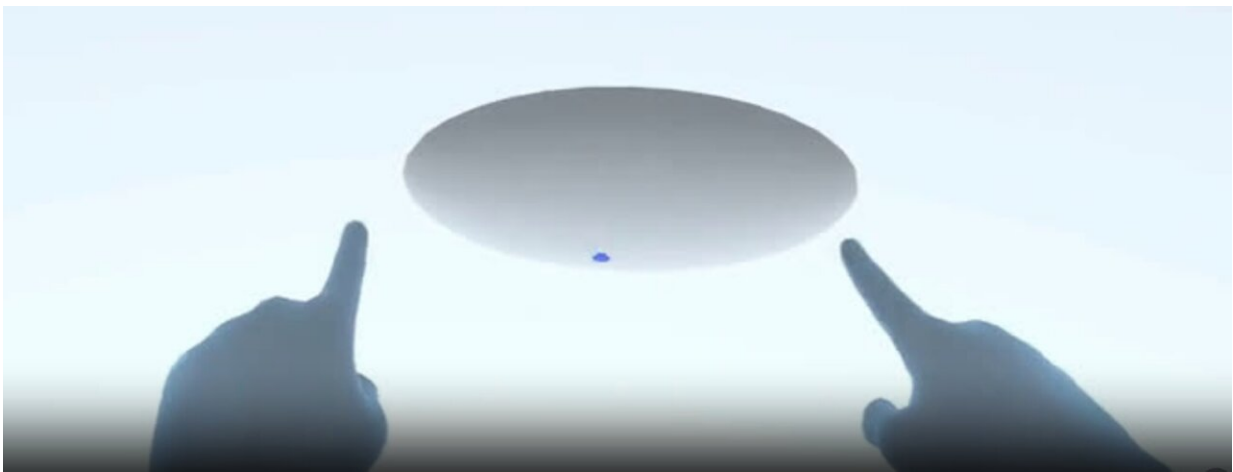


Machine learning gives users 'superhuman' ability to open and control tools in virtual reality

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Credit: University of Cambridge

Researchers have developed a virtual reality application where a range of 3D modeling tools can be opened and controlled using just the movement of a user's hand.

The researchers, from the University of Cambridge, used machine learning to develop 'HotGestures'—analogous to the hot keys used in many desktop applications.

HotGestures give users the ability to build figures and shapes in [virtual reality](#) without ever having to interact with a menu, helping them stay focused on a task without breaking their train of thought.

The idea of being able to open and control tools in virtual reality has been a movie trope for decades, but the researchers say that this is the first time such a 'superhuman' ability has been made possible. The [results](#) are reported in the journal *IEEE Transactions on Visualization and Computer Graphics*.

Virtual reality (VR) and related applications have been touted as game-changers for years, but outside of gaming, their promise has not fully materialized. "Users gain some qualities when using VR, but very few people want to use it for an extended period of time," said Professor Per Ola Kristensson from Cambridge's Department of Engineering, who led the research. "Beyond the visual fatigue and ergonomic issues, VR isn't really offering anything you can't get in the real world."

Most users of desktop software will be familiar with the concept of hot keys—command shortcuts such as ctrl-c to copy and ctrl-v to paste. While these shortcuts omit the need to open a menu to find the right tool or command, they rely on the user having the correct command memorized.

"We wanted to take the concept of hot keys and turn it into something more meaningful for virtual reality—something that wouldn't rely on the user having a shortcut in their head already," said Kristensson, who is also co-Director of the Centre for Human-Inspired Artificial Intelligence.

Instead of hot keys, Kristensson and his colleagues developed 'HotGestures', where users perform a gesture with their hand to open and control the tool they need in 3D virtual reality environments.

For example, performing a cutting motion opens the scissor tool, and the spray motion opens the spray can tool. There is no need for the user to open a menu to find the tool they need, or to remember a specific shortcut. Users can seamlessly switch between different tools by performing different gestures during a task, without having to pause their work to browse a menu or to press a button on a controller or keyboard.

"We all communicate using our hands in the real world, so it made sense to extend this form of communication to the virtual world," said Kristensson.

For the study, the researchers built a neural network gesture recognition system that can recognize gestures by performing predictions on an incoming hand joint data stream. The system was built to recognize ten different gestures associated with building 3D models: pen, cube, cylinder, sphere, palette, spray, cut, scale, duplicate and delete.

The team carried out two small studies where participants used HotGestures, menu commands or a combination. The gesture-based technique provided fast and effective shortcuts for tool selection and usage. Participants found HotGestures to be distinctive, fast, and easy to use while also complementing conventional menu-based interaction.

The researchers designed the system so that there were no false activations—the gesture-based system was able to correctly recognize what was a command and what was normal hand movement. Overall, the [gesture](#)-based system was faster than a menu-based system.

"There is no VR system currently available that can do this," said Kristensson. "If using VR is just like using a keyboard and a mouse, then what's the point of using it? It needs to give you almost superhuman powers that you can't get elsewhere."

The researchers have made the [source code](#) and dataset publicly available so that designers of VR applications can incorporate it into their products.

"We want this to be a standard way of interacting with VR," said Kristensson. "We've had the tired old metaphor of the filing cabinet for decades. We need new ways of interacting with technology, and we think this is a step in that direction. When done right, VR can be like magic."

More information: Zhaomou Song et al, HotGestures: Complementing Command Selection and Use with Delimiter-Free Gesture-Based Shortcuts in Virtual Reality, *IEEE Transactions on Visualization and Computer Graphics* (2023). [DOI: 10.1109/TVCG.2023.3320257](#)

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