the real body and virtual body, it gives an entirely new experience to its audience. His work, *Ourtrospectre*, uses virtual space and lets the audience see themselves from outside of their own bodies. This was part of the exploration of the possibility of overcoming the fear of death by letting people experience their deaths indirectly. There has also been research on exploring the effects of virtual body changes on social stereotypes [8]. Matsumoto et al. [9] proposed a system using visuo-haptic interaction allowing users to touch and walk along a convex surface wall while seeing a straight virtual wall in order to reduce the amount of physical space for efficient redirected working (RDW) in a virtual environment.
**Description “endless stairs in cosmos”**

How it was developed

The unconventional composition is characterized in the picture of M.C. Escher [4]. The space setup of our project is based on the art piece “Relativity” by M.C. Escher, and its 3D model was constructed using Rhinoceros (fig.1). We used Unity3D and Google Cardboard with an Android phone to allow the audience to move around the virtual space as if being present in that space. As the stairs in the original art piece have multiple directions, the 3D modeling of the space was made to have stairs in five different directions as well. All stairs had handrails which guide the character to move along the direction of the stairs. To reduce accidental falls during space exploration, we used transparent colliders to block the open area in the bottom of the 3D modeling. Then, we added a teleport function for when the audience reaches dead-ends or jumps off the structure. These implementations allowed the space to have an endless loop while also letting audiences to experience the whole space. Additionally, we placed transparent stairs that stretch out far into outer space to show the possibility of getting out of the loop and walking into the vast universe (fig.2). The stairs surrounded a planet, and walking continuously along the stairs brought the audience back to their original position. For the background music, we used Bach Cello Suite No.1 Prelude to be played in harmony with the constant ups and downs experienced on the stairs.

This project was exhibited (fig.3) as a part of a group exhibition titled “Aesthetic calculation”, which happened in a gallery in Seoul for three weeks (2017.6.18~7.8). For easy approachability for the audience, we hung the hardware on the wall using a long elastic band. Also, we attached a headset to the Google Cardboard to minimize disturbance from the surrounding (fig.4).

How it works

When the audience approaches the exhibit, they can hold the cardboard that is hanging in the air and change their head direction to explore the virtual stairs space. When they face a certain direction, the character in the virtual space walks toward that direction. When they stop watching the exhibit, the character stays stationary in the last spot, and the next audience starts exploring from that point on. There are three pairs of teleportation points between dead-ends and other points, and when the audience jumps off the stairs, the character is moved immediately to the top of the stair space.

User Experience

During and after the exhibition, we conducted follow-up interviews to collect opinions from four visitors and the curator. The audience who participated in our interview strongly experienced the place illusion and mentioned that they felt as they were actually present in that space. The movement that follows the head direction and the background music increased the immersion. Audiences, despite an initial moment of confusion, could quickly adapt to a virtual space that obeys a different set of rules than those of physical space. “In VR environment, our visual, auditory, spatial and physical senses can easily fall apart. When a contradictory environment is realized using VR, I felt that our various senses are easily misled by the contradictions (P1).” Visitors also found an element of enjoyment in the unexpected behavior of this unconventional space. “It felt like an unknown world for exploration (P2).”
Moreover, the space stimulates reflection in users about their self-awareness and their way of exploring the surrounding space. Even though there was no visual representation of one’s own body, self-awareness was heightened by the surrounding environment. “I was able to be more aware of myself in the situation in which I was in a space in the universe where no other life exists. (P4)” One participant speculated that this awareness was triggered by the act of walking virtually without perceiving the physical force of gravity. “These simultaneous but different real and virtual perceptions and the continuous moving in the space gave me a meditative feeling. I think I can use the words “surrealistic or dreamy” in terms of art (Curator).”

Virtual Surreal Space
This paper is an artistic exploration of how surreal space can be designed to challenge users’ perception, by using non-standard composition of elements that have no equivalent in the physical world.

In the interviews with the audience we found that, after initial moment of confusion, audiences can adapt to a virtual space and experience place illusion and self-awareness. One of the possible reason of the self-awareness is the discrepancies between the physical and the virtual space. From this result, our research question can be extended to how surreal spaces can increase/decrease the sense of self, as seen in artist/architect F. Hundertwasser’s design of unique curved buildings as a human’s “third skin [5].”

For the future work, we will continue to explore the effects of unconventional assemblies of virtual architectural elements in physical space (e.g., augmented reality) that do not necessarily conform with the laws of physics in our daily lives could be a good strategy for both increasing participation and enjoyment of users in notably unappealing spaces, such as office cubicles. Moreover, by fusing the usage of virtual and physical elements in a non-conventional way, a space designer can trigger user’s self-awareness when they use the space, which can lead to more engaging human-space interactions. All these are our objectives for future work, which aims to use virtual elements in traditional space in a non-conventional way, such as transparent walls and shape-changing architectural elements, to augment a physical space.

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References


11. Mel Slater. 2009. Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 364(1535), 3549-3557