TÉCNICO LISBOA

ElectroCap Project Proposal

NaviSmart

Real-Time Tactical Sailing Telemetry

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WEBSITE NAVISMART

Meet Our Team

Gonçalo Silvestre

Mariana Menezes

Maike Guo

Bernardo Lopes

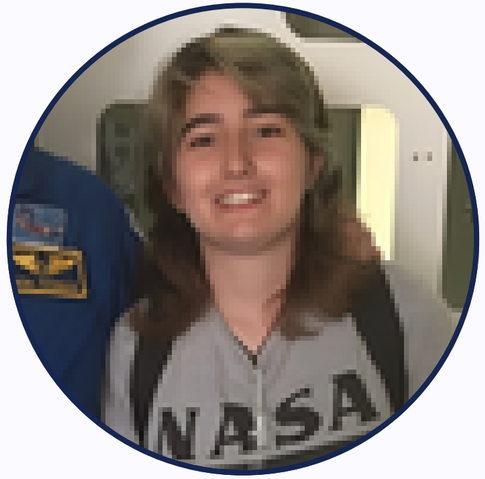
Joaquim Albuquerque

Daniel Ferreira

Advisors and Mentor

Coordinator

Professora Teresa Vazão



Co-Coordinator

Mariana Teixeira

Mentor

Nuno Barreto

Problem Definition

TELEMETRY MISSING

The lack of real-time telemetry deprives sailors of critical data, costing them victories in regattas.

TECHNICAL INCONSISTENCY

The difficulty of achieving perfect tuning daily undermines technical confidence and results in competitions.

SUBJECTIVITY

By relying solely on intuition instead of data, sailors risk making decisions that could cost them podiums.

COST BARRIER

The high cost of current professional systems prevents schools and amateurs from evolving technically.

Solution Benificiaries

Competitive Sailors

Coaches

Sailing School & Clubs

Technological Solution

Sensors

- BNO055 (heel/trim/yaw/heading)
- NEO-8M (location/velocity)

Microcontroller

- ESP32-S3 (Dual-Core)
- ESP32-C3

Data Transmission

- nRF24L01+PA+LNA (Long-Range RF Telemetry Link)

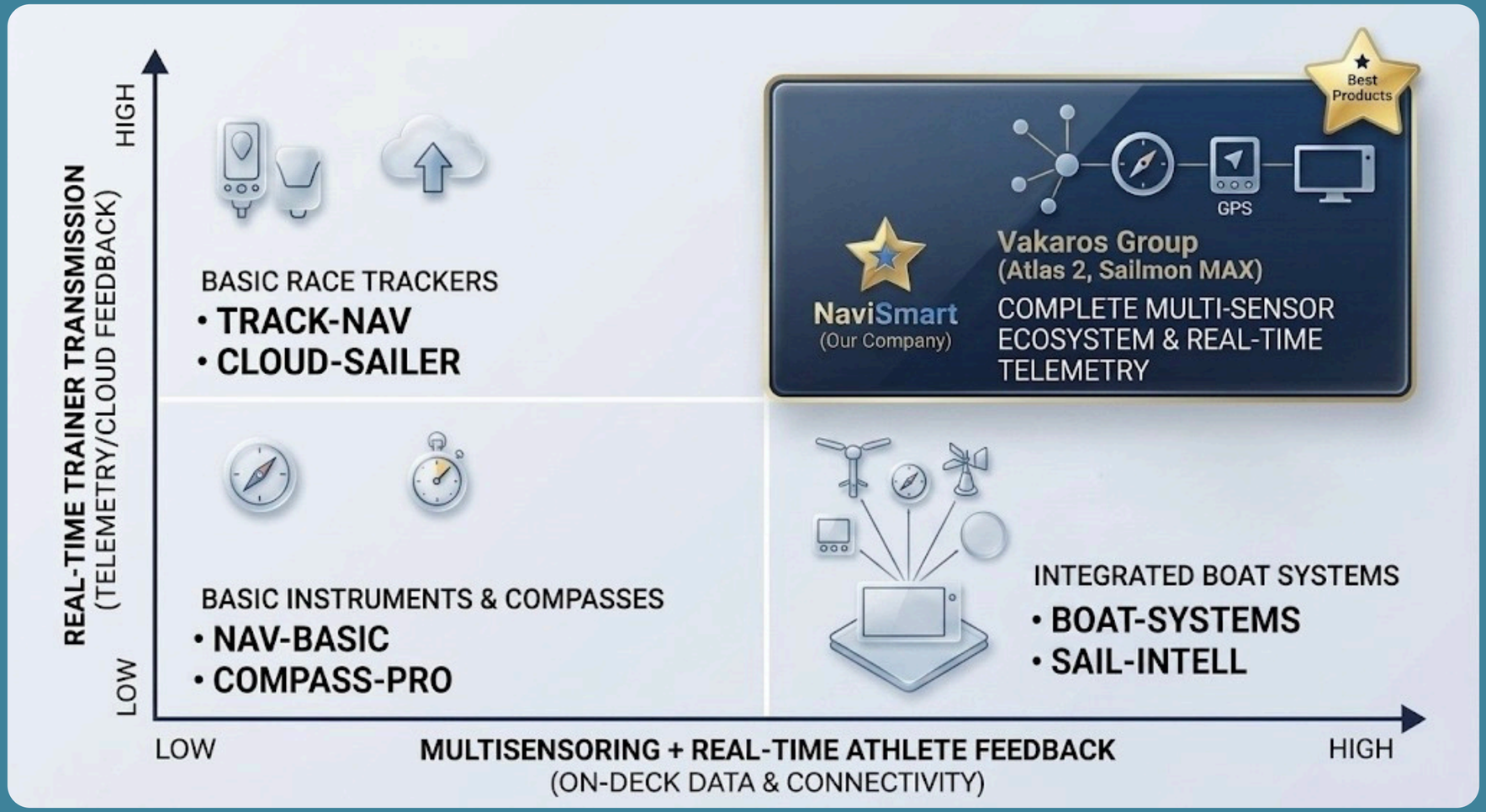
The Innovation Behind It

Live Streaming For The Coach

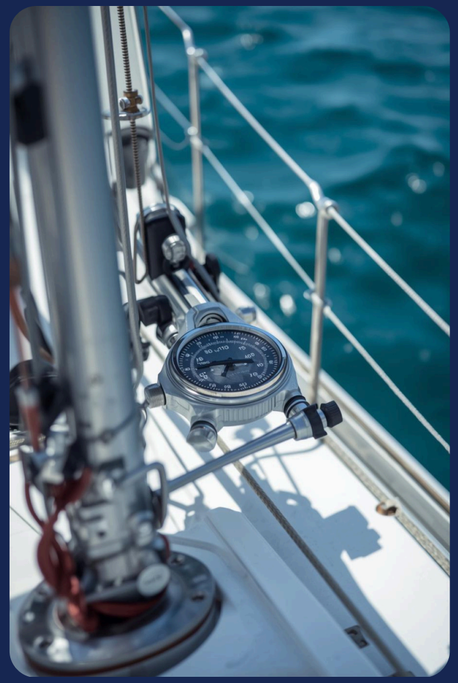
Immediate Feedback

Uncompromised Accessibility

Competitive Analysis



Solution Requirements

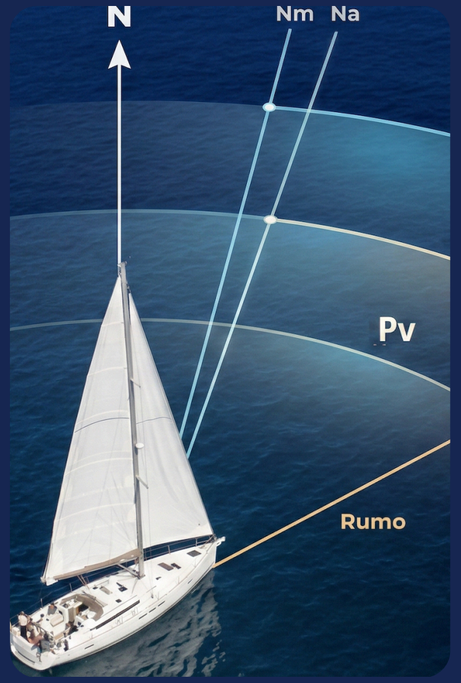


Attitude

Precise measurement of heel and trim angle

Velocity

Monitors the speed of the boat during navigation.



Heading

Capture the direction in which the boat is sailing.

Location

Provides the boat's location in real-time.

Telemetry

Visualization of variables captured in real time.

Technical Challenges

GPIO MATRIX MANAGEMENT

Complex pin mapping on the ESP32-S3 to support an IPS display and three communication buses (I2C, UART, FSPI) without memory corruption.

SIGNAL & RF POWER INTEGRITY

Introduction of LDO regulators and 100µF bypass capacitors to eliminate packet loss caused by 115mA current surges.

READABILITY VS. IP67 SEALING

Transition to a passive telemetry interface, bypassing the need for touch controls to maintain a hole-free, waterproof enclosure.

Challenges Non-Technical

TECHNOLOGICAL LEARNING CURVE

Transitioned from sequential Arduino programming to complex Dual-Core Real-Time Operating System (RTOS) orchestration.

MULTI-VENDOR PROCUREMENT

Managed a sub-€300 budget by coordinating multiple suppliers, balancing logistical risks and fragmented shipping costs.

Tests and Metrics

01 **Attitude precision**

$\pm 1°$

Ensures operation within design parameters, optimizing stability and hydrodynamics

02 **Transmission Latency**

$<200ms$

Instant and imperceptible communication, ensuring pure real-time telemetry

03 **Visual Data Refresh**

20 Hz

Fluid and professional display on the screen, without interruptions or data jumps

04 **GPS Accuracy**

$\pm$ 2m

Robust location through simultaneous reading of multiple satellite constellations

05 **Power Autonomy**

$\geq$ 4 h

Ensures continuous and reliable operation of the battery system throughout the activity.

06 **Wireless Data Rate**

250 kbps

Optimized speed to ensure maximum range and signal stability over water.

Tests and Metrics

07 **LOS Range**

±1 km

Ensures strong communication and reliable remote control over long distances.

08 **Packet Loss Rate**

< 1%

IUltra-efficient data transmission for seamless, lag-free telemetry.

09 **Display Brightness**

> 800 cd/m²

High brightness ensures perfect readability, even under direct sunlight.

10 **Viewing Angle**

± 175°

Full visibility with virtually no distortion from almost any viewing angle.

11 **IP Rating**

IP67

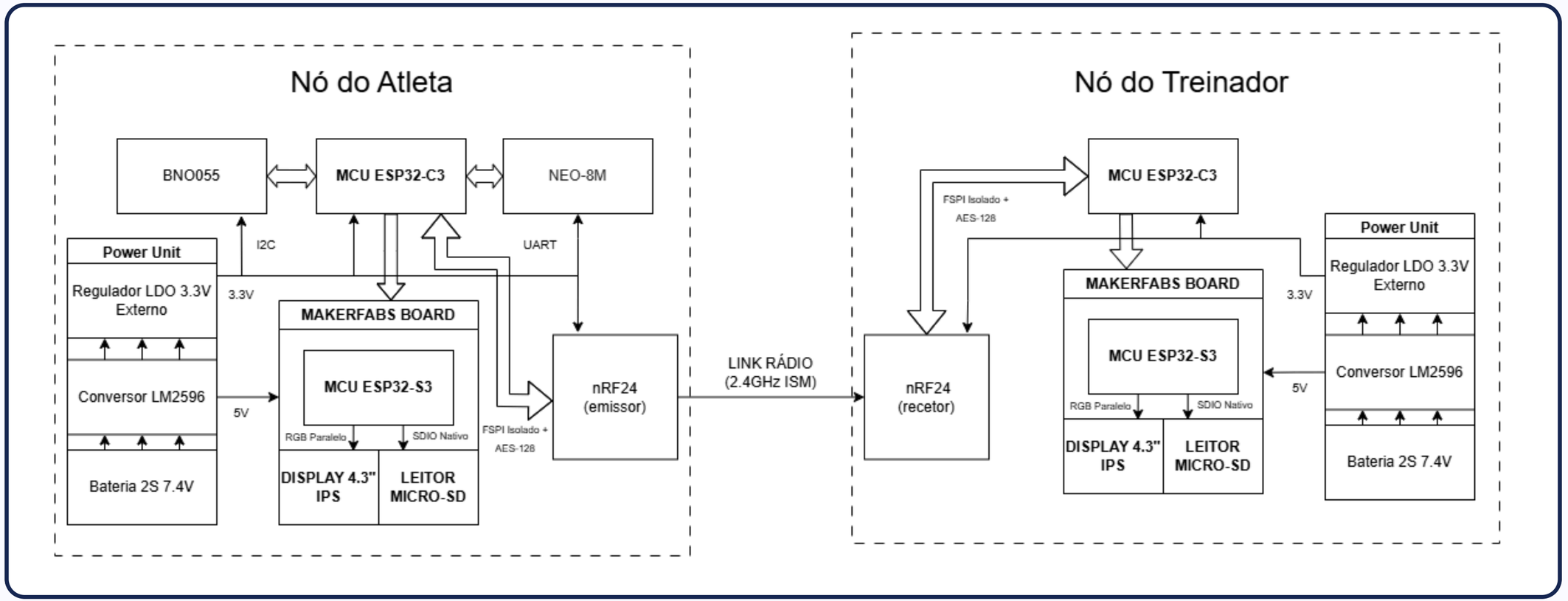
Total protection against dust and water immersion for maximum durability.

12 **Thermal Operation**

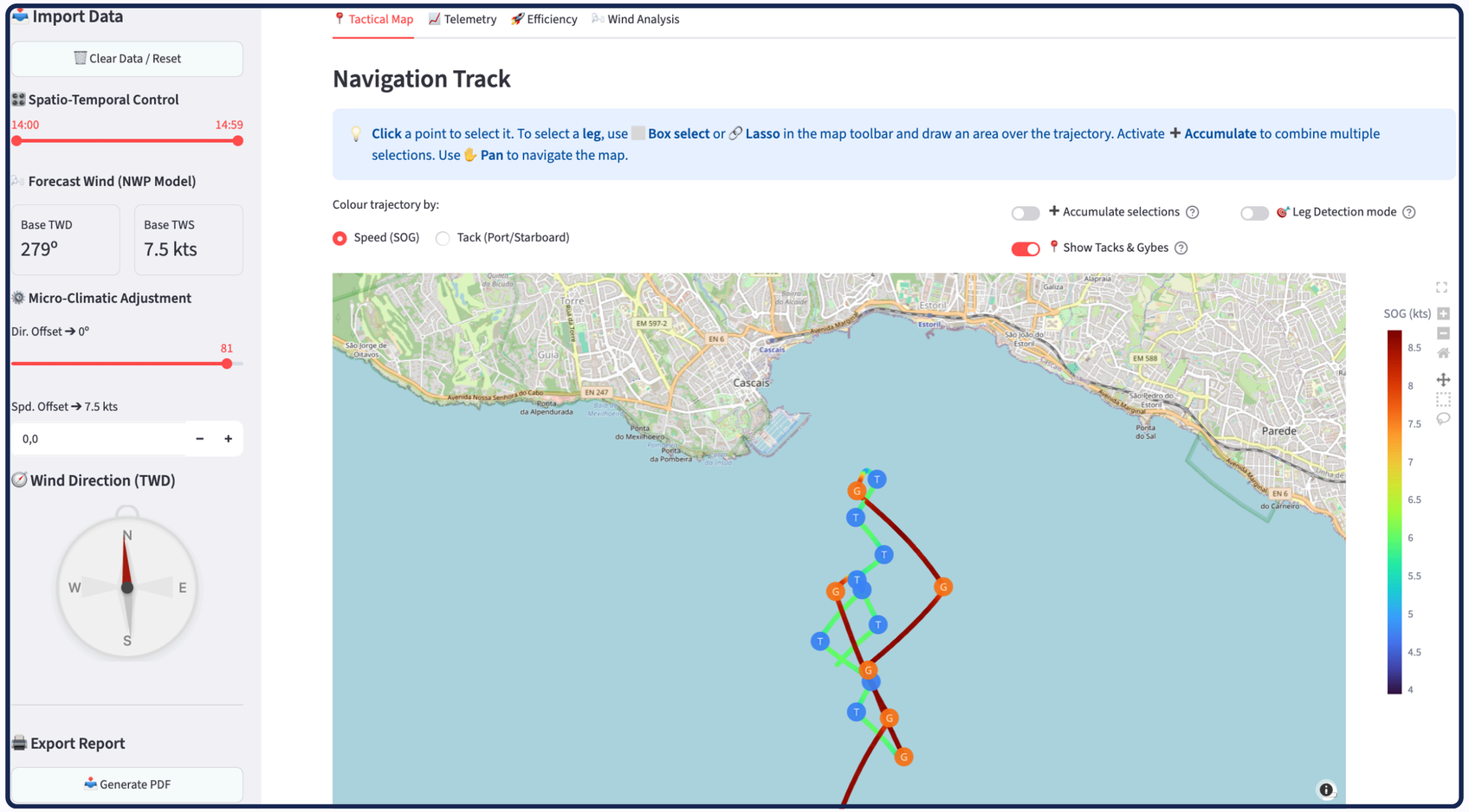
-10°C a +60°C

Consistent and safe performance in extreme cold or heat conditions.

Diagram of Solution Architecture



Results - Dashboard



You can check more here!

Results - Prototype

Task Division

GONÇALO SILVESTRE

Team leadership and decision-making to coordinate the project and ensure strategic direction.

MARIANA MENEZES

Documentation management, web design, and media coordination to support communication and visual identity.

MAIKE GUO

Sensor management and supervision of data capture to ensure accurate collection from the physical world.

BERNARDO LOPES

Telemetry infrastructure and data processing optimization for real-time alerts and decision support.

JOAQUIM ALBUQUERQUE

Data transmission supervision across all platforms to ensure reliable and secure communication flow.

DANIEL FERREIRA

Telemetry-focused development and implementation of remote monitoring solutions.

Contribution of Each Team Member

GONÇALO SILVESTRE

Led the team and stakeholder management for testing. Developed the storage firmware (SD), assisted with sensor troubleshooting, and co-led the creation of the data analysis dashboard.

MARIANA MENEZES

Actively managed project documentation, communications, site, and deliverables. Developed the screen user interface, co-led the data analysis dashboard, and produced the demo video.

MAIKE GUO

Ensured sensor operability and calibration. Developed the inter-microcontroller (ESP32) communication protocol and provided vital support in resolving hardware anomalies.

BERNARDO LOPES

Unified the team's code modules into an integrated system. Developed the 3D modeling of the system enclosure and carried out the mechanical and structural assembly of the final prototype.

JOAQUIM ALBUQUERQUE

Implemented the communication infrastructure and integration of sensors with the transmission modules. Served as the primary debugging element and resolver of complex system failures.

DANIEL FERREIRA

Assisted in the assembly of soldering, ensuring the electrical and circuit integrity of the prototype.

Schedule

Start of Development

Project development began on March 15, with the team focusing on defining the architecture and selecting the necessary electronic components.

Initial Tests

Between April 20th and May 5th, initial tests of the components will be conducted, validating their integration and functioning within the system as a whole, identifying necessary improvements.

Final Adjustments

After the tests, the team will decide on the final adjustments, which will take place between May 6 and 15, ensuring that all components function in perfect harmony.

Validation and Documentation

The final phase of validation and documentation is scheduled for May 20th, where the results will be analyzed and the project's documentation will be completed for presentation.

Partners

Instituto Superior Técnico

TÉCNICO
UNIVERSIDADE
DE LISBOA

Technical and scientific support
for project development.

Federação Portuguesa de Vela

FEDERAÇÃO de VELA
PORTUGUESA

Collaboration in the validation
and practical application of the
solution.

Oficial WebSite

SCAN THE QR CODE OR ACCESS THE LINK BELOW TO VISIT OUR WEBSITE.

WEBSITE NAVISMART

Demo Video

SCAN THE QR CODE OR ACCESS THE LINK BELOW TO SEE OUR VIDEO.

VIDEO NAVISMART