Victorian Age technology can improve virtual reality, study finds

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Emily Cooper, a research assistant professor at Dartmouth, and her Stanford collaborators have discovered that "monovision" -- a simple technique borrowed from ophthalmology that dates to the monocle of the Victorian Age -- can improve user performance in virtual reality environments. Credit: Dartmouth College

Virtual and augmented reality have the potential to profoundly impact our society, but the technologies have a few bugs to work out to better simulate realistic visual experience. Now, researchers at Dartmouth College and Stanford University have discovered that "monovision"—a simple technique borrowed from ophthalmology that dates to the monocle of the Victorian Age - can improve user performance in virtual reality environments.

The findings will be presented May 9 at the ACM Conference on Human Factors in Computing Systems.

Virtual and augmented reality provide a unique platform for entertainment, education, collaborative work, basic vision research and other uses. But these displays still need to overcome technical and perceptual issues to provide high-quality and immersive user experiences. In particular, one long-standing challenge has been the mismatch between convergence and accommodation - or the visual cues that our eye muscles send to our brains as our eyes fixate and focus on objects in 3D - that are inherent to most stereoscopic displays.

A collaboration between electrical engineers at Stanford and a perceptual scientist at Dartmouth has examined how novel optical configurations can improve user experience and performance in virtual reality. Using the Oculus Rift VR headset, the research team created a prototype system with focus-tunable liquid lenses allowing for a range of optical modifications. On the one hand, this prototype allowed for creating adaptive focus cues, which resulted in higher user preferences and better performance in virtual reality. On the other hand, the system also allowed for testing of an extremely low-tech modification that leverages monovision, a technique that allows each eye of an observer to focus to a different distance. While the monovision technique is common practice in ophthalmology, the Stanford-Dartmouth team is the first to report its effectiveness for VR applications with a custom built set up.

"My lab has been conducting research on computational near-eye display optics for a few years now, and tapping into the wealth of techniques commonly used in ophthalmology and by vision science is key for delivering better experiences with virtual reality systems," says co-author Gordon Wetzstein, an assistant professor of Electrical Engineering at Stanford.

"In addition to showing how adaptive focus can be implemented and can improve virtual reality optics, our studies reveal that monovision can also improve user performance in terms of reaction times and accuracy, particularly when simulating objects that are relatively close to the user," says lead author Robert Konrad, a graduate researcher at Stanford.

Co-author Emily Cooper, a research assistant professor in Dartmouth's Department of Psychological and Brain Sciences, adds: "Practical optical solutions for virtual reality are crucial to moving this technology to increasingly more comfortable and immersive experiences. Our work shows that monovision has the potential to be one such solution."

Provided by Dartmouth College

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