# A TMR-Enabled Wristband for Gesture Recognition

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***Abstract*—We present a live demonstration of how tunnelling magnetoresistive (TMR) sensors can be built into a wristband for hand gesture recognition. This wristband has the potential to open new possibilities for interaction in extended reality (XR), prosthetics, and remote-control applications.**

***Keywords— Extended reality (XR); gesture recognition; human-machine interface; magnetomyography; tunnel magnetoresistive; wearable electronics***

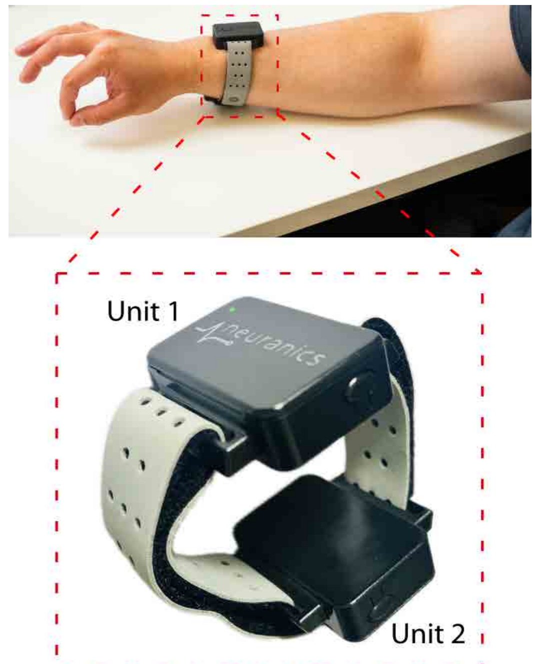


**Fig.1.** Prototype wristband and a close-up view of two units

## I. Demonstration Setup

The proposed wristband features modular PCBs arranged in a two-unit configuration, designed to comfortably wrap around the wrist with an adjustable strap, as shown in Fig. 1. Each unit integrates two TMR sensors alongside signal conditioning circuitry, and incorporates a low-power microcontroller that runs machine learning algorithms for time-series analysis directly on the device. Processed data are transmitted wirelessly via Bluetooth Low Energy (BLE) to an Android device or personal computer (PC), where a custom display interface, developed in Python, visualizes the results. This human–machine interface includes a proof-of-concept interactive application demonstrating real-time hand gesture recognition, implemented using the Axoy library [1].

## II. Visitor Experience

Attendees will have the opportunity to experience the wristband in action as it accurately detects and classifies a range of gestures, including finger taps, double taps, and wrist rotations. Real-time muscle activity signals and classification results will be clearly displayed on-screen, accompanied by integrated visual feedback to enhance engagement. Notably, the system operates without requiring direct skin contact, further highlighting its comfort, practicality, and ease of use in everyday scenarios.

## III. Technical Relevance and Novelty

This demonstration presents the first wearable system to seamlessly integrate a TMR-based biomagnetic signal sensing platform with embedded machine learning for gesture recognition. In contrast to conventional surface electromyography (sEMG) systems [2], the proposed wristband operates entirely without direct skin contact, which makes it inherently robust to sweat, skin impedance variations, and other physiological interferences. Its compact, battery-powered design delivers up to four hours of continuous operation, with a form factor optimized for comfort and all-day wearability. At its core lies an advanced pico-tesla-level TMR sensor [3], specifically engineered to unlock new possibilities for extended reality (XR) hardware and next-generation human‑machine interfaces (HMIs). This combination represents a significant step forward in wearable sensing technology and paves the way to more intuitive, seamless, and natural interaction experiences.

## IV. Conclusions

This live demo showcases accurate, contactless muscle activity monitoring through TMR-based sensing. The wristband's intuitive, comfortable design and robust performance position it as a ready-to-use development kit for seamless integration into next-generation XR technologies.

## References

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