Word Requirements Solicitation

Cpts 484: Software Requirements

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Revision History

Date	Version	Changes	Editor
10/06/2025	1.0	Initial Draft	Fredy Corona
10/08/2025	1.1	Introduction	Fredy Corona
10/08/2025	1.2	Overview + initial draft of preliminary definition	Fredy Corona
10/10/2025	1.3	Initial draft of W + RS	Fredy Corona
10/12/2025	1.4	Revision of W + RS	Fredy Corona
10/12/2025	1.5	Added the appendix + minor fixes	Panashe Dione
10/12/2025	1.6	3.2 and 3.3 complete	Jose Hurtado
12/7/2025	2.0	Replace Prototype Mock Up with UI+ Remove any inconsistencies	Panashe Dione Jose Hurtado

[1] Introduction

1.1. Purpose

The purpose of this document is to define the problem space, goals, requirements, and system specifications for Theia, a smartphone-based indoor navigation application designed for blind and visually impaired users. This WRS serves as a formal reference for the development team, stakeholders, and evaluators by establishing a common understanding of Theia's functional and non-functional objectives, the environment in which it operates, and the constraints governing its design. It also provides traceability between the real-world needs of blind users and the proposed software solution through clearly defined problem statements, goals, and system requirements.

1.2. Scope

The Theia indoor navigation system focuses on providing safe, accessible, and intelligent indoor navigation for blind and visually impaired users through a combination of integrated functional modules. Each core module of Theia contributes to a different aspect of user assistance, sensor interaction, and environment awareness. The system's core architecture is composed of voice interaction, navigation, obstacle detection, and emergency response. For the MVP, Theia will be implemented as a standalone mobile application developed using React Native, integrated with smartphone accessibility APIs. The MVP will focus on single-floor navigation, voice-controlled destination input, basic obstacle alerts, and emergency contact functionality. Core Functionalities of Theia include:

1. Accept and process voice-based destination input.

2. Provide real-time turn-by-turn audio guidance within a single-floor environment.

3. Detect and alert users to obstacles using onboard sensors.

4. Enable emergency call or message activation via simple voice command.

1.3. Objectives and Success Criteria

The Objective and success criteria for Theia will lay the ground for a concise strategy to get a working software. The software development process will follow:

Objectives:

1. Provide blind and visually impaired users with an accessible indoor navigation tool that operates via voice commands.

2. Deliver accurate, real-time audio instructions for reaching destinations safely.

3. Detect obstacles and issue audible alerts to prevent collisions.

4. Offer an emergency assistance feature that can automatically notify caretakers or staff.

Success Criteria

The MVP successfully demonstrates navigation between two points on a single floor.

Voice input and output perform with accuracy under moderate noise conditions.

Obstacle detection works by using smartphone sensors.

The emergency feature reliably calls or messages a designated contact.

1.4. Definitions, Acronyms, and Abbreviations

Term	Definition
Theia	Proposed smartphone application for indoor navigation for blind users.
MVP	Minimal Viable Product.
UI/UX	User Interface / User Experience.
IMU	Inertial Measurement Unit.
GPS	Global Positioning System.
NFR	Non-Functional Requirement.
FR	Functional Requirement.
API	Application Programming Interface.

1.5. Overview

This document defines the World (W)—the problem context, goals, and understanding of the domain—and the Requirements and Specifications (RS) that translate those goals into actionable, measurable software behaviors. Section 4 details the Problem (P#) and corresponding Goals (G#) that justify the system. Subsequent sections describe the Functional and Non-Functional Objectives, the Stakeholders, and the improved understanding of the domain that informs Theia's design. The RS portion defines explicit Functional Requirements, Non-Functional Requirements, and System Specifications, ensuring traceability from user needs to implementation. Overall, this document provides the foundation for designing, prototyping, and validating Theia as a reliable, safe, and accessible indoor navigation tool for the visually impaired.

[2] Preliminary Definition

2.1. Preliminary Domain

PD_ID	Preliminary Domain Description
PD1	Assistive indoor navigation system for a user that is blind or visually impaired.

2.2. Preliminary Functional Requirements

P FR_ ID	Preliminary FR Description
PFR1	The system shall allow users to specify their destination verbally.
PFR2	The system shall allow a second user to lay out a floor plan for the primary user.
PFR3	The system shall determine a feasible route from the users current position to the destination.
PFR4	The system shall provide turn-by-turn voice instructions.
PFR5	The system shall detect obstacles using sensors.
PFR6	The system shall enable users to call or message a designated contact.

2.3. Preliminary Non-Functional Requirements

PNFR_ ID	Preliminary NFR Description
PNFR1	Generating an accurate path to the destination.
PNFR2	Minimize the risk of collision.
PNFR3	UI/UX must be simple, intuitive, and require minimal contribution from blind users.
PNFR4	Floor plans must be stored for later use.

[3] Issues with the Preliminary Definition Given

3.1. Domain Issues

Domain Issue ID	Domain Issue Description	
DI1	PD_ID	PD1. Assistive indoor navigation system for a user that is blind or visually impaired.
	1. A wide range of physical and cognitive abilities makes it difficult to design one specific interaction model. 2. Blind users rely heavily on hearing, which can be overwhelmed in noisy environments	
	Option 1	Choose a simple UI/UX for a universal user base that makes it easy to interact with the system.
	Option 2	Design a system that uses dynamic noise recognition to pick up the voice of a user in noisy environments.
	Option 3	Provide customizable modes so that the user experience can be changed based on the needs of different users.
	Choice	Option 1
	Rationale	Simple and concise implementation based on the timeline of development.
Revised wording		3.1.8.1

3.2. Functional Requirements Issues

FR Issue ID	Description	
FRI1	PFR_ID	PFR1. Generating desired sentences and representing them pictorially as well as associating with a sound/voice.
	1. How to decide between picture and sound for that particular sentence?	
	Option 1	Use common sentences and associate them with sound (for the blind) or pictures (for the deaf).
	Option 2	Allow the user to select whether to associate words with pictures or with sounds at runtime.
	Option 3	Allow the user to configure the system to play sounds and/or associate pictures with sentences.
	Choice	Option 3
	Rationale	If the user wants to see the sentence in the form of a picture (or) in the form of sound he/she will have an option at run-time to choose from. This should be able to be adjusted in options as needed (if a user enters a noisy room, they may want to switch from sounds to pictures, for instance).
Satisfied by	FR1	

FR Issue ID	Description	
FRI2	PFR_ID	PFR2. The system shall allow a second user to lay out a floor plan for the primary user.
	1. How will the second user lay out the floor plan?	
	Option 1	Use a simple UI for second user to drag and create the layout themselves and scale it to their liking along with sensors to determine distances
	Option 2	Approximate distances based on the lay out
	Choice	Option 1

	Rationale	Second user can scale to their liking and decide where the boundary for each room is
Satisfied by	FR2	

FR Issue ID	**Description**	
FRI3	PFR_ID	PFR3. The system shall determine a feasible route from the users current position to the destination.
	1. How will the system determine the route?	
	Option 1	Pre-made route
	Option 2	GPS location approximation
	Option 3	A mix of using the GPS location to decide what pre-made route the user needs to take
	Choice	Option 3
	Rationale	Allows for the voice commands to change depending on the orientation of the device/direction the user is facing (north,west, etc.) while the route is maintained as pre-made
Satisfied by	FR3	

FR Issue ID	**Description**	
FRI4	PFR_ID	PFR4. The system shall provide turn-by-turn voice instructions.
	1. How will the voice navigation work	
	Option 1	Use device camera with AI to guide
	Option 2	Use device premade route along with device GPS orientation to generate instructions
	Option 3	Use premade instructions only
	Choice	Option 2

	Rationale	Generates instructions on based on the direction the device is currently facing along with the premade route that has been made between rooms
Satisfied by	FR4	

FR Issue ID	**Description**	
FRI5	PFR_ID	PFR5. The system shall detect obstacles using sensors.
	1. How will the device know where the obstacles are?	
	Option 1	Preset layout of obstacles and approximate with device GPS
	Option 2	Use sensor data to communicate with device and determine how far the user is from the object
	Choice	Option 1
	Rationale	User inputs obstacles when creating a floorplan as the objects are static
Satisfied by	FR5	

FR Issue ID	**Description**	
FRI6	PFR_ID	PFR6. The system shall enable users to call or message a designated contact.
	1. How will the system know when to call the contact	
	Option 1	The user drops the phone and automatically calls the contact when the device detects that it was dropped
	Option 2	The users says help command that calls the contact
	Option 3	The device drops and gives a 10 second warning that it will call the contact unless cancelled by voice command or users says help command
	Choice	Option 3
	Rationale	More robust and decreases the chance of an accidental call
Satisfied by	FR6	

3.3. Non-Functional Requirements(NFR) Issues

NFR Issues ID	Description	
NFRI1	PNFR_ID	PNFR1. Generating an accurate path to the destination.
	1. How will the path be generated	
	Option 1	Camera being used and AI will help navigate
	Option 2	Premade routes from room to room
	Option 3	GPS device and sensor data
	Choice	Option 2
	Rationale	Premade routes along with accounting for obstacles in the way to prevent crashes
Satisfied by	NFR1	

NFR Issues ID	Description	
NFRI2	PNFR_ID	PNFR2. Minimize the risk of collision.
	1. What will be done to reduce collisions	
	Option 1	Lay out will include pre-mapped obstacles
	Option 2	Sensors placed on static obstacles
	Option 3	AI along with front camera will detect obstacles
	Choice	Option 1 and Option 2
	Rationale	Lay out will have pre-mapped obstacles, along with the choice to include sensors to create better accuracy of how close the obstacle is or just generate an approximation without sensors.
Satisfied by	NF2	

NFR Issues ID	Description	
NFRI3	PNFR_ID	PNFR3. UI/UX must be simple, intuitive, and require minimal contribution from blind users.
	1. What are some blind-friendly features of the UI	
	Option 1	Big buttons announced audiobally
	Option 2	Voice command capable
	Option 3	Tapping system where user can tap once, twice, etc. depending on the length of options and type of option (ex. Selecting floor from a floor plan)
	Choice	All 3 options
	Rationale	A flexible UI that allows for multiple ways to complete the same task can accommodate to user preferences
Satisfied by	NF3	

NFR Issues ID	Description	
NFRI4	PNFR_ID	PNFR4.Floor plans must be stored for later use.
	1. How will floor plans be stored	
	Option 1	SQL or NoSQL database
	Option 2	Excel sheet
	Option 3	Never stored and need to be generated before every use
	Choice	Option 1
	Rationale	A large proper database will be needed to store the floor plan along with the distances from each room and obstacle and allow for data to be queried fast and generate paths quick as well
Satisfied by	NF4	

[4] WRS

4.1. W

4.1.1. Problem

Problem ID	Problem Description	Corresponding Goals
P1	Blind and visually impaired users are unable to navigate unfamiliar indoor environments safely without human assistance.	G1
P2	GPS signals are unreliable indoors, resulting in no precise positioning data for navigation.	G2
P3	Users have difficulty understanding spatial directions without a non-visual cue system.	G3
P4	Indoor obstacles such as furniture, walls, and moving people pose collision risks.	G4
P5	Voice recognition can be affected by outside noise, unclear instructions, and different dialects.	G5
P6	The system is unable to detect an extreme case where a user finds himself/herself unable to use the app properly because of external factors.	G6
P7	Unreliable UI/UX that makes it difficult for primary and secondary users to use the app.	G7

4.1.2. Goals

Goal ID	Goal Description	Backward Traceability	Forward Traceability

G1	Ensure safe and collision free navigation for blind and visually impaired users within indoor environments.	P1	FO1
G2	Enable accurate indoor localization and route generation.	P2	FO2
G3	Provide intuitive, non visual guidance through audio.	P3	FO3
G4	Detect static and dynamic obstacles in real time using built-in sensors.	P4	FO4
G5	Deliver clear voice instructions optimized for noisy environments, unclear instructions, and different dialects.	P5	FO5
G6	The system accurately determines that there is an extreme case and sends appropriate distress signal to emergency contact/services.	P6	FO6
G7	System incorporates simple UI/UX	P7	NFO4

4.1.3. Improved Understanding of Domain, Stakeholders, Functional, and Non-Functional Objectives

4.1.3.1. Improved Domain

Improved Domain ID	Improved Domain Description
ID1	Theia shall provide functions that allow a person suffering from one or more disabilities listed in 3.1.3.1 to augment their ability to navigate a space in order to conduct their daily activities.
ID2	Theia shall include an emergency support mechanism that enables users to quickly contact caretakers or emergency services if assistance is needed, transmitting the user's current location to ensure rapid response.

ID3	Theia shall utilize smartphone sensors—including the camera, LiDAR, and accelerometer—to detect obstacles, identify routes, and communicate spatial information in real time, enhancing safety and orientation for users within complex indoor spaces.

4.1.3.2. Stakeholders

- Sponsors
    - None
- Project Mentor:
    - Name: Bolang Zeng
- Volunteer Faculty Advisors
    - None
- Potential User of Theia
    - Blind Users: Using theia, users with extreme visual impairments will be allowed to navigate and traverse preloaded rooms
    - Caretakers of Blind People: lessens the need for care after loading floors for the person they care for frequently.
    - Business Owners: Owners can upload the layout of their establishments, allowing users who are blind to easily navigate there establishments.
    - Emergency Responders: the App with an emergency button can auto-alert paramedics to the location of the app holder

4.1.3.3. Improved Functional Objectives

Based on the above information and our goals, the functional objectives of Theia are:

Improved FR Objective ID	**Objective Description**	**Alleviates Problems**	**Achieves Goals**
IFRO1	Enable the user to verbally specify a destination.	P1	G1, G4
IFRO2	Determine the user location indoors using GPS and/or gyro sensors.	P1, P5	G1, G5
IFRO3	Provide real time voice navigation with easy to follow instructions.	P3	G3

IFRO4	Detect static and moving obstacles using camera and/or LiDAR sensors to immediately warn the user with audio or vibration.	P4	G1, G4
IFRO5	Implement a simple voice command like “help me” to trigger an emergency call or sms to designated contact.	P6	G6

4.1.3.4. Improved Non-Functional Objectives

Improved NFR Objective ID	**Objective Description**	**Alleviates Problem**	**Achieves Goal**
INFRO1	The system shall provide redundant and accurate methods for calculating paths to the destination using the proper best path algorithm.	P1,P2	G1, G2
INFRO2	The system shall calculate a safe path by calculating a route that evades all obstacles by using AI.	P1, P2	G1, G2, G3
INFRO3	Development will be focused on a simple UI/UX that is easy to use for the primary and secondary user. It will be built using a plain frontend built over React Native.	P7	G7
INFRO4	The system will store floor plans and rooms so that users can come back to floor plans that have already been setup.	P7	G7

4.2. RS

4.2.1. Functional Requirements

FR ID	**Description**
FR1	If a user tells the system to set a destination then the system will calculate the best shortest path while avoiding obstacles.

Satisfies Functional Requirement Issue	FRI1
Satisfies Objectives	FO1, FO2, FO3
Satisfied by prototype feature	Shown below.

FR ID	**Description**
FR2	If a user signs on to the system they will be able to lay out a floor plan specifying the rooms with names and obstacles that might affect the route.
Satisfies Functional Requirement Issue	FR1, FR3
Satisfies Objectives	FO1, FO2.
Satisfied by prototype feature	Shown below.

FR ID	**Description**
FR3	If a user tells the system to set a destination then the system will calculate the best shortest path while avoiding obstacles.
Satisfies Functional Requirement Issue	FRI2
Satisfies Objectives	FO1, FO2, FO3
Satisfied by prototype feature	Shown below.

FR ID	**Description**
FR4	The system will receive the instructions to select a destination and accurately calculate the route while avoiding obstacles.
Satisfies Functional Requirement Issue	FRI4

Satisfies Objectives	FO4
Satisfied by prototype feature	Shown below.

FR ID	**Description**
FR4	System will alert emergency contact given the user inputs a distress signal via manual input or vocal input.
Satisfies Functional Requirement Issue	FRI6
Satisfies Objectives	FO6
Satisfied by prototype feature	Shown below.

4.2.2. Non-Functional Requirements

NFR ID	**Nonfunctional Requirement 1**	
NFR1	The system shall be accurate.	
Operationalized Functional Requirements	OFR1 OFR2	The system algorithms shall be optimized The program will make use of the device's systems accurately.
Satisfies Nonfunctional Requirement Issue	NFRI, NFRI2	
Satisfies Non-functional Objective	NFO1, NFO2	
Constraints	FO1, FO2	

NFR ID	**Nonfunctional Requirement 1**	
NFR2	The system shall be easy to use.	
Operationalized Functional Requirements	OFR1	The system’s will be plain.

	OFR2	The program will have only the necessary features.
Satisfies Nonfunctional Requirement Issue	NFR3	
Satisfies Non-functional Objective	NFO3	
Constrains	FO3	

NFR ID	**Nonfunctional Requirement 1**	
NFR3	The system shall store multiple floor plans.	
Operationalized Functional Requirements	OFR1	The system will have a proper database format to store user floor plans.
Satisfies Nonfunctional Requirement Issue	NFR4	
Satisfies Non-functional Objective	NFO4	
Constrains	FO4	

4.2.3. Specifications

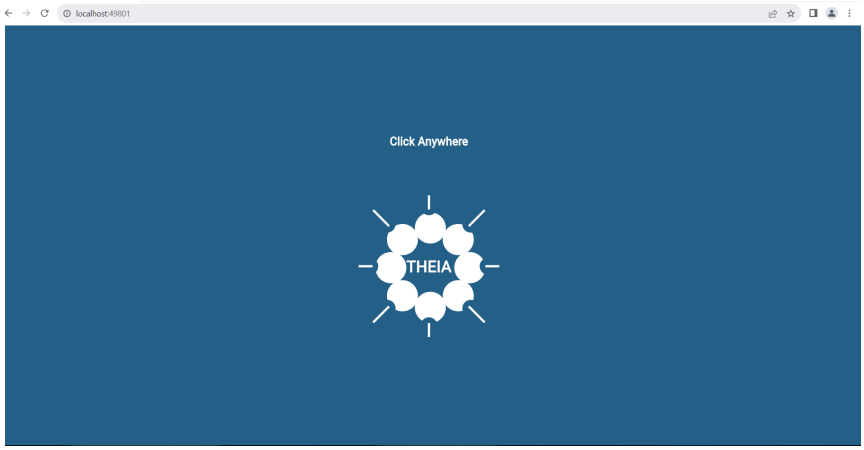
Functional Specification ID	**Functional Requirement**
FS1	If a voice command is given to the system the output will be instructions leading to the destination.
Satisfies Functional Requirement	FR1
Satisfies Objectives	FO1, FO2, FO3

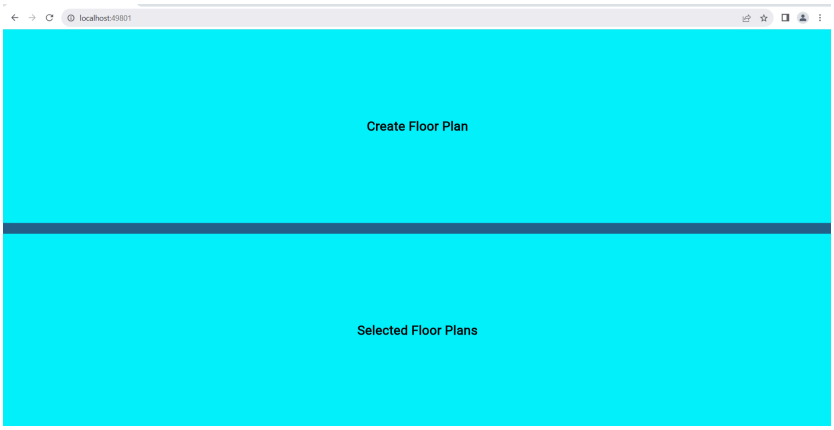
Functional Specification ID	**Functional Requirement**
FS2	The system will use a gyro sensor to determine location on the floor plan and output the directions accordingly.
Satisfies Functional Requirement	FR1
Satisfies Objectives	FO1, FO2

Functional Specification ID	Functional Requirement
FS3	The system will use a LiDAR sensor to determine location of obstacles and output directions accordingly.
Satisfies Functional Requirement	FR4
Satisfies Objectives	FO1, FO2, FO4

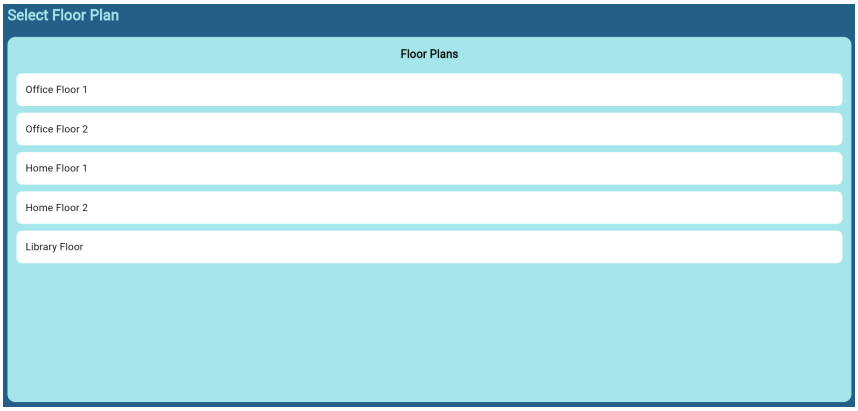
Functional Specification ID	Functional Requirement
FS4	If a user inputs a voice/manual command the system will send a call or sms to the designated emergency contact.
Satisfies Functional Requirement	FR5
Satisfies Objectives	FO5

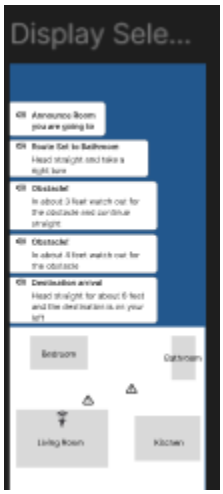
[5] User Interface Design

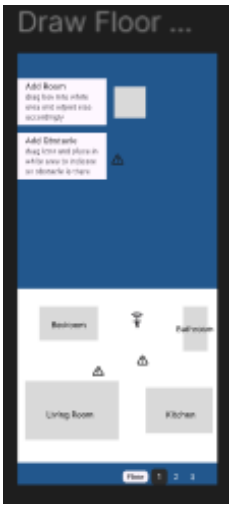



localhost:49801
Create Floor Plan
Selected Floor Plans


Name of Floor Plan
How Many Floors?
Next


Select Floor Plan
Floor Plans
Office Floor 1
Office Floor 2
Home Floor 1
Home Floor 2
Library Floor


Display Sele...


Draw Floor ...

[6] User Manual

User Manual can be read here: Theia User Manual.docx

[7] References

[1] Erickson, W., Lee, C., & von Schrader, S. (2012). 2010 Disability Status Report: United States. Ithaca, NY: Cornell University Employment and Disability Institute(EDI).

[2] Erickson, W., Lee, C., & von Schrader, S. (2012). 2011 Disability Status Report: United States. Ithaca, NY: Cornell University Employment and Disability Institute(EDI).

[3] L. Chung (2014). *CS/SE 6361 Advanced Requirement Engineering, Spring 2014, Project Phase 1: Requirements Elicitation: Initial Understanding.* [Online]. Available: [material url]

[8] Appendix

8.1 Phase 1 Roles

- Fredy Corona: Led the WRS document and made final revisions before submission.
- Jose Hurtado: Worked on the prototype and helped write requirements
- Panashe Dione: helped coordinated meetings, created tasks and helped on presentation slides
- Muath Alsawaier: wrote and formatted the user manual.
- Levi Chapman: made the presentation slides, Researched background information on navigation systems for visually impaired
- Moises carranza: Helped create and edit slides for the presentation slides
- All Members: helped with the project plan, meeting records, and reviewing of each section before submission

8.2 Meetings

- September 10: Assigned initial project roles and begin project plan
- September 13: Finalized roles, checked requirements, and prepared for initial submission
- September 24: Reviewed feedback and brainstormed ideas for Theia design and purpose
- September 29: set up Figma and Lucidchart, selected projects leads, and divided up tasks
- October 1: Organized our Jira board, assigned tasks, and refined project direction
- October 6: Reviewed progress and made sure everyone had at least 203 tasks to complete by our next meeting
- October 8: Checked on task progress and finalized the WRS document.
- October 10: Presented AS-IS TO-BE presentation slides and discussed app features like navigation, fall detection, and emergency
- November 6: figured out how to divide the work, and figured out the tools

- November 14: progress check for each item on the Jira board
- November 24: another progress check + voting on demo time
- December 4: Organize Demo details, Review work completed

8.3 Activities completed

- Created and submitted the project plan with defend roles and timelines
- Research indoor navigation tools and accessibility features for blind users
- Brainstormed core features such as voice input, pathfinding, and emergency contact options
- Wrote, reviewed, and revised the functional and non-functional requirements.
- Designed and refined the Figma prototype
- Finalized and formatted the WRS document and presentation for submission

8.4 Phase 2 Roles

- Fredy Corona: Coding pathways from distance A to B, Vision and Scope Document
- Jose Hurtado: Coding database insertion, Vision And Scope Document, IDEF0 Model
- Panashe Dione: Coding User Interface, Vision and Scope Document, KAOS Models
- Muath Alsawaier: Coding Fall Detection and Emergency Contact Calling
- Levi Chapman: Coding pathways from distance A to B, Vision and Scope Document
- Moises Carranza: Vision and Scope Document

[9] Models

Found on Process Specification Document