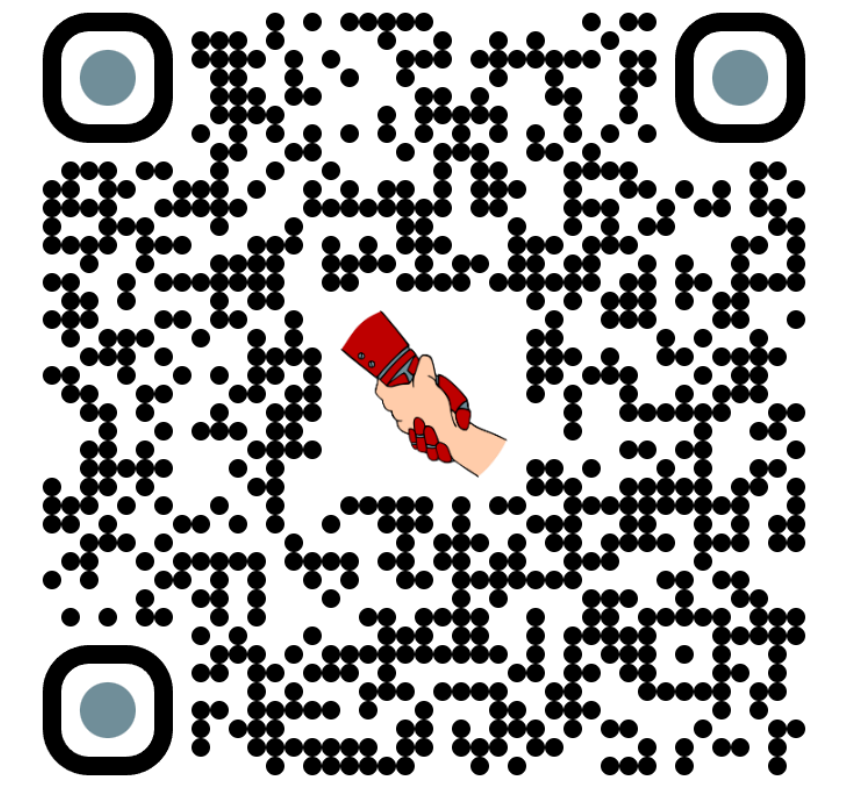


A Modular Platform for Customizable Biosignal-Based Control of a Simulated Assistive Robot



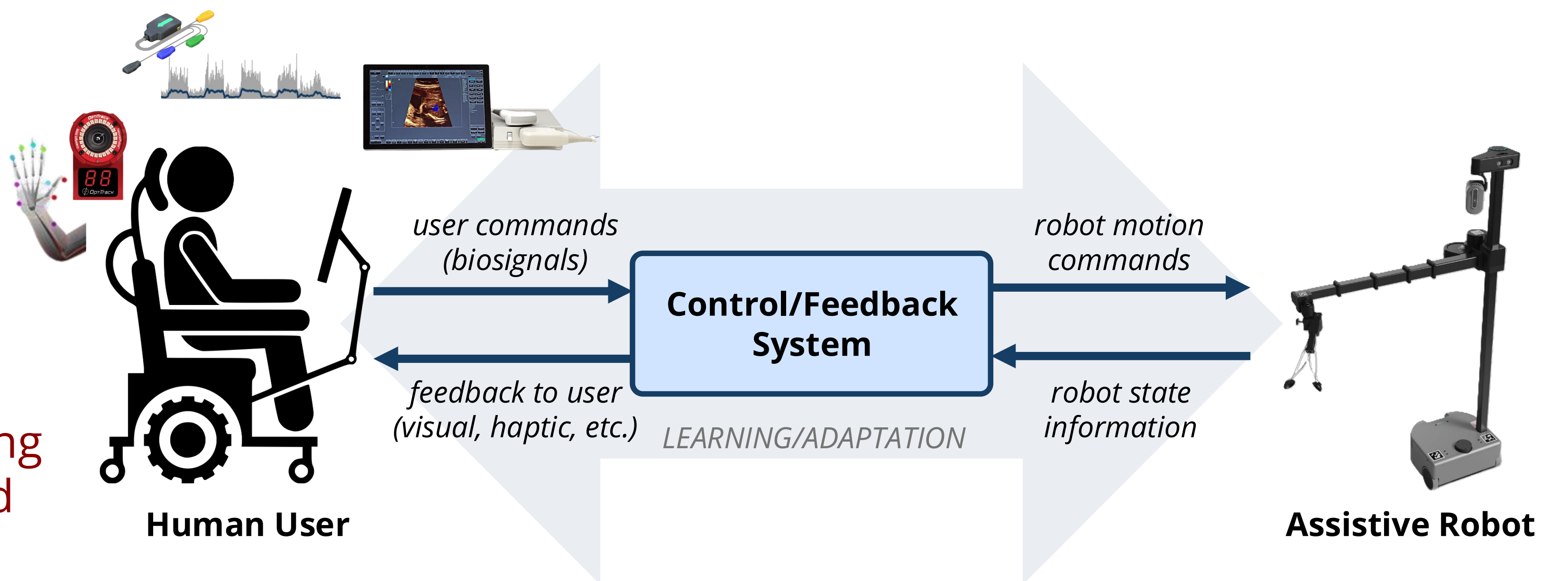
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We created a modular ROS 2 platform that enables **rapid development and testing of biosignal-based control schemes** for an assistive mobile manipulator.

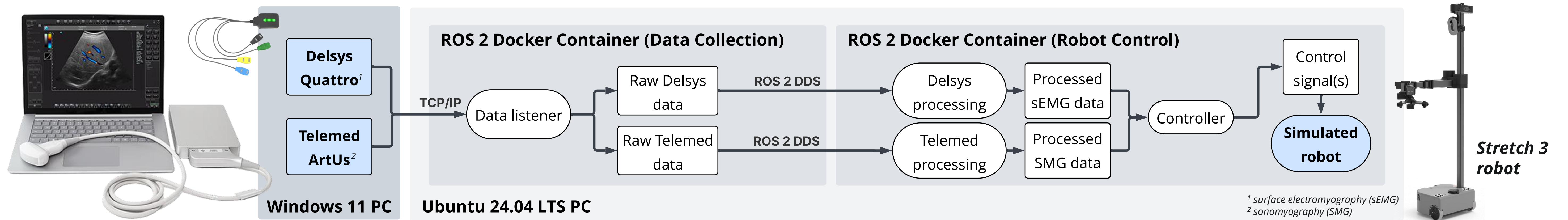


Motivation

- Spinal cord injury (SCI) survivors exhibit **heterogeneous capabilities** [1], but current assistive manipulator control schemes are slow, unreliable, and/or make assumptions about the user's level of motor function [2-4].
 - Many control schemes are possible, but there is no consensus on what will work best for a given user.
- **GOAL:** Develop a system for the rapid iteration and testing of different **robot morphologies, control mappings, and feedback paradigms.**



System Architecture



Pilot Study

Predefined Control DoF:

- Vertical Lift
- Horizontal Extension
- Wrist Yaw
- EE Opening/Closing

Preliminary **system test** with a naive control scheme. SMG signal is used to control one of four virtual Stretch 3 robot motions at a time, switched via sEMG.

This system is **highly modular** and allows a user to test many different possible combinations of biosignals and control schemes.

A continuous **SMG** control signal is defined after 3-point calibration and mapped to the full range of one of the four robot control states.

scan for full algorithm (Suetz et al. 2026)

Activating an **sEMG** signal above a programmed threshold cycles through predefined control states.

Significance

Our system enables rapid deployment of new **sensing modalities, data processing methods, and control schemes** within a **single experimental session**, toward discovery of **intuitive, personalized control schemes.**

Current Extensions

- Expanded system capabilities**
- Expanded sensing: IMU; multi-probe, multi-DoF SMG
 - Improved/standard simulator (MuJoCo)
- Control scheme development and testing**
- Task space control
 - Airplane-inspired control
 - Neuroscience-inspired control (e.g., separability/integrity)

Acknowledgments / Sponsors / References

*These authors contributed equally to this work.

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[1] Sheldon et al. (2025), *World Neurosurgery*.
 [2] Nazari and Zheng (2023), *Sensors*.
 [3] Henderson et al. (2013), *Technology Disability*.
 [4] Mougharbel et al. (2013), *Science and Information Conference*.