Enhancing Mobility: An Innovative Indoor Navigation Solution for the Visually Impaired

Team 3

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Indoor navigation is crucial for enhancing the **mobility** of visually impaired individuals. This presentation explores an innovative solution designed to improve their **independence** and **safety** within indoor environments. We will discuss the technology, benefits, and real-world applications of this system.

Understanding the Challenges (As-Is)

Visually impaired individuals face significant **challenges** in navigating indoor spaces, such as **obstacles**, lack of **landmarks**, and **inconsistent layouts**. These barriers can lead to feelings of **disorientation** and **dependence** on others, highlighting the need for effective navigation solutions.

Innovative Technology Overview (To-Be)

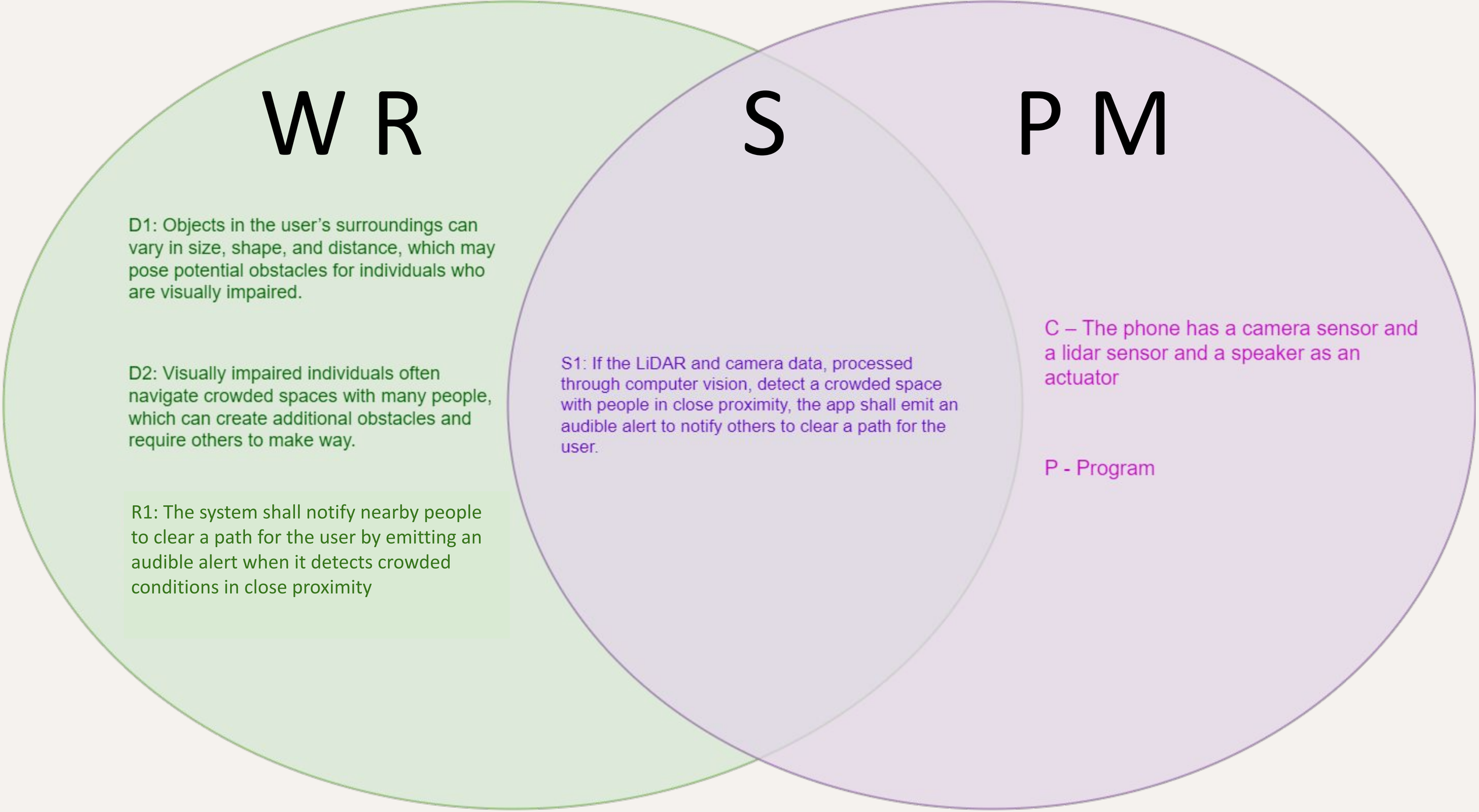
Our proposed solution utilizes camera and LiDAR fusion to track objects and estimate distances. These tools work together to provide real-time **guidance**, ensuring users can navigate their environment **safely** and confidently, enhancing their overall **experience**.

Stakeholders

Of
- Investors
- Iphone App Store

By
- Development Team
- Architect Team
- Requirements Team
- Deployment Team

For
- Visually Impaired
- Healthcare Providers
- Caregivers
- Family Members of Visually Impaired


W R
S
P M
D1: Objects in the user's surroundings can vary in size, shape, and distance, which may pose potential obstacles for individuals who are visually impaired.
D2: Visually impaired individuals often navigate crowded spaces with many people, which can create additional obstacles and require others to make way.
R1: The system shall notify nearby people to clear a path for the user by emitting an audible alert when it detects crowded conditions in close proximity
S1: If the LiDAR and camera data, processed through computer vision, detect a crowded space with people in close proximity, the app shall emit an audible alert to notify others to clear a path for the user.
C – The phone has a camera sensor and a lidar sensor and a speaker as an actuator
P - Program

Functional Requirements

FR1 - Accepting from the user the destination location to go

FR2 - Suggest or confirm a possible destination location, utilizing the user’s routine schedule or habit

FR3 - Figuring out and telling the user which routes can reach the destination location, and accepting the user’s preference

FR4 - Telling the user to walk a distance (e.g., 2 minutes to reach a turning point, 30 steps to take)

FR5 - Telling the user to stop at the right place to turn

FR6 - Detecting obstacles and telling the user what to do in order to avoid collision

FR7 - Placing emergency calls and messages, possibly after detecting a fall or when the system cannot figure out the current location

FR8 - Figuring out what would be the next action(s), based on the user’s schedule or habit, and suggesting and accepting the user’s choice

Non-Functional Requirements

NFR1 - The system shall help the user safely navigate indoors

NFR2 - The system shall lead the user through the fastest route

NFR3 - The system shall lead the user through the route the user would feel the most comfortable with

NFR4 - The system shall be easily usable

NFR5 - The system shall be ubiquitous

NFR6 - The system should be customizable to every user (e.g., the volume, the interval at which the system says something, the order of different things the system says, etc.)

NFR7 - The system should be easily extensible to accommodate the following typical variations: variations in interface, language, definitive needs of the user, new features, new sensors and hardware etc.

NFR8 - The system shall make safe, informed, and reasonable decisions regarding a user’s preferences and physical capabilities

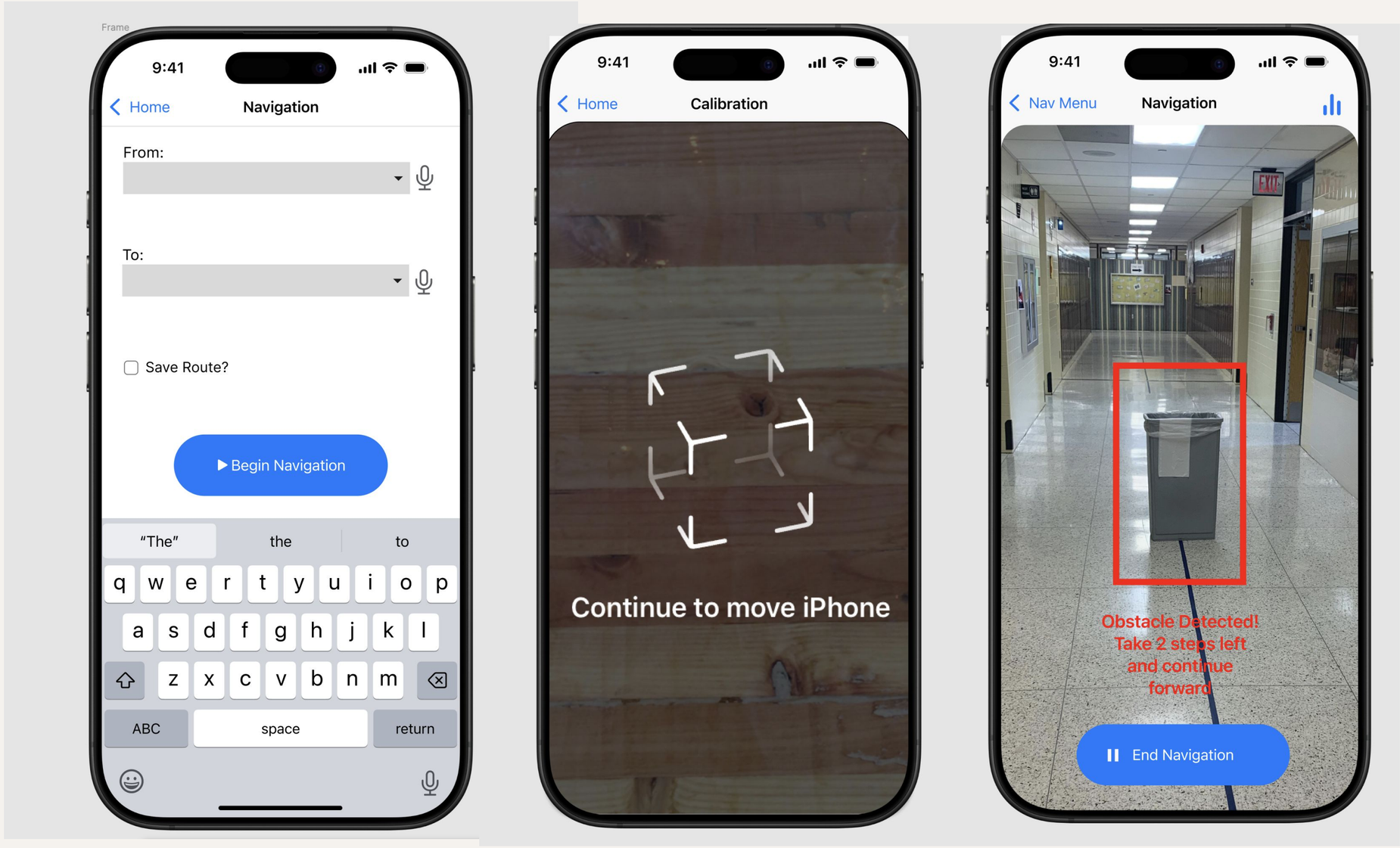
User-Centric Design Approach

The design of our navigation solution is centered on the **user experience**. We conducted extensive **user research** to understand their needs and preferences, ensuring that the interface is **intuitive**, accessible, and tailored for **ease of use** for visually impaired individuals.

Real-World Applications

This innovative indoor navigation solution has potential applications in various settings, including **malls**, **airports**, and **hospitals**. By implementing this technology, we can significantly improve the **independence** and **quality of life** for visually impaired individuals in these environments.

Mockups


Frame
9:41
Home
Navigation
From:
To:
Save Route?
▶ Begin Navigation
"The"
the
to
q w e r t y u i o p
a s d f g h j k l
z x c v b n m
ABC
space
return
9:41
Home
Calibration
Continue to move iPhone
9:41
Nav Menu
Navigation
EXIT
Obstacle Detected!
Take 2 steps left
and continue
forward
End Navigation

On Requirements Creep

Our team shall handle up to **10%** change in requirements per month. We have a well-defined scope, but understand that software should adapt to the needs of its users.

We will work with stakeholders to find out what needs to be added or changed.

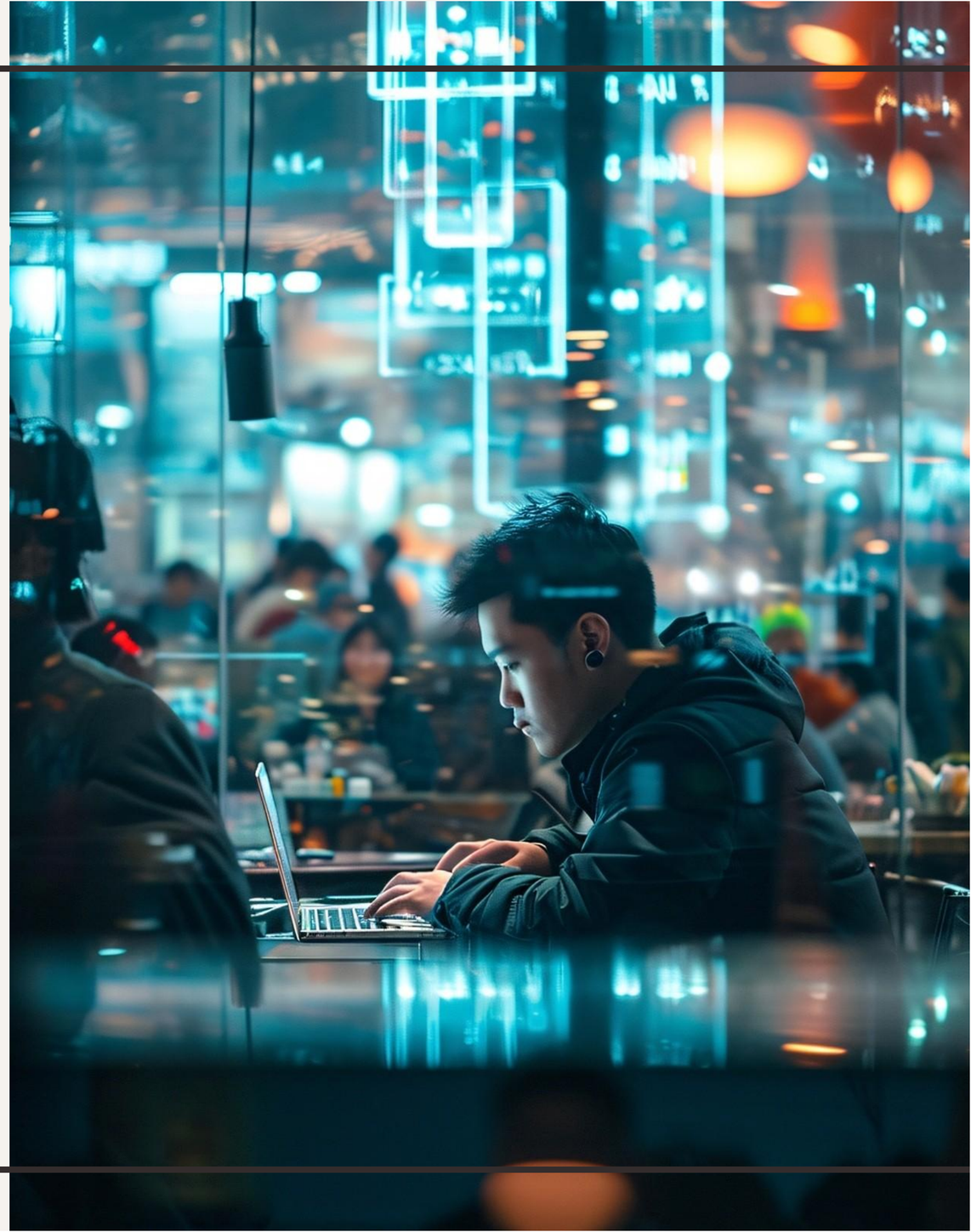
Why Choose Our Solution?

- Highly Accessible and User-Centric Design
- Intuitive and easy-to-use UI
- Cutting Edge LiDAR Technology
- Real time, Reliable Guidance
- Committed to improving Quality of Life
- Doesn’t Rely on GPS

Conclusion and Future Directions

We are committed to enhancing mobility through an innovative indoor navigation app.

Future developments will focus on **expanding functionalities**, integrating with smart city initiatives (**IOT**), and fostering **collaborations** to ensure widespread adoption and impact.



Appendix: Questionnaire

Questionnaire for Mobility Enhancement System

The purpose of the following questionnaire is to gauge the prospective direct and indirect users of an application that intends to assist those with visual impairments. Our study will try to find the major challenges blind people face in navigating in order to better tailor functionality that directly addresses these issues. If you know someone that has a visual impairment of any kind, please help them fill out this questionnaire to help make a difference.

Age:

- <20
- 20-35
- 40-55
- 55-70
- 70+

How often do you use your phone in a single day to assist you with everyday chores?

- 1-3 times a day
- 4-6 times a day
- 6-9 times a day
- 9+ times a day

How would you describe your level of vision impairment?

- Partially Blind
- Legally Blind
- Totally Blind

How do you typically navigate indoors?

- Cane
- Service Animal
- Assistance from others
- Other (please specify) _____

How do you typically navigate outdoors?

- Cane
- Service Animal
- Assistance from others
- Other (please specify) _____

How difficult is it to navigate indoors?

- Very Difficult
- Difficult
- A Little Difficult
- Not Difficult

How difficult is it to navigate outdoors?

- Very Difficult
- Difficult
- A Little Difficult
- Not Difficult

What challenges are you most cautious of when navigating new environments?

- Lack of clear paths
- Lack of planned accessible assistance
- Difficulty identifying obstacles
- Uneven surfaces

How do you like to interact with electronic devices?

- Voice commands and audio responses
- Screen Readers
- Tactile buttons with braille
- Other (please specify) _____

Thanks!

Do you have any questions?

samuelpreston.me/se4351-project/