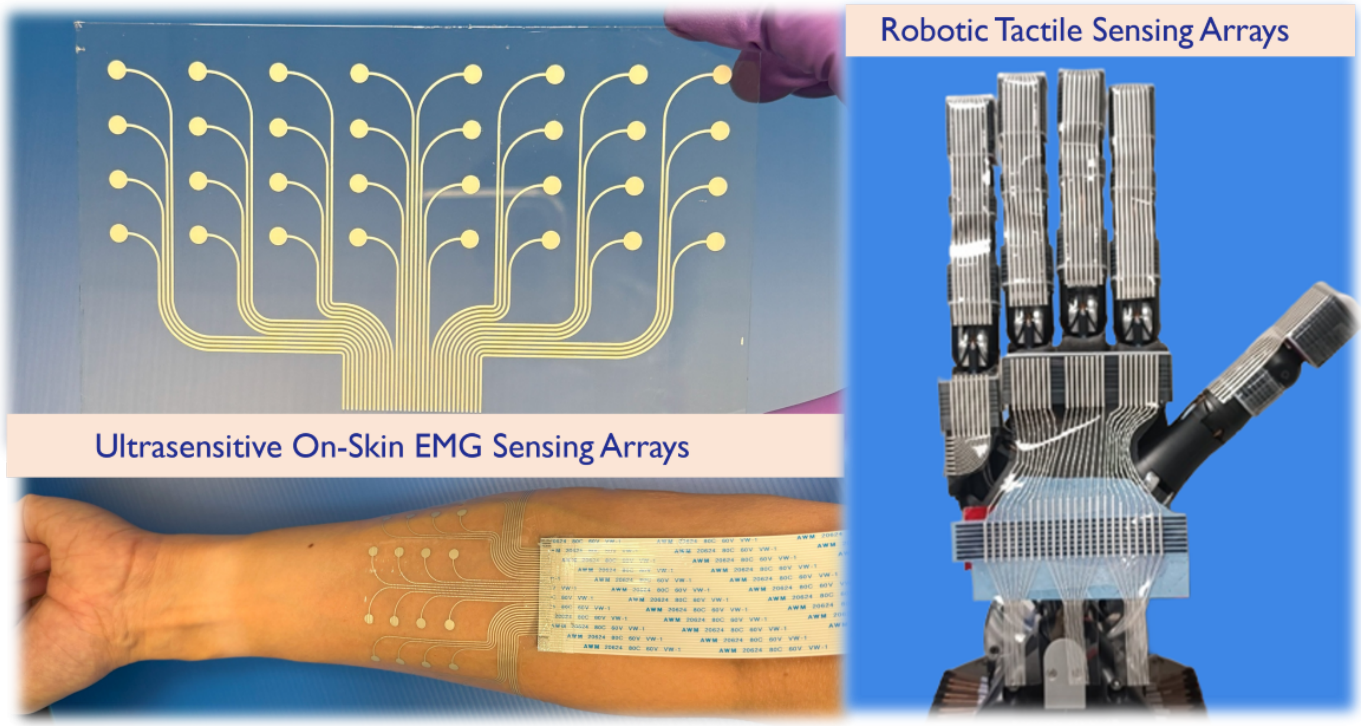
TECH OFFER

On-Skin EMG Sensing for Smart Robotic Control and Immersive Haptics



KEY INFORMATION

TECHNOLOGY CATEGORY:
Electronics - Sensors & Instrumentation
Electronics - Printed Electronics
Healthcare - Medical Devices

TECHNOLOGY READINESS LEVEL (TRL): TRL4
COUNTRY: SINGAPORE
ID NUMBER: TO175405

OVERVIEW

This technology introduces a closed-loop wearable human–machine interface (HMI) that enables natural robotic control with real-time sensory feedback.

At its core are ultrasensitive, flexible on-skin electromyography (EMG) sensing arrays that capture comprehensive muscle activity with high fidelity and stability. Unlike conventional EMG systems that rely on a few electrodes and often miss weak signals or suffer from noise, this platform delivers exceptional responsiveness for intuitive and precise robotic hand movement, making it ideal for advanced robotic control applications.

The robotic hand is further equipped with high-density tactile sensors, providing force and texture feedback to the user. This bidirectional interface not only enables seamless control of robotic limbs but also creates a more immersive connection with the physical environment. In parallel, an EEG module with preparation-free gel materials is under development to integrate

brain–computer interface (BCI) functions, further extending the system's capabilities.

Designed for next-generation prosthetics, rehabilitation robotics, assistive exoskeletons, and advanced HMIs, this technology offers a comprehensive platform for restoring and enhancing motor function. The team is actively seeking collaboration with medical device manufacturers (prosthetics, rehabilitation robotics, wearable sensors), rehabilitation centers and hospitals (for clinical test-bedding), deep-tech companies specializing in AI, data analytics, or biosignal processing, as well as robotics firms to co-develop and deploy this innovation in real-world applications.

TECHNOLOGY FEATURES & SPECIFICATIONS

This system combines materials science, electrophysiology, and robotics innovations to create a robust, skin-integrated platform:

- **Ultrasensitive EMG Sensing**
  - Conductive gel with ultra-low skin-electrode impedance
  - Detects EMG signals as low as 1.5% Maximum Voluntary Contraction (MVC)
  - 32–64 channel high-density sensor arrays
  - Stretchable, conformable design with excellent motion artifact resistance
- **Robotic Tactile Sensor Arrays**
  - > 1000 distributed sensors across the robotic hand
  - Sensitivity: 0.01 N, with shear force detection
  - Proven durability: >100,000 cycles
- **EEG Module (in development)**
  - Preparation-free electrode system
  - Thermally responsive phase-change materials
  - Delivers high-quality, stable EEG signals for brain–computer interface integration

Together, these features deliver a closed-loop system that supports multi-channel EMG-driven control with robotic tactile feedback, enabling real-time, natural, and immersive human–robot interaction.

POTENTIAL APPLICATIONS

This technology can be applied across prosthetics, rehabilitation robotics, assistive exoskeletons, and advanced human–machine interfaces (HMIs). It enables the commercialization of:

- **EMG-Controlled Prosthetic Limbs**
  - Delivering intuitive, high-resolution muscle signal decoding for natural prosthetic control.
- **Robotic Rehabilitation Devices**
  - Adapting therapy in real time through continuous monitoring of muscle activity.
- **Assistive Exoskeletons**
  - Supporting mobility with muscle-driven, responsive control for users with motor impairments.
- **Robotic Hands with Tactile Feedback**

    - Providing force and texture sensing to enhance dexterity and object interaction.
- **Multimodal HMIs**
    - Combining EMG and EEG inputs for gesture-based and brain–computer interface applications.
- **Wearable Biosignal Platforms**
    - Extending use to clinical diagnostics, tele-rehabilitation, and immersive VR/AR systems.

UNIQUE VALUE PROPOSITION

This solution is a closed-loop wearable interface that integrates ultrasensitive on-skin EMG sensing with robotic tactile feedback for truly intuitive human–machine interaction. Unlike conventional systems that rely on a few electrodes with poor signal fidelity, it delivers high-density, high-stability EMG acquisition capable of detecting even subtle muscle activations. The robotic hand further provides force and texture feedback, creating a responsive two-way interface. Engineered with advanced conductive gels, stretchable materials, and clinical-grade stability, this technology sets a new standard for intelligent prosthetics, rehabilitation robotics, and next-generation HMI.