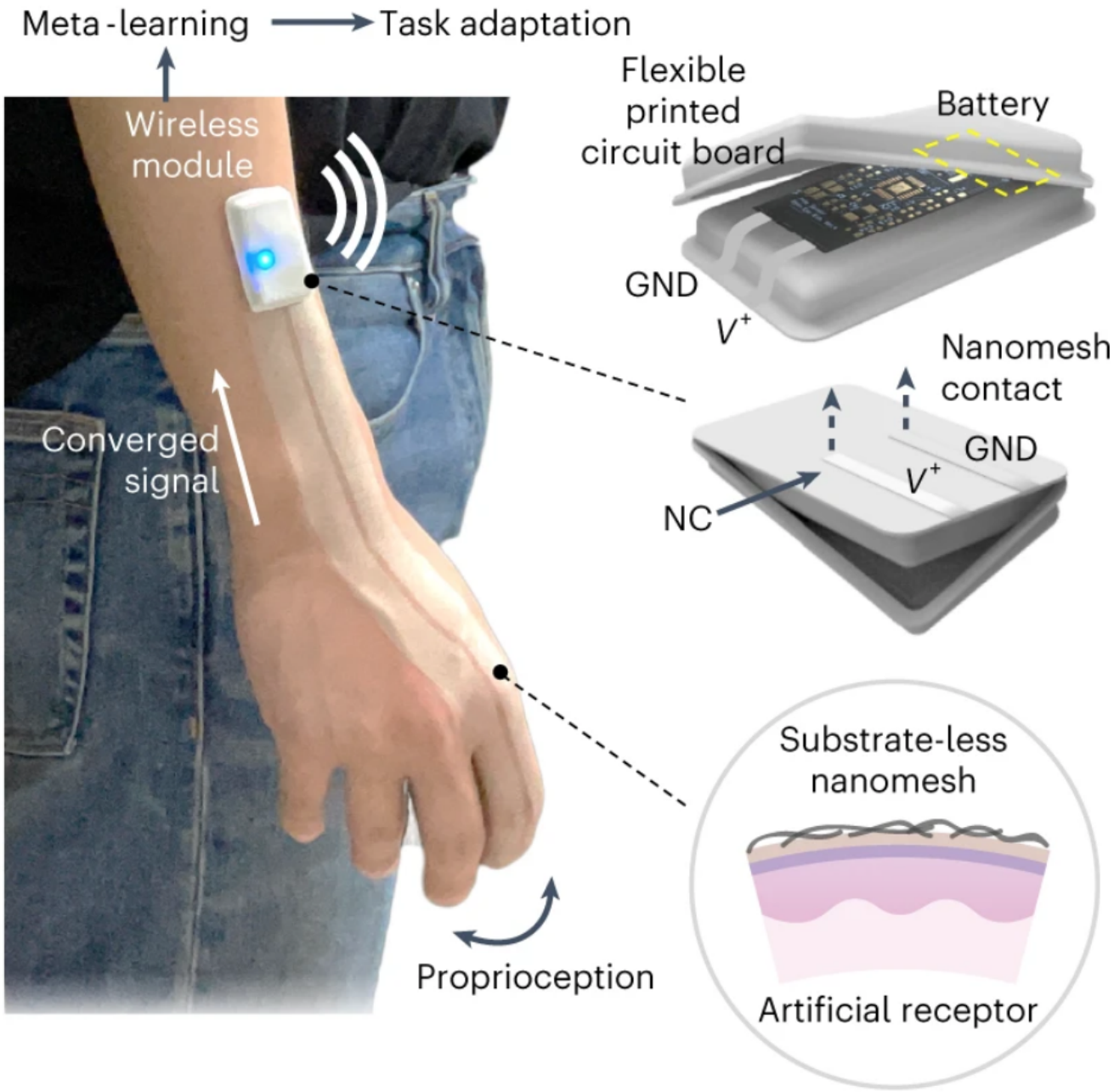
Docket #: S22-322

Biocompatible, directly printed, meta-learning, human-machine input nanomesh

Stanford researchers in Zhenan Bao's Group have developed a nanomesh sensor printed directly on the hand that uses an AI-trained model to detect multiple movement types from a single sensor. Current movement sensing technologies are bulky, complex, and require multiple sensors on a substrate. The Bao Group nanomesh is made from biocompatible materials that can be directly printed on a person's skin. It mimics human cutaneous receptors by translating electrical resistance changes from fine skin stretches into proprioception. A single nanomesh simultaneously measures finger movements from multiple joints. A time-dependent contrastive learning algorithm differentiates between different unlabeled motions. The meta-learned information rapidly adapts to various users and tasks, including command recognition, keyboard typing and object recognition.



Biocompatible nanomesh sensory system trained through meta-learning - The sensory system connects directly with a wireless Bluetooth module through a nanomesh connector (NC) and is trained through few-shot meta-learning. (Image courtesy the Bao Group)

Stage of Development – Prototype

The Bao Group developed and tested the sensor system on human users in a lab

setting.

Applications

- **Human-machine** and **AR/VR** input such as, virtual keyboard and object interaction.

Advantages

- **Slim, discrete, and biocompatible**. Mesh conformably attaches to user's skin with the developed portable printer. Signals read through attaching the wireless module. Nanomesh sensory system that is substantially less bulky than conventional devices.
- **Low complexity and computational cost**. Multi-joint proprioceptive information gathered through a single sensor element. Low-dimensional, multi-joint information provided from the substrate-less sensor **reduces learning network computational processing time** and **adapts faster** to multiple tasks.
- **Highly adaptive** - sensor quickly adapts to different daily tasks, such as motion command, keypad typing, two-handed keyboard typing, and even object recognition, where users give only few-shot examples linking their sensor signals to the corresponding task labels.
- **Stable** - Printed sensor stability tested for 1500 scratch cycles.

Publications

- Kim, K. K., Kim, M., Pyun, K., Kim, J., Min, J., Koh, S., ... & Bao, Z. (2023). A substrate-less nanomesh receptor with meta-learning for rapid hand task recognition. *Nature Electronics, 6*(1), 64-75.

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