ElectroCap Mid-Program Pitch Deck

Wearable Motion Tracker for Advanced Physiotherapy and Gait Analysis

Francisco Valente
Gonçalo Duarte
Rita Ramos
Miguel Gouveia
João Fonseca
Afonso Oliveira

TÉCNICO LISBOA

Problem definition

- Physiotherapy still relies on infrequent, subjective assessments or expensive lab equipment, limiting continuous and objective monitoring of patient progress.

- The lack of real-time motion data makes it difficult to accurately track gait cycles, limb orientation, and adherence to prescribed exercises, potentially delaying recovery.

- The challenge is to design a small, body-mounted electronic device capable of measuring, analyzing, and transmitting motion data about a human body in real time.

Solution beneficiaries

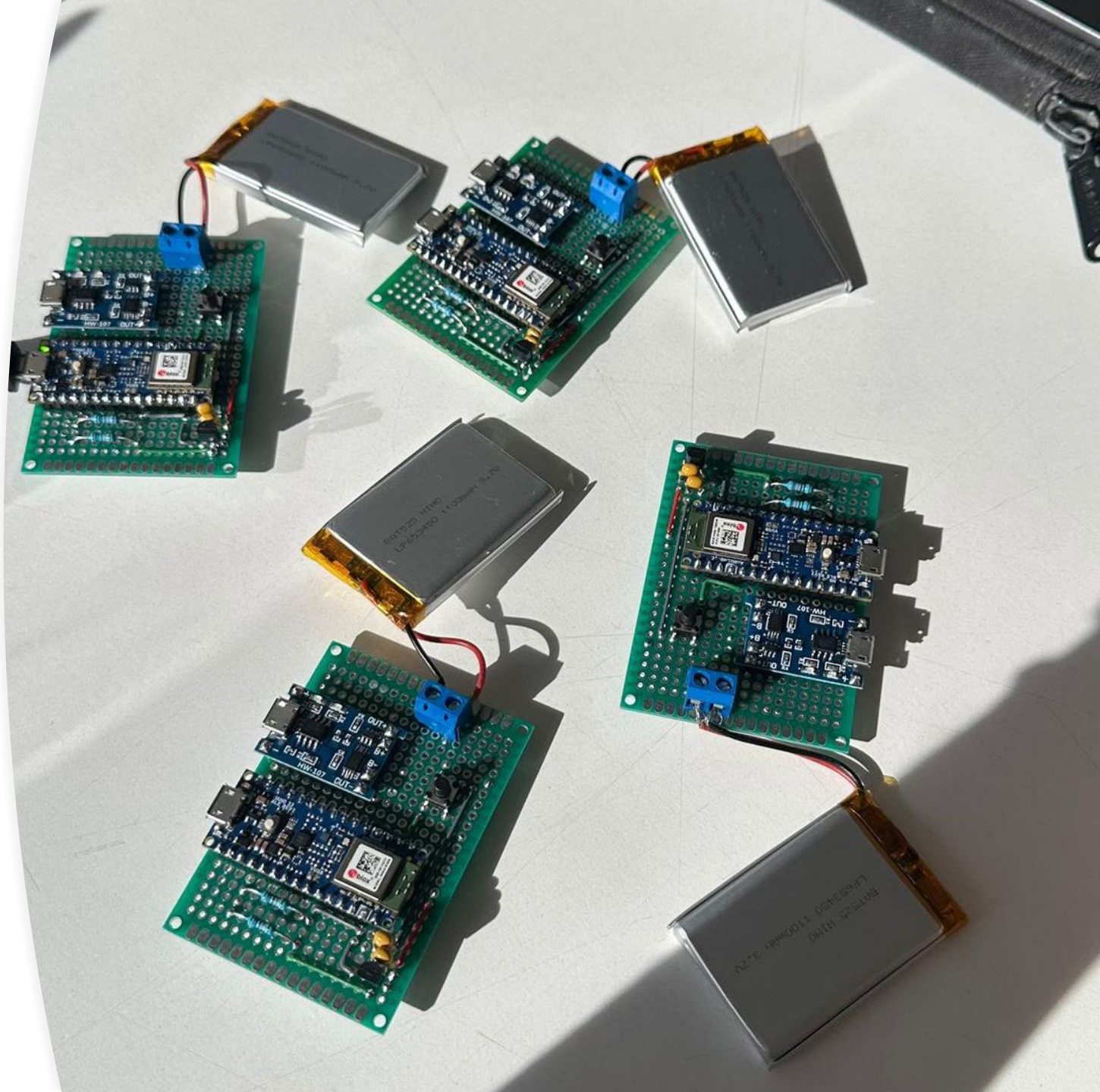
- Patients undergoing physical rehabilitation could benefit from improved and more personalized treatment approaches that enhance the effectiveness of their recovery process.
- We could also use the product to spot neurophisiologic problems earlier, like Parkinson and AVC.
- As well as physiotherapists, sports performance analysts.

Technological solution

- Our Prototype:

- A wearable motion-tracking network composed of multiple IMU-based sensor nodes that capture and analyze human movement for physiotherapy and gait assessment.

- Core Technologies:
  - 5 microcontroller with IMU sensors
  - BLE wireless communication
  - Sensor-fusion algorithms (EKF/Madgwick)
  - Dashboard for visualization & analytics



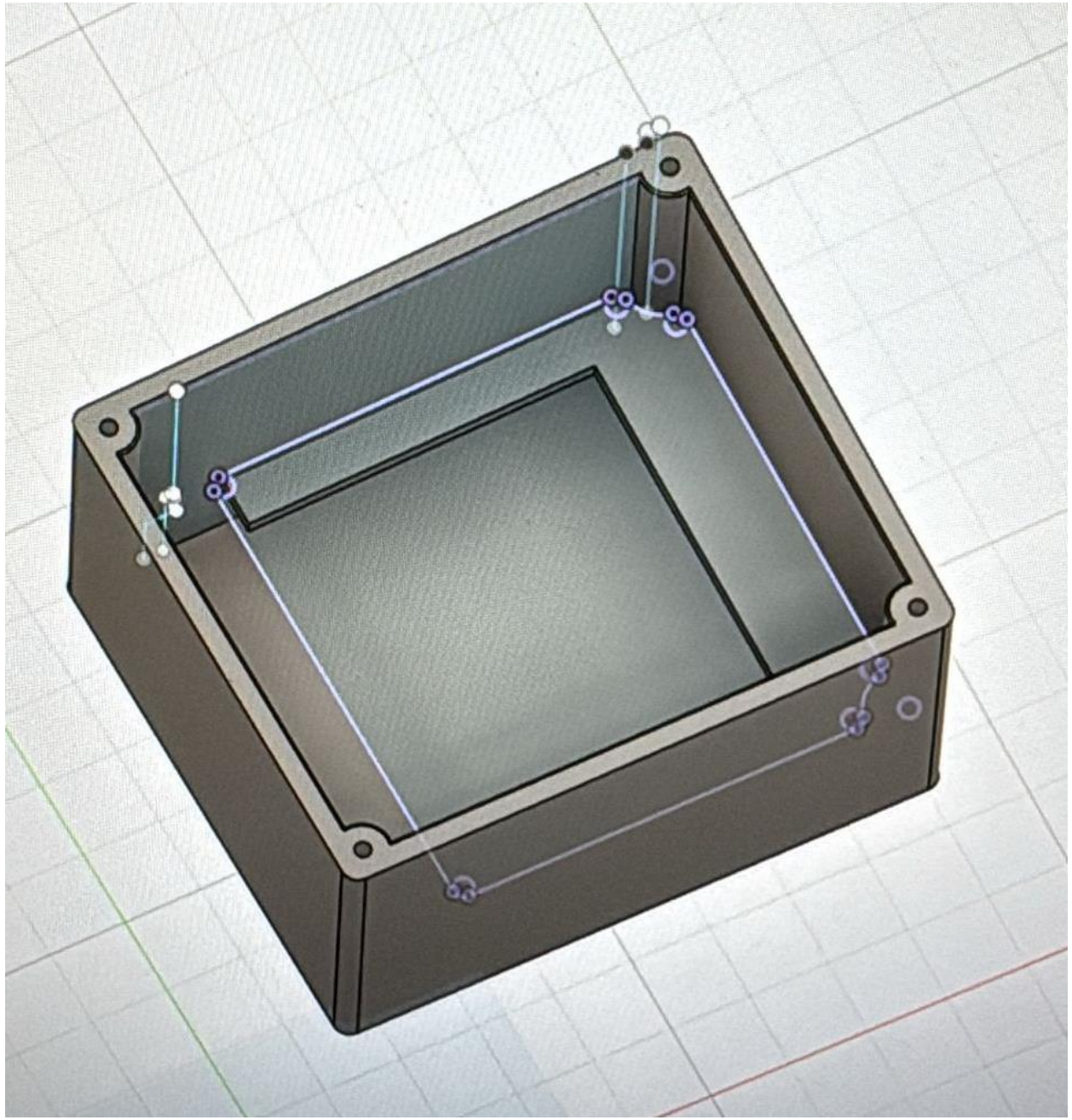
Technological solution

Key Capabilities:

- Real-time estimation of gait phases, and movement patterns
- Drift-corrected orientation tracking with synchronized multi-sensor data
- Long-battery-life wearable modules optimized for clinical use

Addresses Constraints:

- Low-cost alternative to camera-based systems
- Portable, comfortable, and scalable
- High accuracy in any environment



Competitors

Commercial Wearable Gait Analysis Systems:

- Xsens Awinda –Excellent accuracy but high cost and complexity.
- Noraxon MyoMotion – Wearable IMU-based kinematic tracking for clinical gait labs; high price, requires trained staff.
- Delsys Trigno – Expensive and not optimized for low-cost deployment.
- Moticon Science Sensor Insoles – Limited to foot analysis only.

Most systems are too expensive, not patient-portable, or focus on lab environments rather than everyday physiotherapy settings.

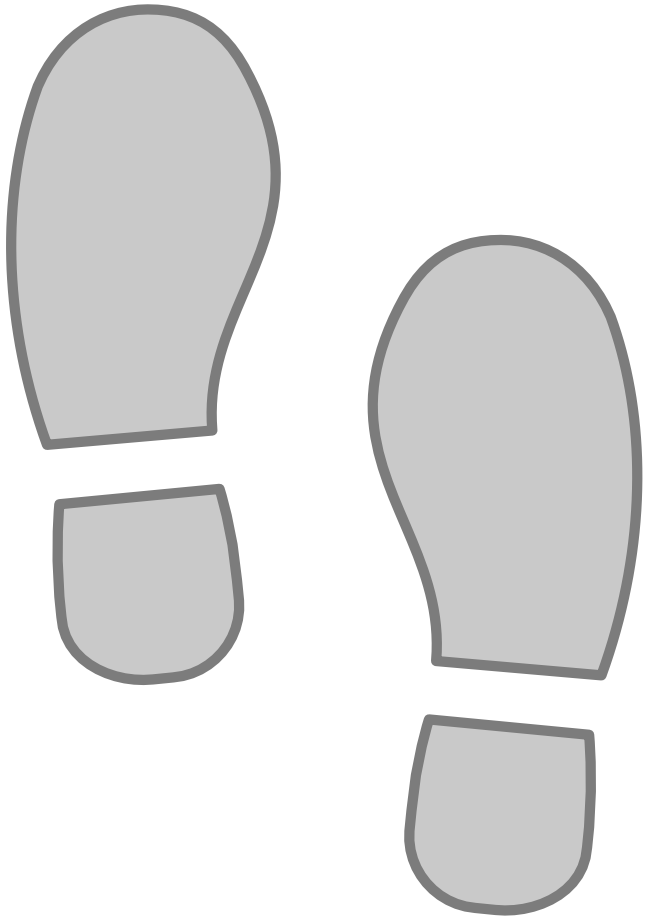
Previous work

IMU-based Gait Analysis Studies

- Many papers demonstrate that multiple IMUs on shank, thigh, and foot can estimate:
  - stride length
  - joint angles
  - temporal gait phases
  - gait asymmetry
  - fall-risk indicators
- These validate feasibility but are rarely translated into user-friendly clinical tools.

- Sensor Fusion Algorithms (EKF, Madgwick, Mahony)
- Proven methods for orientation and drift reduction; established foundations your project will build upon.
- Wearable Rehab Systems (exergames, biofeedback)
- Show that patients respond well to real-time feedback, but systems lack precise biomechanical tracking.

- Key Gap: Academic solutions often stop at prototypes — no scalable, clinically deployable wearable system is widely available at low cost.



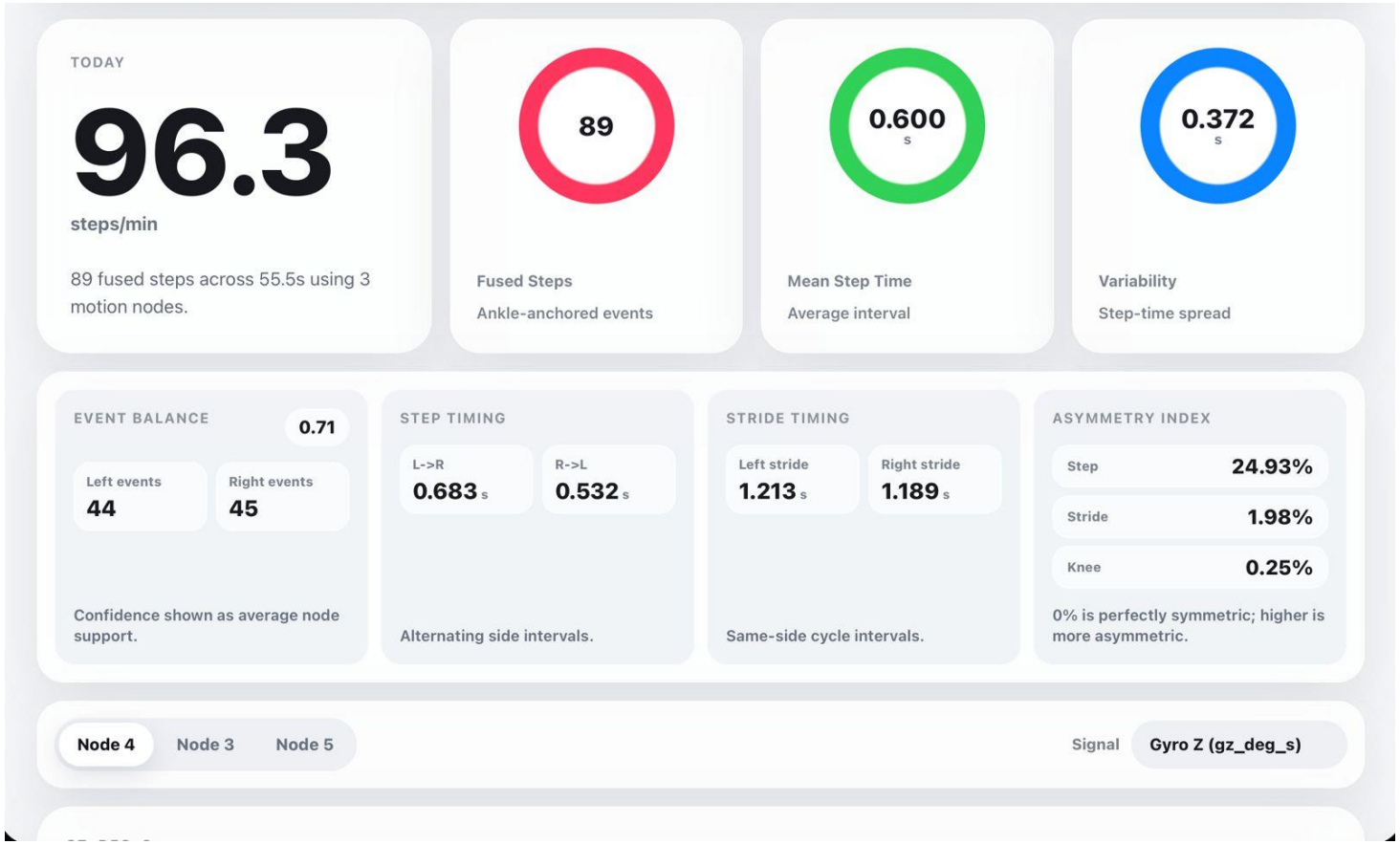
Solution requirements

- Accurate motion tracking (gait phases)
- Real-time feedback via Dashboard
- Drift-resistant fusion
- Performance:
- Supports multiple sensor nodes
- Lightweight, comfortable wearables
- Setup in <2 minutes

Real Data

We tested our prototype at Hospital Egaz Moniz with patients with different pathology’s .

With these tests, we can analyse data to understand how different neurophysiological problems affect a patient’s walking ability and how they recover after a procedure.

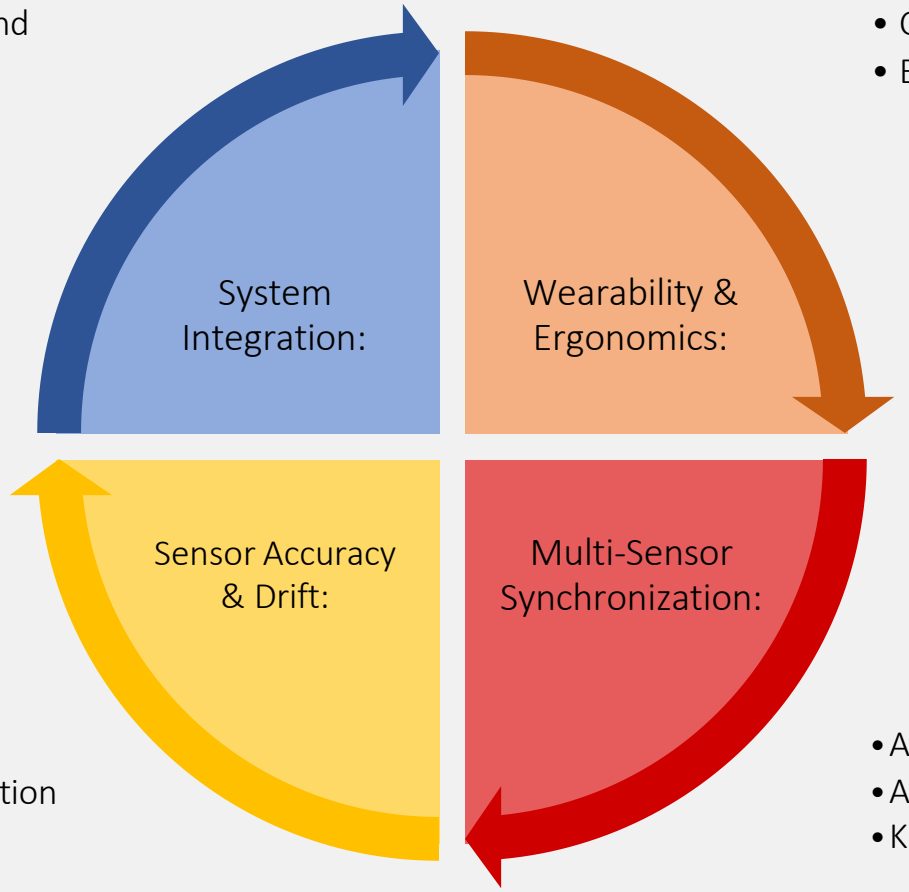


Real data

We have to give a special thanks to the hospital staff, from the neurology department. It was a great oppurtunity for us to test our project

Technical challenges

- Coordinating firmware, app, and backend
- Secure, GDPR-compliant data handling



- Compact, lightweight hardware design
- Ensuring stable attachment during movement

- Gyroscope drift over long sessions
- Magnetic interference affecting orientation

- Aligning timestamps across all nodes
- Avoiding packet loss and time skew
- Keeping end-to-end latency <100 ms

Schedule

Idea development and formalization	10/12/2025	1/04/2026
Submission of revised proposal + Website launch	01/02/2026	03/03/2026
Final selection of materials	26/03/2026	05/04/2026
Prototype development	24/03/2026	19/05/2026
Final testing and prototype completion	19/05/2026	26/05/2026
Finalization of communication materials	02/06/2026	09/06/2026