

# ELETROCAP PROJECT PROPOSAL

## NAVGUIDE: Smart Navigation System for Visually Impaired in Supermarkets

# Advisors & Mentors



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**Coordinator:** Prof. Pedro Vítor

**Mentors:** Prof. João Paulo Costeira / Prof. João Pedro Gomes

# PROBLEM DEFINITION

**Blind and visually impaired individuals** face challenges navigating supermarkets independently. Traditional layouts lack accessibility features, leading to reliance on external assistance and limiting their autonomy.

This issue is present in **all supermarkets in Portugal**, hence the importance of addressing it.

# Solution Beneficiaries

01

## Blind People

The system empowers fully blind individuals to navigate supermarkets independently, reducing reliance on external assistance.

03

## People with Cognitive or Navigational Difficulties & the Elderly

Individuals who struggle with spatial awareness or memory can benefit from clear, step-by-step guidance.

02

## Visually Impaired People (Amblyopes)

Provides enhanced support for those with partial vision, improving their shopping experience by offering real-time guidance and product identification.

04

## Markets & Supermarkets

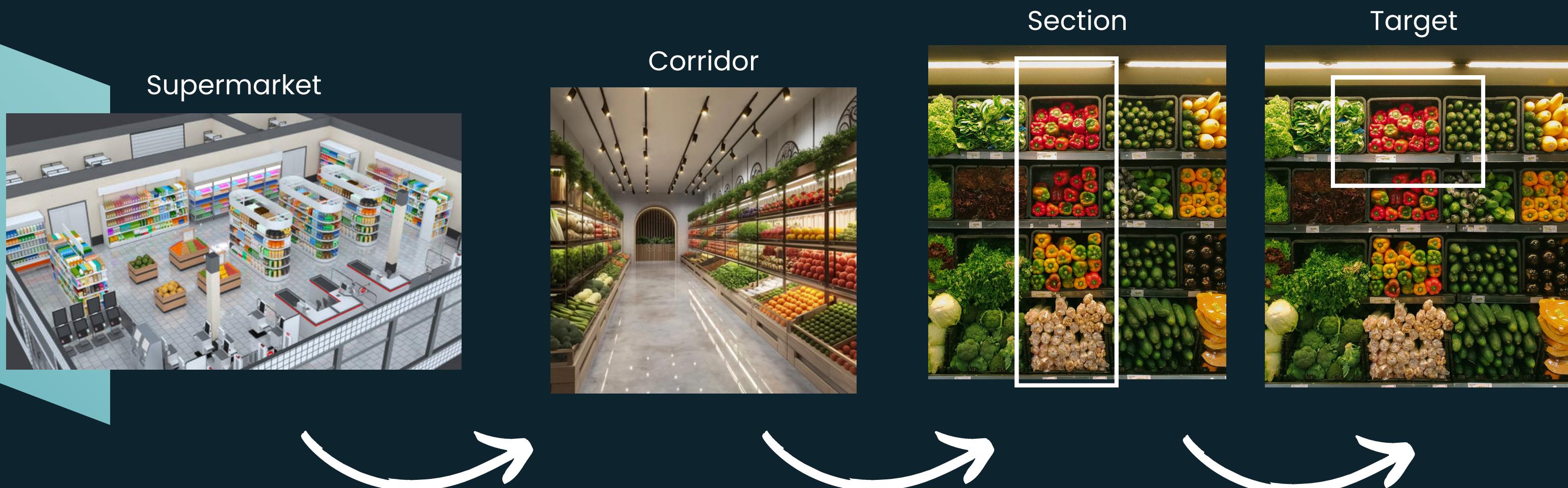
Supermarkets can enhance accessibility and improve customer experience by providing an inclusive shopping environment.



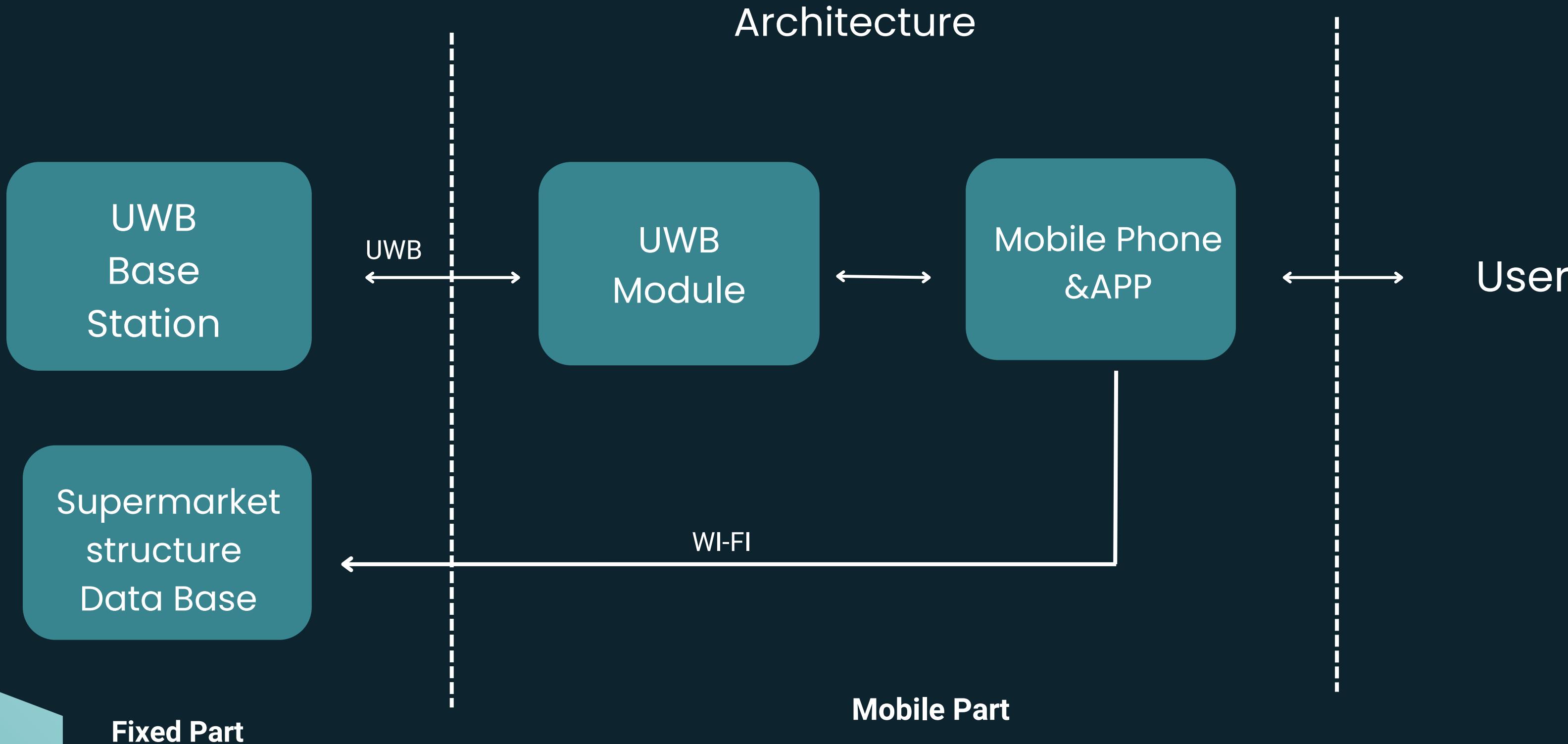
# Technological solution

Develop a system using **Ultra-Wideband (uWB) technology** to assist visually impaired individuals in navigating supermarkets.

This system will offer real-time, precise and location-based guidance, enhancing their independence and shopping experience.



# Technological solution



# Technological solution

## Main Areas

### **Ultra-Wideband (UWB) Technology**

**Short-range wireless communications** that uses high-frequency radio waves to transmit data

### **Mobile Application**

Offers **voice-guided instructions**, helping users navigate the store independently by delivering real-time updates and directions

### **Supermarket Mapping System**

Digital maps the supermarket layout, integrating with the UWB system to identify the user's location and guide them to desired products or areas

### **Accessible User Interface**

Designed specifically for visually impaired users, the app includes **audio feedback** and an intuitive interface to ensure ease of use

# Competitors and previous work



## NaviLens

Their system uses **color-coded markers** that can be detected by a **smartphone app** from up to 20 meters away, without the need for precise alignment, offering **audio guidance** in 36 languages. This system works relatively well in supermarket with all the products identify by the color-coded marker.



## RightHear

An **assistive technology** designed to guide visually impaired individuals in navigating indoor and outdoor spaces. It uses **Bluetooth beacons** installed in facilities to transmit location-specific audio cues to a free smartphone app. The system provides real-time directions, contextual information about surroundings, and updates like operating hours.

### Previous Work

A good part of the projects, found online, are based on **RFID technology** and not on location systems like ours. However, some studies have explored **UWB** for indoor navigation, such as :

**Developing an Ultra Wideband Indoor Navigation System for Visually Impaired People.**

# Solution Requirements

The solution must be **cost-effective** for widespread adoption, balancing affordability and reliability.

It should provide highly accurate **UWB-based indoor positioning** with minimal error.

The system must be **intuitive** and **accessible**, offering clear audio or haptic **feedback**.

Seamless **integration** with existing supermarket infrastructures and **compatibility** with personal assistive devices are essential.

It must be **scalable** for supermarkets of different sizes.

Ensuring **user privacy** and **data security** should be a top **priority**.

# Technical Challenges

01

**Frequent Layout Change:** Supermarkets frequently change the layout of aisles and shelves, requiring regular updates to digital mapping.

02

**Physical Obstacles:** High shelves, crowded spaces, and other obstructions can interfere with signal accuracy, affecting navigation reliability.

03

**Instruction Accuracy:** Misinterpretation of instructions or poor execution of them.

04

**Cost Constraints:** Ensuring the system remains affordable while maintaining high-quality performance is a key challenge.

05

**Adaptability:** The solution must be flexible enough to accommodate different supermarket layouts, product placements, and segmentation variations

# Partners

## APEC - Associação Promotora do Ensino dos Cegos

APEC is supporting us in the development of our project by providing valuable feedback and insights. They are also open to testing our prototype, helping us refine and improve it.

# Testing and Validation Metrics

## Lab Testing

- The **Positioning accuracy** of both the UWB locator and user;

## Supermarket Testing

- The **Success rate of the navigation** in the mapped space;

## Metrics

- Results of the **Lab & Supermarket testing**;
- Success rate of the **individual's navigation**;
- **Ability** of the individual to **complete the tasks** they set out to do and to be guided by the system;
- Tests with target users- **Satisfaction survey**.

# Division of tasks

**Ana Cláudia Vilela**

## Website

- Performing sensor accuracy tests
- Creation and weekly maintenance of the website with project updates
- Creating an accessible interface for visually impaired users through audio integration within the application

**João Simões**

## Sensors

- Configuration and calibration of UWB sensors
- Integration of sensors with the mobile application
- Implementation of the UWB Positioning System
- Development of the indoor localization algorithm

**Sofia Vicente**

## Partnerships & Documentation

- Establishing strategic partnerships with companies and organizations to support project development
- Development of the project website's structure and design (ux/ui)
- Conducting application tests with real users
- Validation of navigation functionality in a real environment

# Division of tasks

Afonso Ribeiro

## Positioning & Localization

- Integration of the Application with the Positioning System
- Establishment of communication between the application and UWB sensors
- Conducting tests to ensure synchronization of location data
- Troubleshooting compatibility issues

Tomás Almeida

## Mobile application

- Development of the mobile application design
- Creation of an accessible interface for visually impaired users
- Implementation of guided navigation with audio feedback

Filipa Cunha

## Tests & Metrics

- Conducting tests with blind or visually impaired users
- Performing system accuracy tests; Conducting tests with blind or visually impaired users
- Preparing user training materials to ensure effective interaction with the application

# Schedule

