On-Device Context-Informed Incremental Learning for Myoelectric Control on RISC-V-based Wearable Platform

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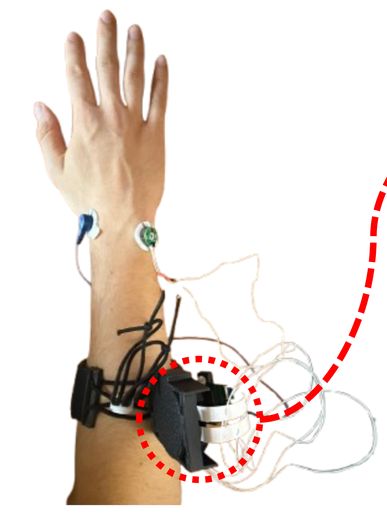
Objective and Hypotheses

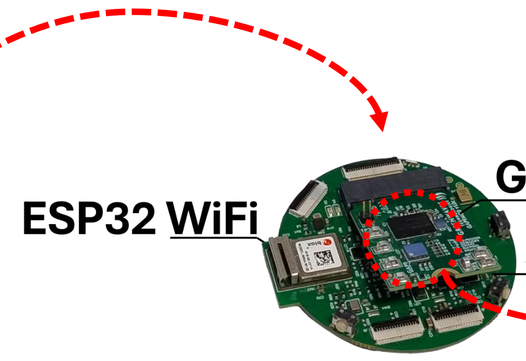
Build and validate an **EMG human–machine interface** based on a **custom armband** equipped with **GAP9**, a **RISC-V neural accelerator**. The proposed wearable platform runs a **context-informed incremental learning** (CIIL) pipeline directly **on-device**, allowing the model to **integrate user-in-the-loop information**.

- **H1. Online adaptation improves user control**, resulting in faster task-completion times compared with a fixed decoder
- **H2. The decoder can learn from user-in-the-loop information alone**, with no pre-training phase

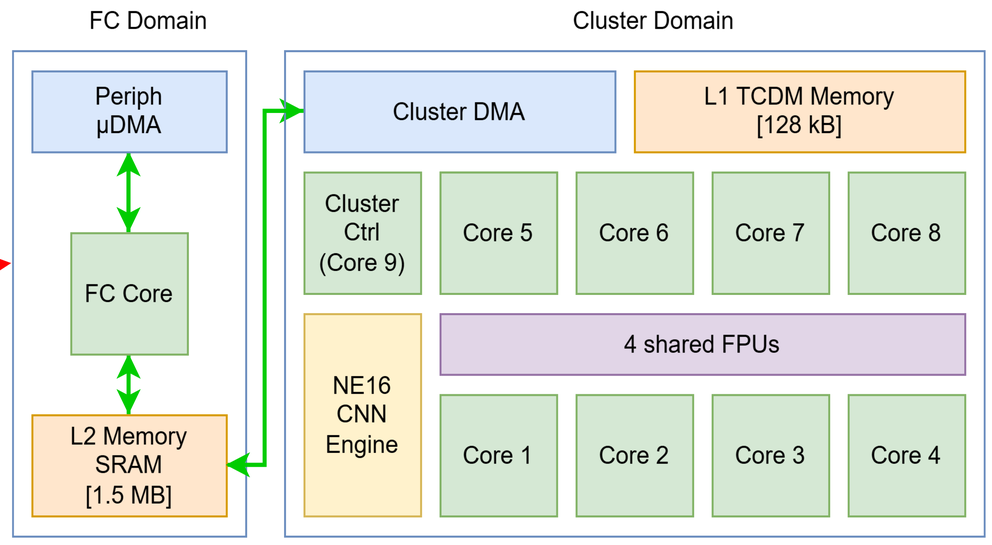
GAPWatch-based sEMG Armband



sEMG armband



GAPWatch Platform



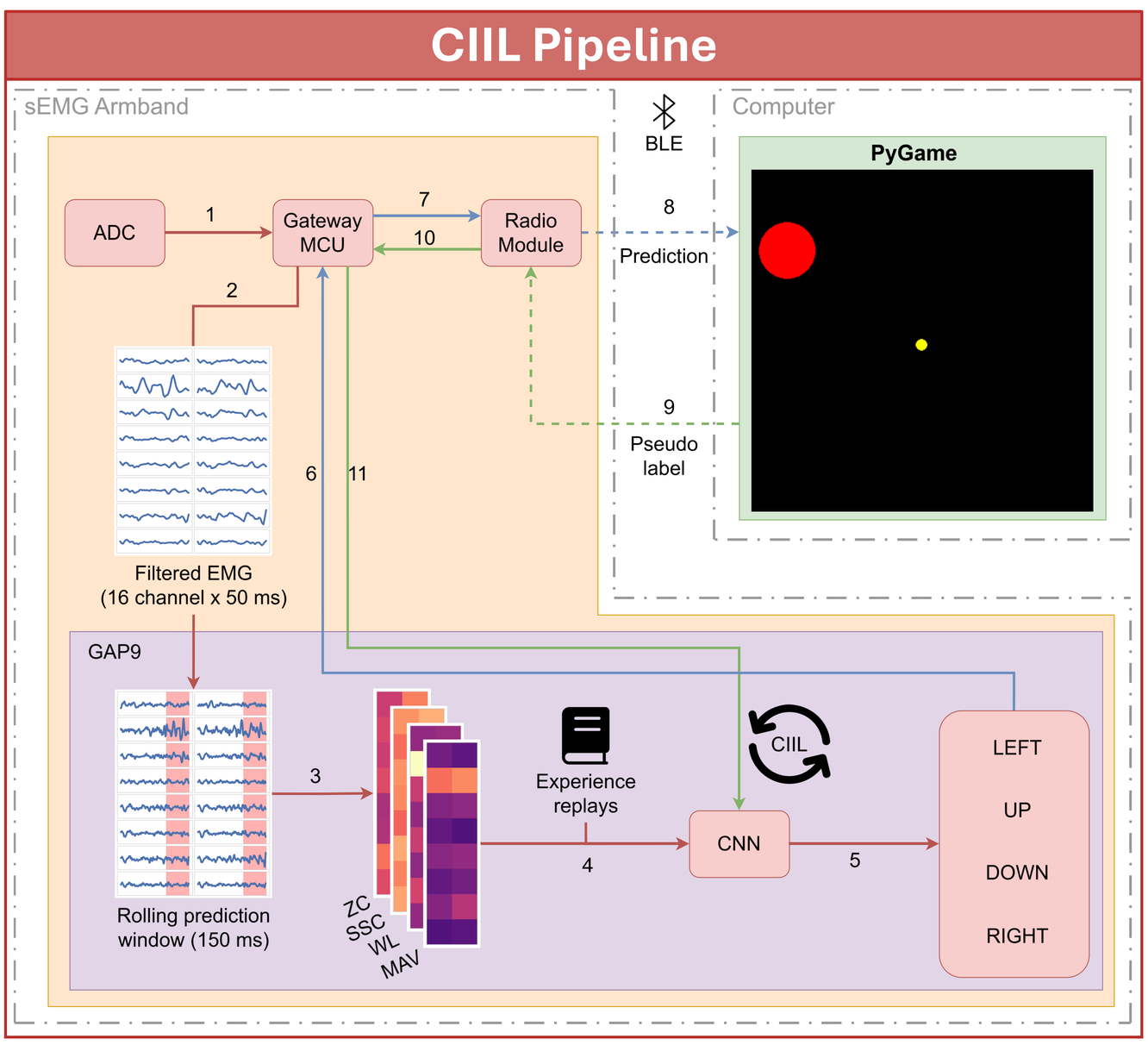
RISC-V GAP9 SoC

System Description

The user **controls a cursor with hand movements** during a functional task. The task runs in a PyGame program on a PC, which communicates with the armband via BLE.

- **Pseudo labels.** The program generates **pseudo-labels based on the outcome** of the predicted action: the cursor moves towards the target → hard *reward* label; the cursor moves away from the target → soft *corrective* label—0.5 probability for the two possibly correct directions.
- **Experience replays.** A **per-class, rolling buffer is replayed** alongside the live updates, preventing catastrophic forgetting.
- **On-device training.** Full FP16 forward+backward optimization on the **GAP9 cluster**.

CIIL Pipeline



Demo video

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