Finanziato dall'Unione europea NextGenerationEU

Ministero dell'Università e della Ricerca

Italiadomani
PIANO NAZIONALE DI RIPRESA E RESILIENZA

ICSC Centro Nazionale di Ricerca in HPC, Big Data and Quantum Computing

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ICSC Innovation and Community Day

11 Novembre 2025

DAMA - Tecnopolo Data Manifattura Emilia-Romagna (Bologna)

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HPC4Wearables – Big Data Platform for Acquisition and AI-Based Analysis of Wearable Sensor Data

Giorgio Delzanno

DIBRIS
Università degli studi di Genova

ICSC Innovation and Community Day

Outline

- Research objectives
- Coherence with the PNRR project
- State of art and proposed innovation
- Achieved results and research products
- Last steps

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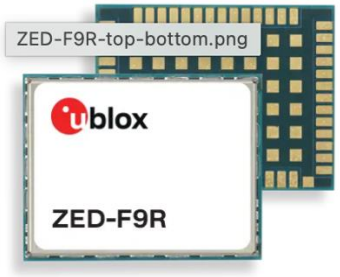
G.ter
Innovazione in Geomatica

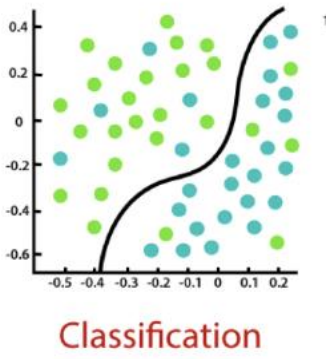
ComfTech

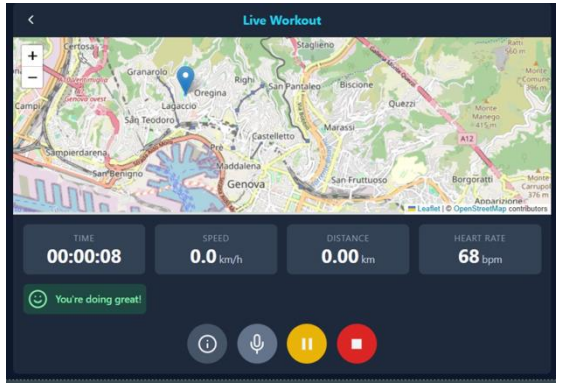
Research Objective

The project goal is to design and implement an Internet of Things (IoT)/Big Data system assisted by artificial intelligence (AI) algorithms.

The system will support the acquisition and analysis of georeferenced data relating to the physical state, movement and posture of teams of amateur cyclists, as recorded by wearable sensors.







Coherence with THE PNRR project

The project aligns with the goals of the PNRR by promoting digital transformation, data-driven innovation and the integration of AI technologies into everyday life applications.

It leverages high-performance computing and Big data to create value-added services in the health and wearables technology sector, contributing directly to the goals of Spoke 6.

State of art and proposed innovation

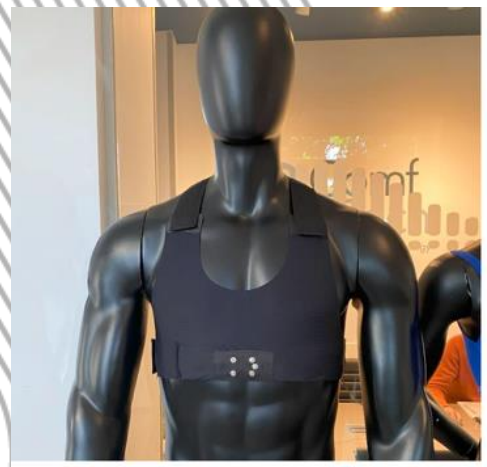
The project introduces a novel combination of High Performance Computing with AI-based analytics, adapted to the context of wearable sensor data.

The innovation consists in the use of a scalable architecture capable of processing heterogeneous data in real time, improving the detection of anomalies and user-specific trends with reduced latency.

Achieved results and research products

- Creation of a private cloud platform for data acquisition
- Creation and use of a wearable system
- Customization of the app to integrate GPS data
- Data collection campaign
- Training of AI models for activity classification
- Creation of a webapp for real time analysis and visualization of cyclist data

TEXTILE KIT, COMPANION APP and GNSS+IMU SENSOR



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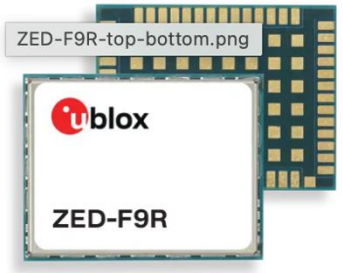

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WHAT KIND OF SENSOR DATA?

Comftech's Howdy Senior Textile Medical Device + Comftech App:

- Vital parameters such as heart rate, breathing rate and posture
- Metrics such as heart rate variability and stress index
- Smartphone's GPS

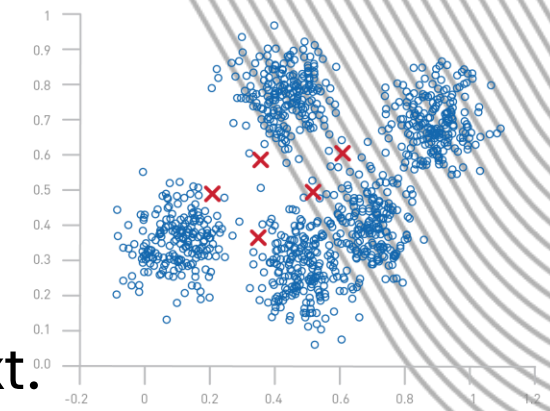
https://comftech.com/en/hpc4wearable/

Gter's GNSS device + IMU + RTK processing:

-Combination of a GNSS receiver+IMU (Ublox F9R) with a Taoglas AGPSF.36C antenna
-RTKLib + Extended Kalman filter to improve GNSS position

https://www.gter.it/il-progetto-hpc4wearable/

Training of a Classifier



- A **K-Means clustering algorithm** for individual cyclists has been **applied to** the public GoldenCheetah OpenData dataset in an **unsupervised learning** context.
- The **algorithm predicts the fatigue state of a single athlete**.
- Generation of synthetic data of cyclist teams using SUMO to predict behavior of a cyclists team

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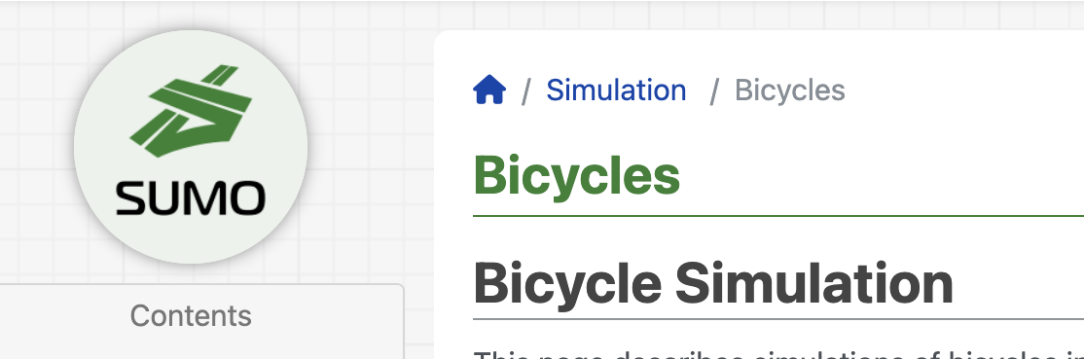
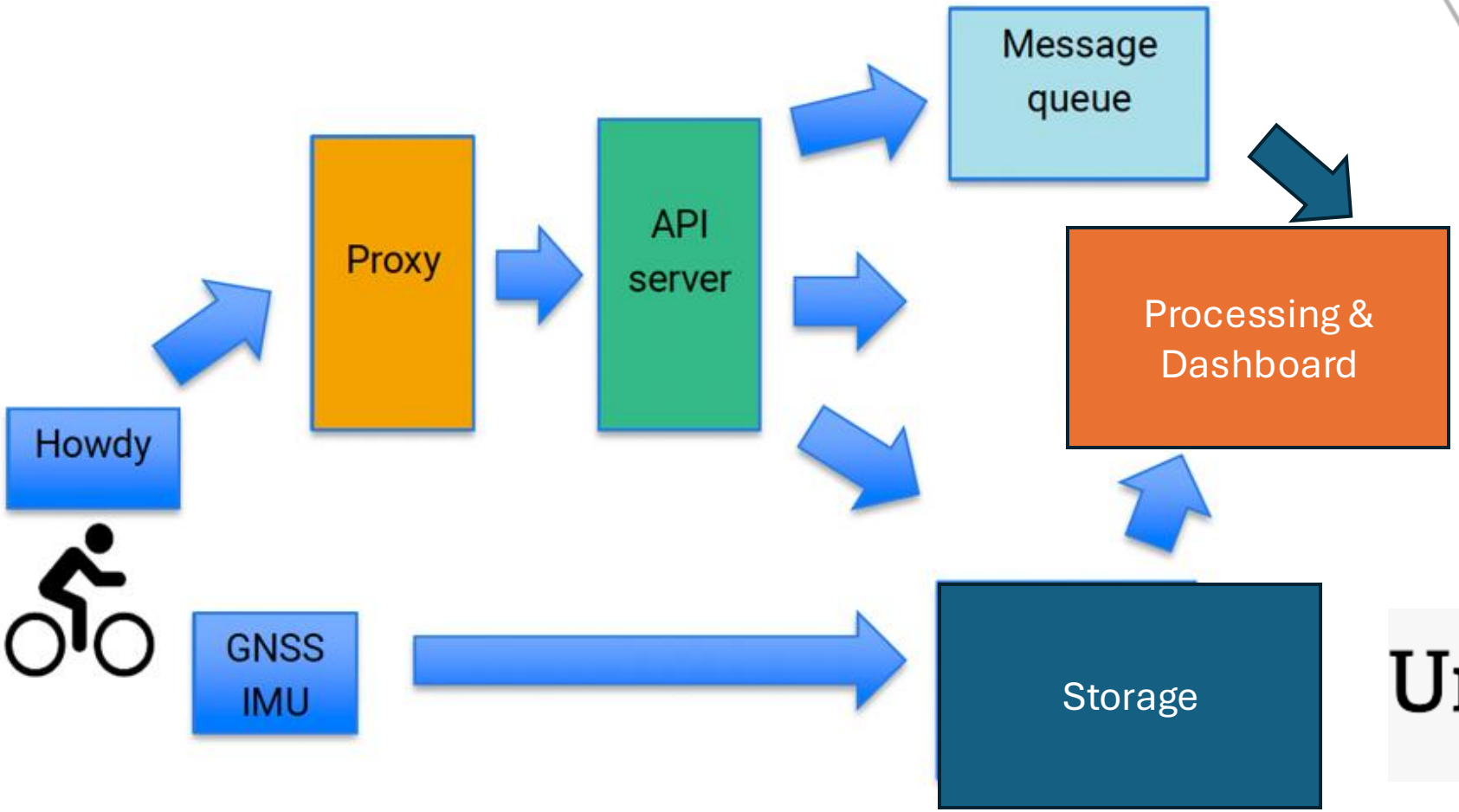


HPC4WeaRABLE ARCHITECTURE



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CYCLE-SYNC WEBAPP

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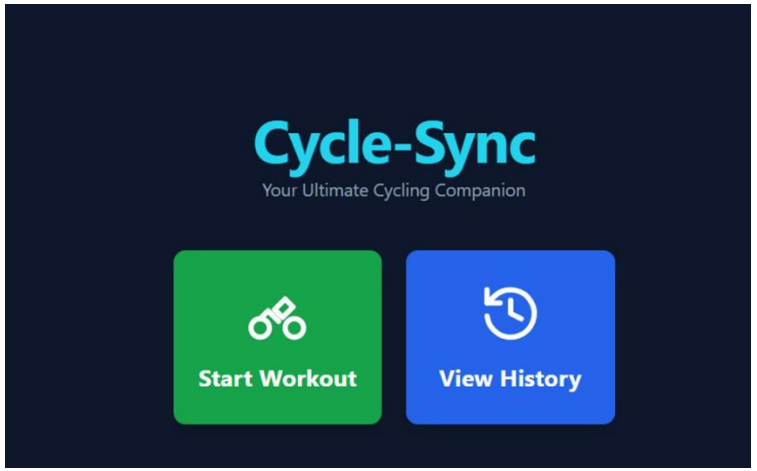

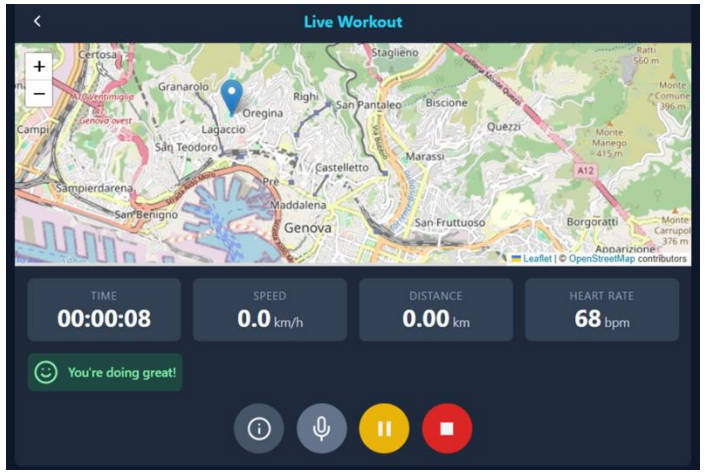

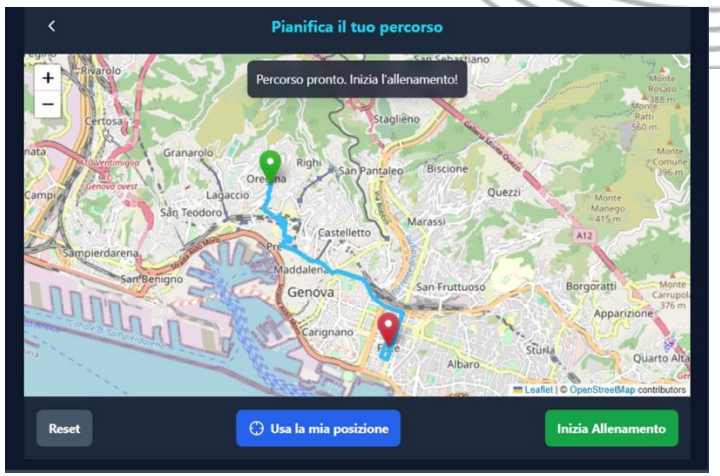

DATA COLLECTION

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Individual cyclist and groups of 2-3 athletes

In Veneto, Trentino, Liguria, Cilento (July-August)

Around 100 hours of recordings

LAST STEPS

- Training of AI models for team activity classification
- Integration real time classification step in the webapp together with team metrics and notifications
- Test based on collected data

Grazie per l'attenzione

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