Keeping it real—Virtual reality could empower end-users during the building design phase

New study shows how virtual reality can be used to make the process of building design easier

Researchers at Incheon National University, Hanyang University, and Yonsei University find out whether immersive virtual reality systems can realistically convey spatial perception. Such systems could be used by the future end-users of buildings to give valuable feedback during the design review.

Immersive virtual reality could be an excellent tool to help end-users visualize the design of a future building, allowing them to give their opinion. Photo courtesy: Shutterstock

Designing a building requires much effort and collaboration among architects, engineers, and construction workers, but often, end-users' perspectives are not taken into account. Feedback from end-users can vastly improve the final design of a building, but this is a challenge because end-users naturally find it difficult to understand and visualize architectural 2D drawings and technical specifications. This represents an opportunity where virtual reality devices could really shine.

By wearing a head-mounted immersive virtual reality (HIVE) device, users can navigate through a virtual representation of a building and judge the current design. But until now, research providing evidence that HIVE systems can realistically simulate a physical environment has been limited—more so in the area of "spatial perception" (the ability to be aware of one's environment), which is one of the most important aspects that architects have to consider. In a study published in *Building and Environment*, a group of researchers from

Incheon National University, Hanyang University, and Yonsei University in Korea, including Prof. Choongwan Koo, wanted to fill this knowledge gap.

The scientists conducted a study with over 40 student volunteers to test the capabilities of HIVE systems. In this study, participants wore a virtual reality headset and navigated through an office floor—complete with computers, a coffee area, and window walls showing the outside world. "In building a virtual environment, the most important goal is to make the model as similar as possible to the real world, as HIVE is not merely a way of looking at 3D models through head-mounted devices," remarks Prof. Koo. Two variables that affect spatial perception—ceiling height and ceiling type—were analyzed. Participants then completed a questionnaire on their perception of the office floor through the simulated office computers so as not to break the immersion.

The results proved the remarkable capabilities of HIVE—the perceptions reported by participants were in line with what was expected according to previous architecture and psychology studies. "We believe that our study adds to our understanding of immersive virtual environments and their potential for end-user participation as part of the design review phase," concludes Prof. Koo.

Prof. Koo is even optimistic that by combining immersive virtual reality with big data analysis and artificial intelligence, these systems could be integrated with the design of buildings for improving the well-being of occupants—for example, by monitoring their body movements and emotion-triggered micro-vibrations in real time and adjusting their surroundings to make them more comfortable. Such a system could be very useful for improving the health and quality of life of the elderly—thus, it should surely be the object of future research!

Reference
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About Incheon National University

Incheon National University (INU) is a comprehensive, student-focused university. It was founded in 1979 and given university status in 1988. One of the largest universities in South Korea, it houses nearly 14,000 students and 500 faculty members. In 2010, INU merged with Incheon City College to expand capacity and open more curricula. With its commitment to

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About the author
Professor Choongwan Koo obtained his Ph.D. degree in the field of Sustainable Facility & Construction Management from Yonsei University in 2014 and has a good mix of academic and industrial experiences. After joining as an Assistant Professor at the Department of Building Services Engineering, Hong Kong Polytechnic University in 2016, he focused on the field of intelligent facility management and construction management with a transformative and innovative strategy toward enhancing the building performance (e.g. energy efficiency, indoor environmental quality, and human satisfaction). Since September 2019, he has been working in the Division of Architecture & Urban Design at Incheon National University. He has continued to focus on intelligent facility management as a director of various research projects funded by government agencies such as National Research Foundation (NRF-2018R1C1B4A02022690) and Korea Institute of Energy Technology Evaluation and Planning (KETEP-20189220200060).