



How to head into VR without wearing a headset

Kyushu University researchers rethink the 'mounted' default in head-mounted displays, using aerial imaging optics to propose a new way to enter virtual reality simply by sitting down

Fukuoka, Japan—A person wearing bulky goggles, turning awkwardly in circles and reaching out to grab something that isn't there. That is the image many of us have of virtual reality, and one that researchers at Kyushu University want to change.

In a paper published July 19, 2026, in the [*Proceedings of the Special Interest Group on Computer Graphics and Interactive Techniques Conference Emerging Technologies \(SIGGRAPH Emerging Technologies '26\)*](#), the team rethought what a VR display could be. Their specially designed chair uses aerial imaging optics to make a stereoscopic virtual scene appear far beyond the physical confines of the system. This enables users to experience an expansive, theater-like view from within the compact space of a chair, without wearing a headset.

“Actually, the project started when one of our students complained about how difficult it was to spend long periods in VR,” recalls [Shogo Fukushima](#), Associate Professor at Kyushu University's [Faculty of Information Science and Electrical Engineering](#). “Some days he's in VR more than he's out of it. He'd even try to sleep there, but the headset made it hard to get comfortable.”

Most VR devices are designed for relatively short sessions. Wider fields of view, higher resolution, and greater processing power all require more hardware, adding weight and pressure on the head and neck. That limits how comfortably VR fits into everyday life. Rather than making these devices lighter, Fukushima's lab explored a VR system that requires nothing to be worn on the head.

Conventional VR headsets create a three-dimensional view by showing slightly different images to each eye through displays and lenses placed close to the eyes. Fukushima's team showed that the same optical effect can be achieved by using a micromirror array, a device made up of many tiny mirrors that direct a different image to each eye. It builds on aerial imaging optics, a technique that makes images appear to float in space rather than on a physical screen.

While this optical principle has been explored before, the team took it a step further by developing a working VR system that users can sit in and look around. They mounted the optical module on a chair. A built-in gyroscope tracks the chair's rotation in real time, allowing the stereoscopic view to respond to the user's movements. As users turn their bodies, the stereoscopic view changes with them, allowing them to look around the virtual world without wearing a headset or calibrating the system. The compact setup also makes it possible to create an immersive VR experience within a relatively small space.

“Our system also has the potential to reduce VR sickness in the future,” Fukushima adds. “Without a headset to constrain the design, larger optical components and moving mechanisms can be incorporated more freely. This flexibility could enable new approaches to

reducing the mismatch between visual and physical sensations that can contribute to VR sickness.”

Meanwhile, the team is seeking industry partners to bring the technology into everyday life, with potential applications ranging from in-car workspaces and interactive museum exhibits to remote-controlled construction machinery and disaster-response robots.

Looking further ahead, Fukushima hopes to create something like Doraemon’s “Anywhere Door,” allowing two people to share the same immersive virtual scene.

“Our lab has always wanted to question what we take for granted in our routine,” he says. “Technical skills aren’t the most important thing to imagine a different future. We’d love to welcome more people who want to challenge the way things are usually done.”

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For more information about this research, see “Mountless Aerial HMDs: Designing Non-Wearable HMD Experiences Based on Aerial Imaging Optics,” Shogo Fukushima, *Proceedings of the Special Interest Group on Computer Graphics and Interactive Techniques Conference Emerging Technologies (SIGGRAPH Emerging Technologies '26)*, <https://doi.org/10.1145/3799826.3812427>

About Kyushu University

Founded in 1911, [Kyushu University](#) is one of Japan's leading research-oriented institutions of higher education, consistently ranking as one of the top ten Japanese universities in the Times Higher Education World University Rankings and the QS World Rankings. Located in Fukuoka, on the island of Kyushu—the most southwestern of Japan’s four main islands—Kyushu U sits in a coastal metropolis frequently ranked among the world’s most livable cities and historically known as Japan’s gateway to Asia. Its multiple campuses are home to around 19,000 students and 8,000 faculty and staff. Through its [VISION 2030](#), Kyushu U will “drive social change with integrative knowledge.” By fusing the spectrum of knowledge, from the humanities and arts to engineering and medical sciences, Kyushu U will strengthen its research in the key areas of decarbonization, medicine and health, and environment and food, to tackle society’s most pressing issues.



Fig. 1. Kyushu University researchers develop a non-wearable VR system. Kyushu University researchers rethink the 'mounted' default in head-mounted displays, using aerial imaging optics to propose a new way to enter virtual reality simply by sitting down.

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