



# NaviSense

Ubadah Saleh, Omar Hussain, Tabarak Abaid, and Shay  
Abaid

# Problem Statement

The problem of	inadequate indoor navigation aids for the blind
affects	visually impaired students, employees, and visitors
the impact of which is	a lack of independence and increased risk in indoor navigation
a successful solution would be	an intuitive app that provides reliable guidance, enhances safety, and fosters autonomy.

# Product Position Statement

For	blind or visually impaired individuals
Who	require assistance with indoor navigation
The (product name)	NaviSense is a smartphone application
That	offers voice-guided navigation and obstacle detection indoors
Unlike	traditional methods like canes or guide dogs alone
Our product	integrates with a smartphone's suite of sensors to provide a more comprehensive and empowering navigation tool

# AS-IS Scenario

*Currently, blind individuals face significant obstacles when navigating indoor spaces, which hinders their independence and mobility. Key challenges include:*

- ❖ **Orientation and Starting Location:** Determining the starting point within a building can be difficult without visual cues. Blind individuals often rely on memory or assistance from others to identify their location.
- ❖ **Pathfinding:** Finding the correct path involves navigating complex hallways and turns, which can be challenging without sight. Traditional aids like canes provide limited information, primarily detecting immediate ground-level obstacles.
- ❖ **Safety Concerns:** Safety is important. Without the ability to visually detect obstacles, there is a risk of collisions, trips, and falls. Braille indicators, while useful, are static and cannot signal temporary hazards.
- ❖ **Time Efficiency:** Reaching a destination in a timely manner can be stressful, especially in unfamiliar environments or when under time constraints.
- ❖ **Route Familiarity:** Repeatedly traversing the same route helps build familiarity, but changes in the environment or navigating new routes require constant adaptation.

# TO-BE Scenario

**Intuitive Start Location Identification:** Upon opening NaviSense, users will be greeted with an audio message that confirms their current location using GPS and indoor positioning technologies. This removes the guesswork from identifying their starting point.

❖ **Intelligent Pathfinding:** NaviSense will guide users through complex indoor spaces with audio directions. By processing real-time data from the phone's sensors and indoor maps, NaviSense can direct users along the safest and most efficient paths.

❖ **Enhanced Safety Measures:** The app will include features such as obstacle detection using the phone's camera and sensors, providing audio and haptic feedback to alert users of potential hazards and safely navigate around them.

❖ **Learning and Adaptation:** NaviSense will remember frequently travelled routes and will learn to suggest these to the user over time. It will also adapt to changes in the environment, such as temporary obstructions, updating its guidance accordingly.

❖ **Reduced Dependence on External Aids:** By leveraging NaviSense, users can gain more autonomy and reduce their reliance on guide dogs, human assistance, and braille indicators, which may not be uniformly available in all indoor environments.

❖ **Emergency Support:** In case of an emergency, users can shake their phone to immediately call a predefined emergency contact and share their location.

## AS-IS

- Billy is walking to his Requirements Engineering at UTD
- He does not see the banana peel on the floor
- He slips and falls to the floor and hits his head
- Billy does not make it to class



## TO-BE

- Billy is walking to his Requirements Engineering class at UTD
- He is using NaviSense to navigate to class
- NaviSense picks up the location of the banana peel and directs Billy to walk away from it
- Billy makes it to class safely



# Questionnaire

- ❖ **Objective:** To refine NaviSense, a navigation app for the blind, by understanding user preferences and experiences.
- ❖ **Focus Areas:**
  - **Prioritizing Features:** Obstacle avoidance, mapping, social features, and personalization.
  - **User Experience:** Accuracy and usability of indoor navigation and voice interactions.
  - **Navigation Details:** Preferences for obstacle instructions and route options.
  - **Integrations:** Importance of app compatibility with other services and wearables.
  - **Safety and Personalization:** Critical safety features and adaptive learning from user habits.
  - **Community Input:** Valuing community feedback and interest in beta testing.

# Stakeholder Types

## ❖ **Caregivers/Family Members**

- Can act as guides for blind people. The app can provide accurate directions and assist in navigating indoor spaces, ensuring the safety and well-being of blind individuals.

## ❖ **Researchers**

- Researchers in the field of assistive technology, human-computer interaction, and accessibility can use the app as a tool for conducting studies and gathering data on indoor navigation challenges faced by blind individuals. This analysis can contribute to the advancement of knowledge and the development of future research initiatives.

## ❖ **Accessibility Department Staff**

- Can use the app to conduct testing and evaluation of its accessibility features. They can assess the effectiveness of the app in facilitating indoor navigation for blind individuals and provide valuable feedback for further improvement.

## ❖ **Police**

- The app can facilitate coordination and communication among police officers during emergency incidents. Officers can share their locations, movements, and relevant information through the app, enabling effective teamwork, avoiding duplication of efforts, and ensuring a synchronized response.



# Stakeholder Types Cont.

## ❖ **Fire/Ambulance Services**

- By using the app's navigation capabilities, first responders can optimize their routes within indoor spaces, minimizing response times and maximizing the allocation of resources. This efficiency can be particularly crucial in large and complex buildings, where finding the shortest and safest path can be challenging.
- Can integrate with building information systems, enabling first responders to access crucial information such as floor plans, emergency exits, utility shut-off locations, and hazardous material storage areas. This information can help them navigate complex buildings and respond appropriately to the specific emergency at hand.
- The app can provide first responders with audio cues and alerts about potential hazards or obstacles within indoor environments. This increased situational awareness can help them make informed decisions and respond effectively to emergency situations, ensuring their safety and the safety of those they are assisting.

## Further Issues with domain requirement

- 1) **Lack In Detail:** The description of NaviSense does not provide detailed information about its features, functionalities, and intended user group, which makes it difficult to understand its distinctive advantages.
- 2) **Missing Essential Elements:** The overview fails to mention crucial aspects such as sensor technology, audio cues, accessibility options, and compatibility with smart home systems, which are key to comprehending how NaviSense caters to the needs of visually impaired users.

# Functional Requirements

FR1: NaviSense shall offer real-time visual and audible inputs based on the user's location.

FR2: NaviSense shall provide customizable feedback options tailored to ambient conditions and user preferences.

FR3: The system shall support voice commands, enabling hands-free control and navigation adjustments.

FR4: The app shall provide contextual location-based information, including descriptions of nearby places and points of interest.

FR5: NaviSense shall include an extensive mapping system, incorporating indoor navigation for public buildings and transportation hubs.

FR6: NaviSense shall support multiple languages to serve a multilingual user base and improve accessibility.

# Non-Functional Requirements

NFR1: NaviSense should ensure data encryption and user anonymity to safeguard user privacy.

NFR2: NaviSense shall guarantee peak performance and reliability, ensuring prompt responses and minimal downtime.

NFR3: NaviSense should deliver an outstanding user experience by ensuring user-friendly navigation, quick load times, and seamless interaction, accommodating varying levels of technical proficiency.

NFR4: NaviSense shall uphold the highest standards of accessibility and inclusivity, making the app fully usable by people with a wide range of disabilities.

NFR5: NaviSense shall offer data encryption and user anonymity to protect user privacy.

NFR6: In order to guarantee that the app is fully useable by people with a wide range of disabilities, NaviSense shall uphold the highest standards of accessibility and inclusivity.

# Further Issues with NFRs

## ❖ **Performance:**

- Issue: Lack of specific performance targets (e.g., maximum acceptable latency).

## ❖ **Accessibility:**

- Issue: The requirement mentions compliance with accessibility standards but does not specify which standards or guidelines will be followed.

## ❖ **Reliability:**

- Issue: The requirement lacks clarity on how reliability will be measured or ensured.

## ❖ **Security:**

- Issue: The requirement mentions encryption and secure storage but does not specify the encryption algorithms or security protocols that will be used.

## Further Issues with FRs

### ❖ **Navigation:**

- Issue: The requirement lacks specificity on the types of indoor navigation instructions provided (e.g., turn-by-turn directions, landmark descriptions).

### ❖ **User Feedback:**

- Issue: The requirement mentions user feedback but does not specify how it will be collected or utilized.

### ❖ **Emergency Assistance:**

- Issue: Emergency assistance features are mentioned but not specified in terms of how users can request assistance or what actions the app will take in emergencies.

# Specification Model

**World(W):** NaviSense focuses on indoor environments where visually impaired individuals must navigate through specific navigational problems.

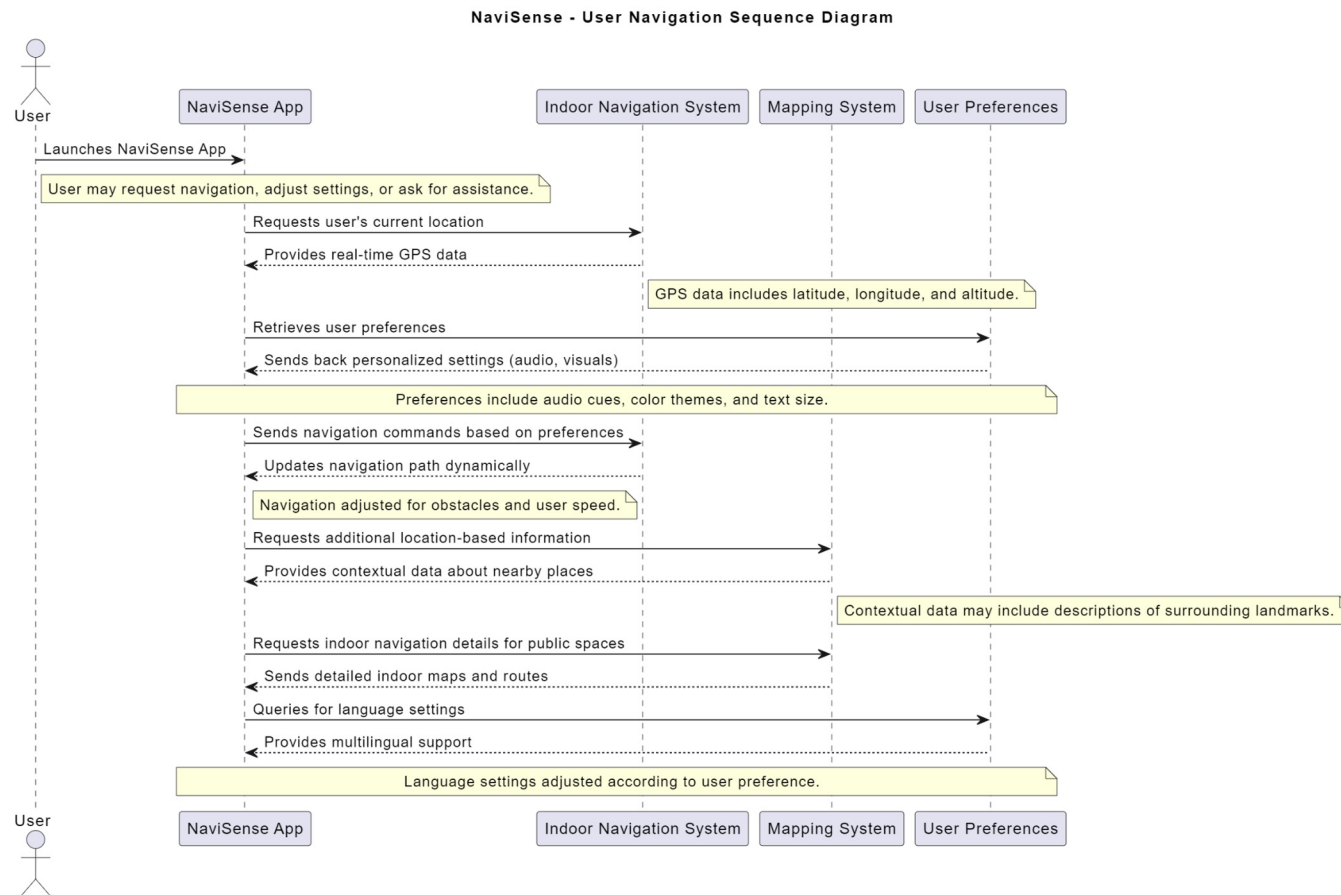
**Requirement(R):** The goal of NaviSense is to offer visually impaired people a simple navigational experience while guaranteeing their safety

**Specification(S):** GPS guidance in real time, sensor-based obstacle detection, a user interface that can be adjusted to various settings, robust data security protocols, speech audio cues for hands-free operation, and auditory feedback.

**Program(P):** Camera-based visual identification for enhanced interior obstacle detection, uses algorithms to secure user data, and combines advanced voice recognition for input and audio feedback for navigation.

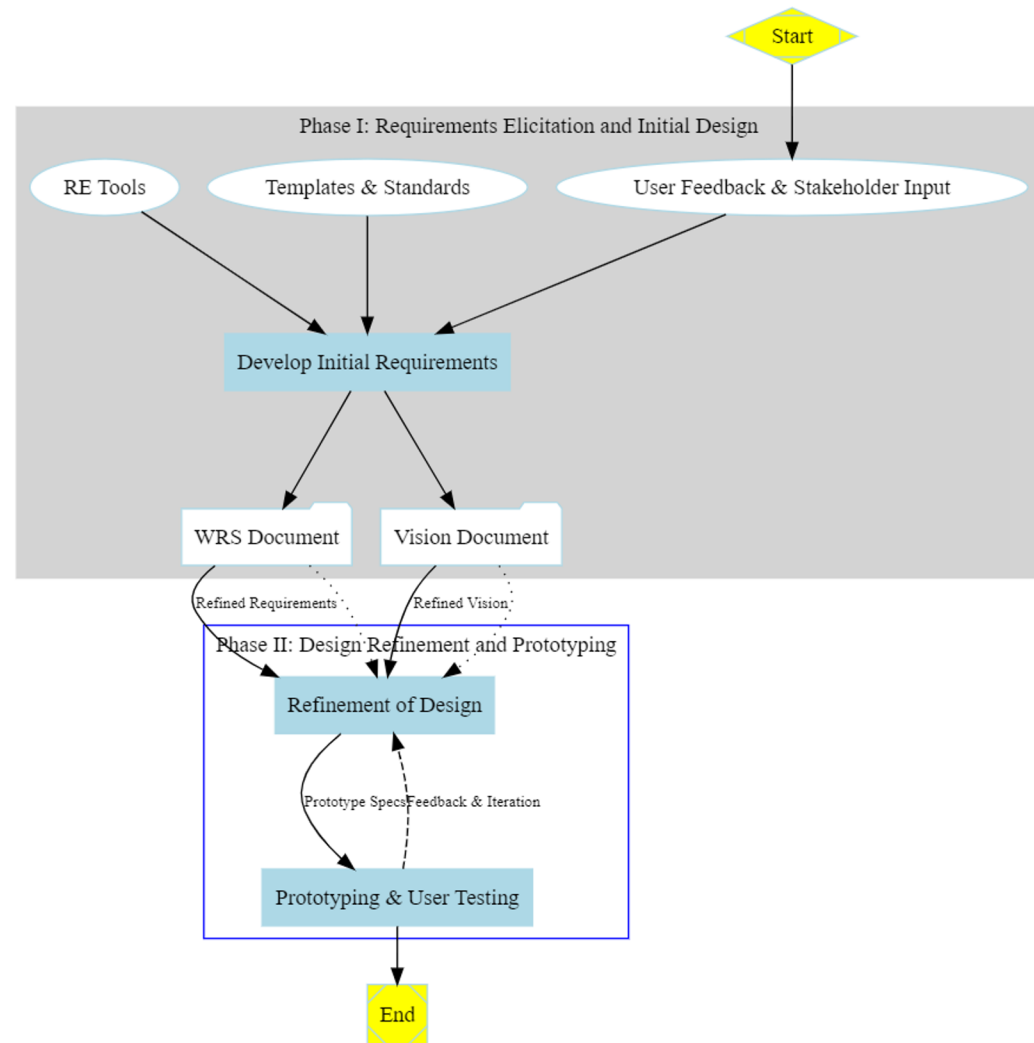
**Machine(M):** User's Smartphone

# Sequence diagram

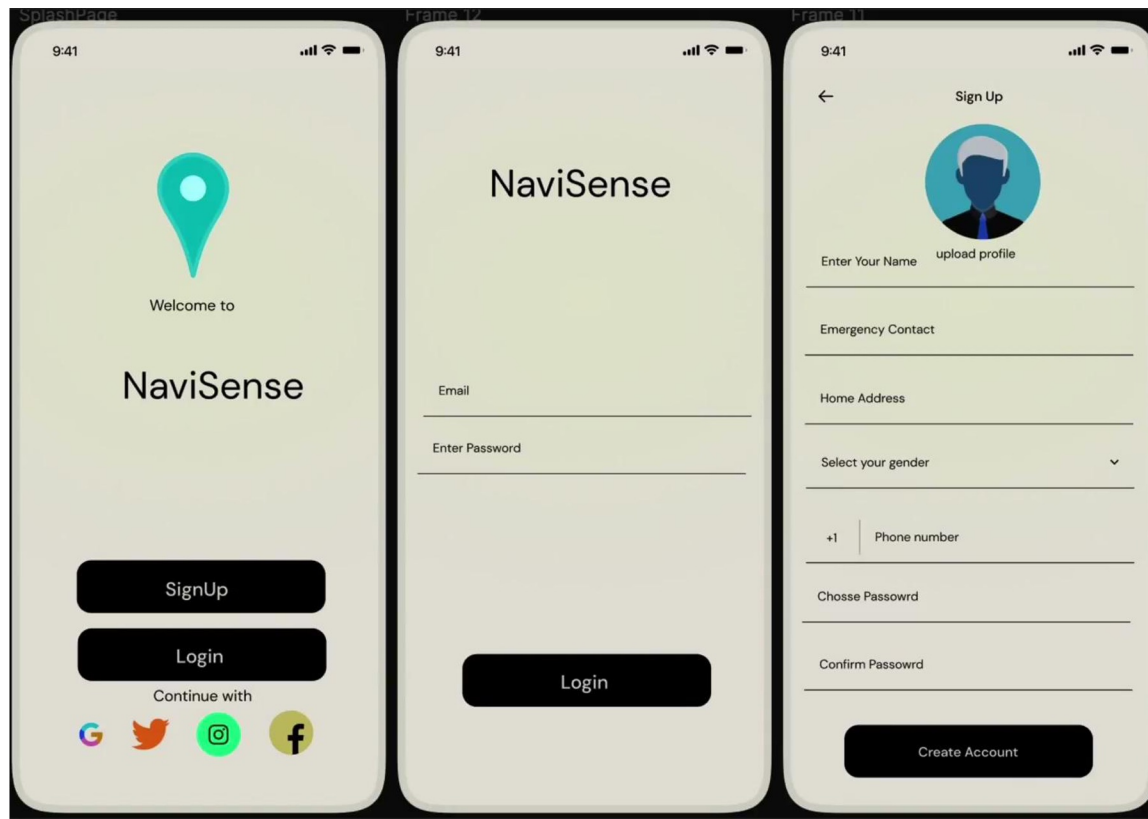




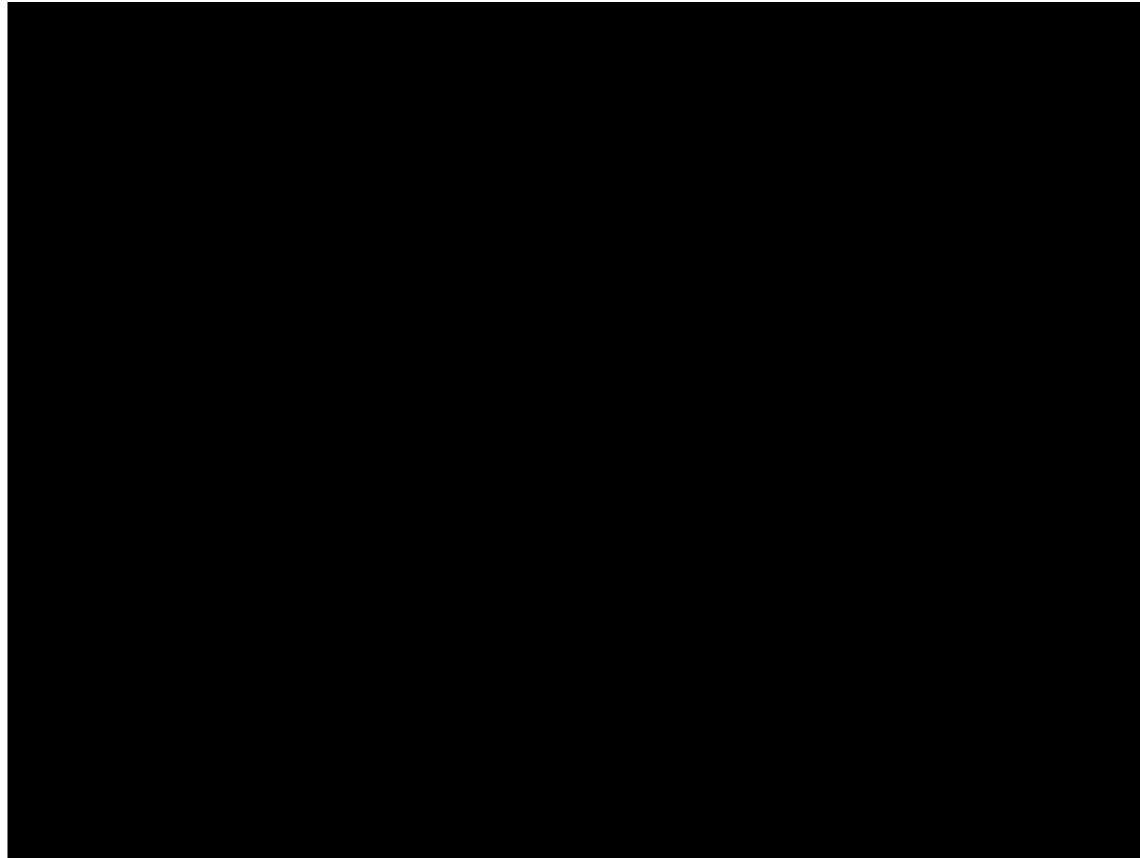
# IDEF0 Diagram



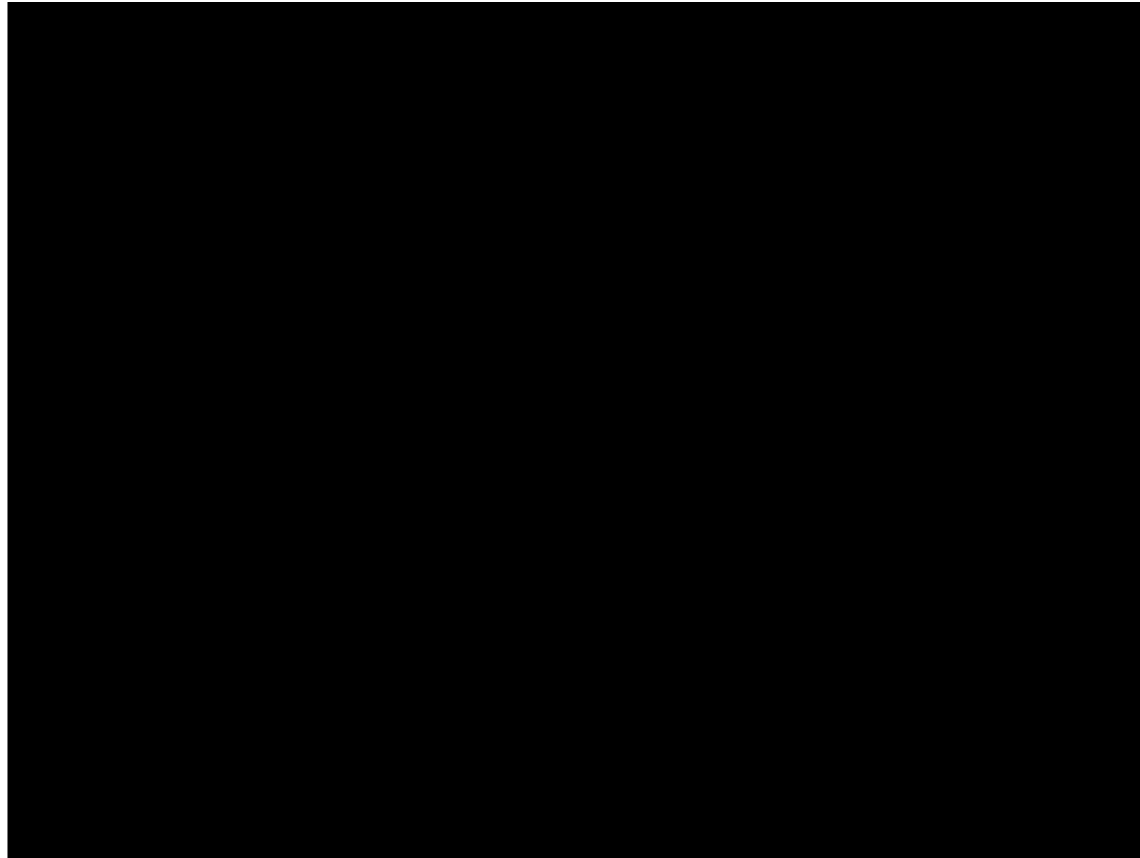
# App Demo (1)



## App Demo (2)



## App Demo (3)



# Requirements Creep Reasonability

At a 25% creeping rate, our progress aligns with the expanded scope of our project. It's reasonable in a way where it now includes compatibility with wearable devices, integration with external services, and advanced AI-driven obstacle detection. These enhancements, while increasing our workload, significantly improve the app's functionality and appeal, justifying our current and overall pace.

# Why Choose Our App

- Encompasses an innovative and highly accurate indoor positioning system
- Integrated cutting-edge technology utilizes Bluetooth beacons strategically placed throughout indoor environments
- Intuitive and user-friendly interface that combines auditory and haptic feedback, allowing users to receive real-time information about their surroundings through a combination of sound and vibrations
- Enhances user experience and provides a high level of spatial awareness
- Goes beyond basic navigation by incorporating advanced obstacle detection capabilities
- Ensures that blind individuals have full control over their navigation experience, making it truly personalized and empowering
- Top choice for blind individuals seeking a reliable, comprehensive, and empowering indoor navigation solution



Thank you  
for listening!