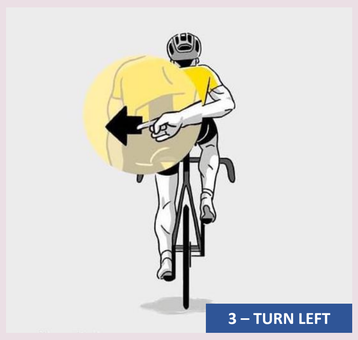
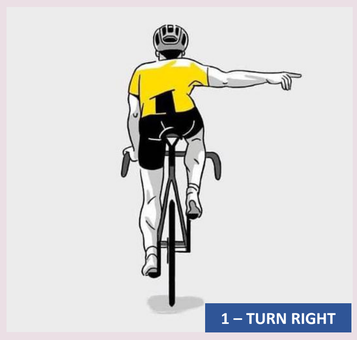
Fusing EMG and Inertial Data for Cyclist Gesture Recognition

I²MTC 25 CHEMNITZ

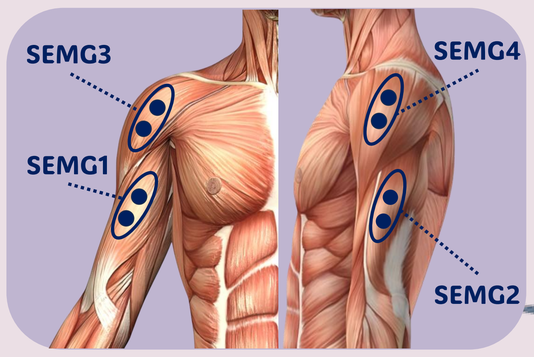
Poster No.

Objective



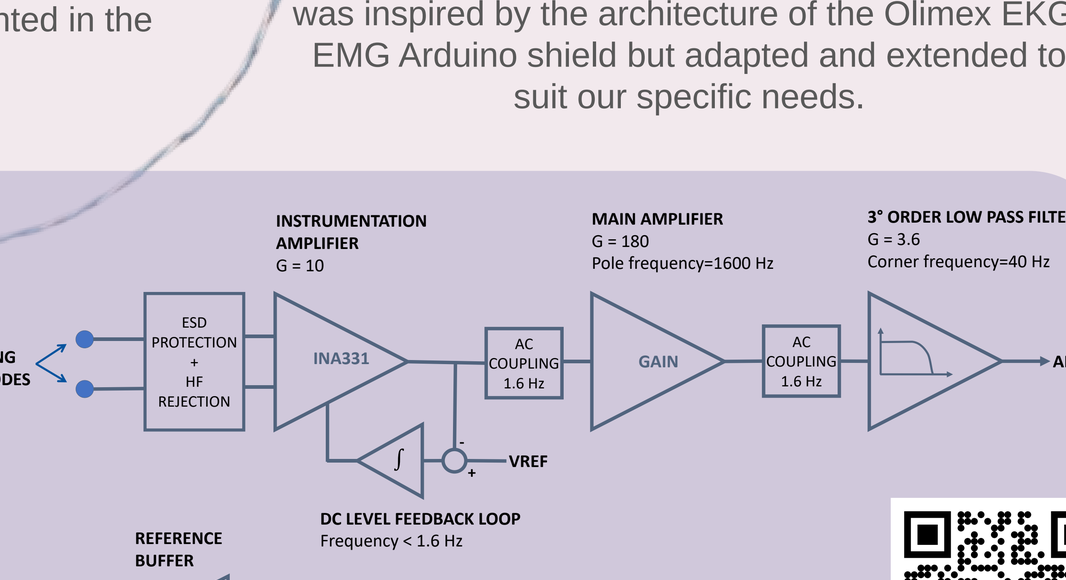


The proposed system is designed to recognize certain movements of a person's right arm. The **movements** analyzed are those commonly **performed by cyclists** to signal a change in speed, in direction or a stop.
To recognize the arm movement, electrodes were placed on the arm muscles.

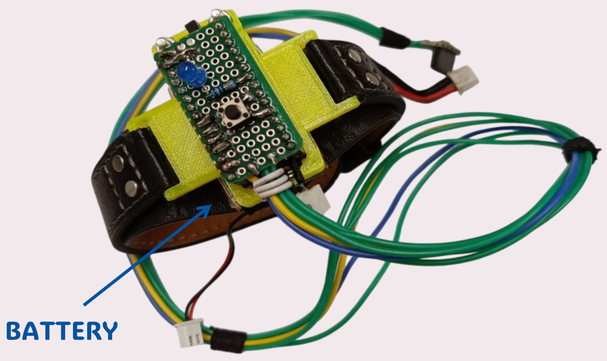


Experimental Setup

The system is composed of three main parts. An **Arduino Nano RP2040 Connect** is placed on the wrist to acquire **motion data** through an accelerometer and gyroscope. A custom PCB on the forearm collects **sEMG signals**. The third board is a **Raspberry Pi Model 3B+**, positioned on the bike, which **receives the data** in real time and executes a **neural network to classify the movement**.

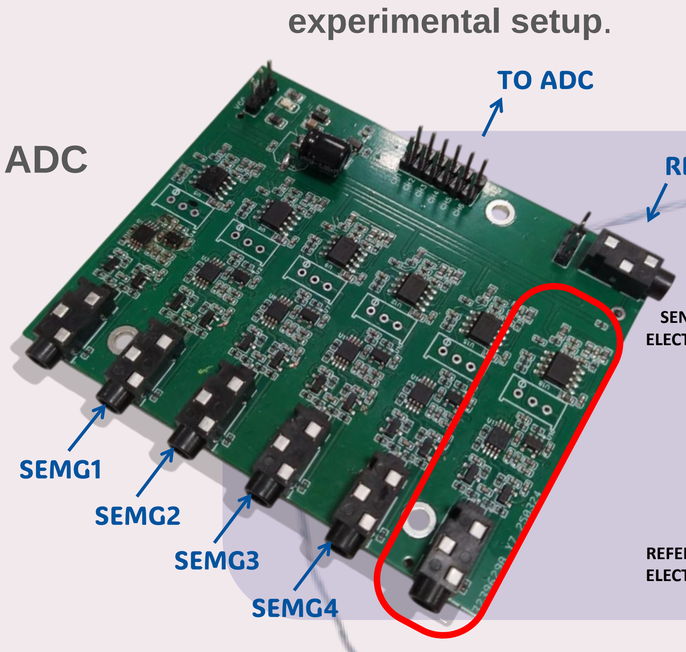


EMGesture Prototype



The Arduino Nano RP2040 Connect **is powered by a rechargeable battery**, allowing fully wearable and wireless operation. **Gesture acquisition** can be performed continuously or can be **manually controlled** by the user via a **button press,** as implemented in the **experimental setup**.

To meet the specific requirements of our acquisition system (a single reference electrode and the integration of multiple EMG channels) an **analog front-end**, implemented on a custom PCB, is responsible for **signal amplification and filtering**, was inspired by the architecture of the Olimex EKG-EMG Arduino shield but adapted and extended to suit our specific needs.



Raspberry Pi RP2040 - ADC

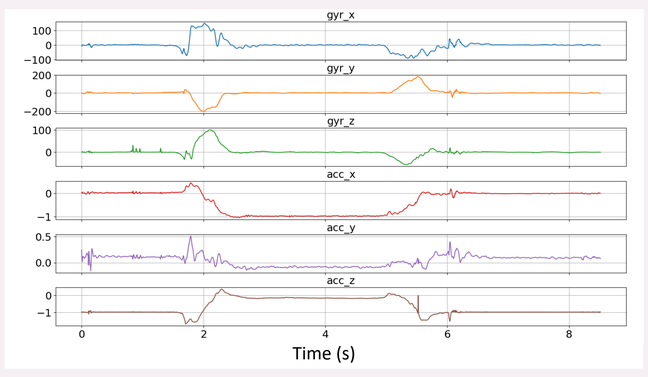
- 4 channel
- 12 bit @ 1kSa/s

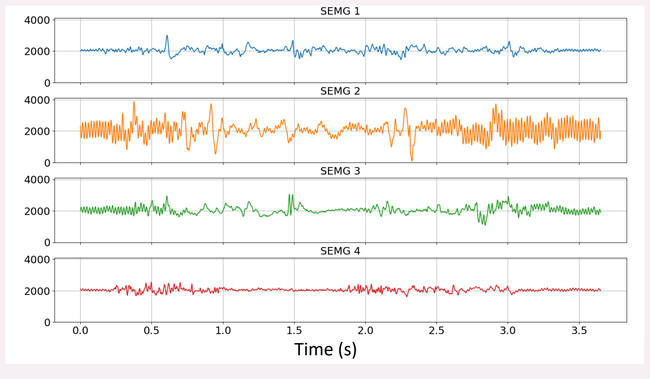
ST Microelectronics LSM6DSOXTR

- 3-axis accelerometer
  - ± 4 g
  - 16 bit @ 208 Sa/s
- 3-axis gyroscope
  - ± 2000 dps
  - 16 bit@ 208 Sa/s

SEE THE FULL PROJECT

Testing & Data Collection

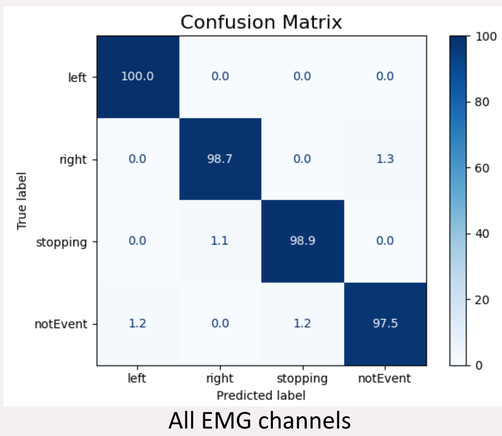




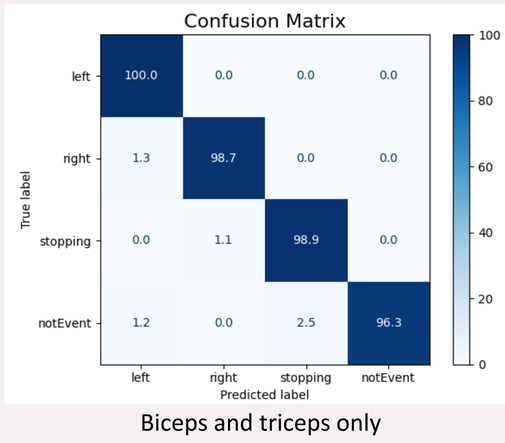
Results

The developed system successfully **classifies arm cyclist gestures** using data from EMG and IMU sensors, reaching an **accuracy of 96%.** Accurate classification is achieved using only EMG signals from only the biceps and triceps muscles.
The **EMG** data can be used to monitor the physiological **state of the muscle**, allowing a more complete analysis of the **user's activity.**
Future developments will focus on automating gesture detection, identifying the start and end of movements using accelerometer data, **eliminating the need for a manual trigger**.

The **dataset** collected during this project **will be released** as open source to facilitate reproducibility and further research.



All EMG channels



Biceps and triceps only

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