Virtual reality glove system takes shape in digital realm

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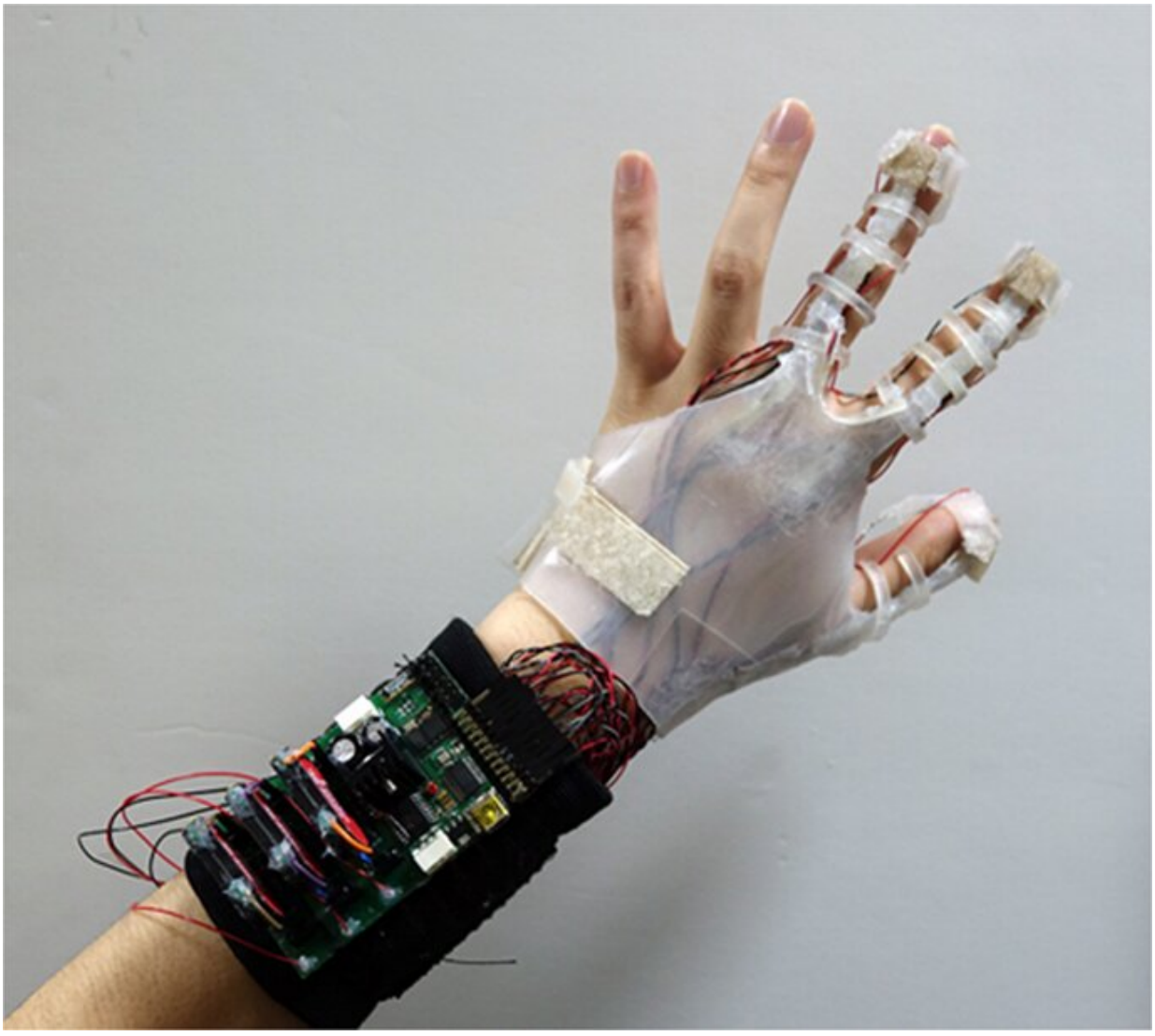

Credit: *Scientific Reports*

A glove focused on user experience in interacting with virtual objects is in the news. This virtual reality glove is the topic of a research article. The researchers described their virtual reality glove in detail in their paper, "Pneumatic actuator and flexible piezoelectric sensor for soft virtual reality glove system," in *Scientific Reports*.

No, this is hardly the first instance of researchers able to reproduce texture but this attempt is noteworthy. As pointed out in natureasia.com, the glove system in this instance is one that allows the wearer to manipulate a virtual hand, pick up an object in virtual reality *and feel its shape*.

Bill Andrews took to the D-brief blog on *Discover* to examine the glove's characteristics— of (1) sensors and (2) actuators. The Korean team designed it as a glove to manipulate a virtual hand inside a digital realm, said Andrews.

The sensors make use of piezoelectric technology materials that produce an electric charge when squeezed, said Andrews. "Line the glove with them, and every bend and flick of a finger produces a measurable electric pulse, which the software can translate into commands for the virtual hand." (The authors described finger motions "detected by attached flexible piezoelectric sensors and transmitted to a virtual space through Bluetooth for interconnecting with a virtual hand.")

Sensors are placed on the thumb, index and middle fingers. The authors wrote that "A total of 11 sensors were attached to the glove, to detect the movements of the thumb, index finger, and middle finger, with a silicone adhesive."

Those actuators in the glove are interesting—each one "a flat little air bubble encased in a thin silicone skin," wrote Andrews. So, of what use are all those bubbles? "By using an electric current to change the shape

of the silicone, the researchers could force the air inside into a tighter space that 'popped up.' Varying the signal changed the height of the bubble."

With the bubbles in the glove's fingertips, the user's hand "is tricked into thinking it's touching, or holding, something."

Eva Frederick, *Science,* said the entire device, including battery and circuit attached to strap around wrist weighs about the same as a medium-size apple."

How they tested: The authors focused on a virtual knight from a computerized chess board to test their VR glove. The actuators mimicked physical dimensions by expanding appropriately into the real fingertips, said Andrews.

The researchers could pick up the knight and hold it.

As for how the system works as a whole—hardware glove, sensors, actuators, interface board along witih software—a research press release from *Scientific Reports*, appearing in *natureasia.com*, stepped readers through their process.

As the glove's wearer moves a hand to pick up the object, the finger movements are detected by sensors in the glove. Data from the sensors are transferred via Bluetooth to a software program that recreates corresponding movements of the virtual hand on a screen.

"Taking hold of the virtual object activates a set of soft silicone actuators developed by the authors. The actuators receive a signal from the virtual reality environment, which causes air inside them to move and expand the silicone in their center. The user's fingertips sense the pressure of the expanded silicone as if they were touching the virtual

object, allowing them to feel its shape, pick it up and hold it in virtual reality."

Overall, Andrews said in the D-brief blog that "It's a step forward not just for video games and novelty toys, but more serious technology as well."

"Whether it helps make learning software more immersive, virtual scientific experiments more informative or even just video games more realistic, this kind of VR glove could be the preferred way to fool our minds in the future."

More information: Kahye Song et al. Pneumatic actuator and flexible piezoelectric sensor for soft virtual reality glove system, *Scientific Reports* (2019). DOI: 10.1038/s41598-019-45422-6