

The University of Texas at Dallas

World Requirements Specification

Theia - Indoor Navigation App for the Blind

Team Visionaries - <<https://theiavisionaries.weebly.com/>>

SE 4351.001

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Meetings

Meetings will occur on an as-needed basis and will be organized over Discord. Meeting records will be kept in the table below and updated as needed.

Date	Location	Agenda	Participants	Summary	Signatures
2/12/2024	Virtual (Discord)	PPP	Bakr Alkayal, Ann Rogers, Sebastian Deleon, Kaiden Gallardo	Discussed how the team should approach setting up the PPP.	<i>Bakr Alkayal</i> <i>Ann Rogers</i> <i>Sebastian Deleon</i> <i>Kaiden Gallardo</i>
2/13/2024	Virtual (Discord)	PPP	Bakr Alkayal, Ann Rogers, Sebastian Deleon, Kaiden Gallardo	Determine who will write the project description, who will write the schedule, who will write additional content (such as tools and team organization), and who will set up and format the PPP document.	<i>Bakr Alkayal</i> <i>Ann Rogers</i> <i>Sebastian Deleon</i> <i>Kaiden Gallardo</i>
3/21/2024	Virtual (Discord)	Project Phase 1	Bakr Alkayal, Ann Rogers, Sebastian Deleon, Kaiden Gallardo	Divided the responsibilities necessary for Project Phase 1.	<i>Bakr Alkayal</i> <i>Ann Rogers</i> <i>Sebastian Deleon</i> <i>Kaiden Gallardo</i>
3/24/2024	Virtual (Discord)	Project Phase 1	Bakr Alkayal, Ann Rogers, Sebastian Deleon, Kaiden Gallardo	Update on Project Phase 1's documentation progress. Divided responsibilities for remaining Project Phase 1 activities.	<i>Bakr Alkayal</i> <i>Ann Rogers</i> <i>Sebastian Deleon</i> <i>Kaiden Gallardo</i>

4/14/2024	Virtual (Discord)	Project Phase 2	Bakr Alkayal, Ann Rogers, Sebastian Deleon, Kaiden Gallardo	Divided the responsibilities necessary for Project Phase 2.	<i>Bakr Alkayal Ann Rogers Sebastian Deleon Kaiden Gallardo</i>
4/28/2024	Virtual (Discord)	Project Phase 2	Bakr Alkayal, Ann Rogers, Sebastian Deleon, Kaiden Gallardo	Update on Project Phase 2's documentation progress. Divided responsibilities for remaining Project Phase 2 activities.	<i>Bakr Alkayal Ann Rogers Sebastian Deleon Kaiden Gallardo</i>

Revision History

Version	Date	Comments
1.0	3/21/2024	Creation of WRS document
1.1	3/21/2024	Updated WRS overall format
2.0	3/25/2024	Added content + finalized WRS

1. Introduction

1.1. Project Description

The Theia app is designed to empower blind and visually impaired individuals with greater independence and confidence in navigating indoor environments, such as schools, offices, and public buildings. Utilizing advanced smartphone sensors, Theia provides real-time audio guidance, obstacle detection, and route optimization to assist users in reaching their destinations safely and efficiently.

1.2. Purpose

To enhance indoor mobility for blind individuals through a user-friendly smartphone application, making use of existing technology to create a safer, more accessible indoor environment.

1.3. Intended Audience

The primary stakeholder is any blind person who needs to navigate indoors. Secondary stakeholders may include a caretaker (a person who assists the blind), family members who help the blind person set up the system, and any other person who assists the blind person.

1.4. Product Scope

The system's indoor navigation system will contain a plethora of features including but not limited to smart destination suggestions, accurate pathfinding from a source to a destination, clear audio guidance, safety mechanisms in case of emergencies such as falls, etc.

2. Preliminary Definition

2.1. Preliminary Domain

This domain of Theia will primarily focus on indoor environments, encompassing multiple floors that may include various facilities such as classrooms, offices, washrooms, lounges, elevators, and more.

2.2. Preliminary Functional Requirements

- Real-Time Audio Guidance: The app should provide step-by-step audio instructions to guide users through indoor environments.
- Obstacle Detection: The app must detect obstacles in the user's path and provide audio warnings or alternative routes.
- Route Optimization: Theia should offer optimized routes based on user preferences, such as shortest path, least obstacles, or avoidance of stairs.
- Indoor Navigation: The app should accurately navigate users through complex indoor environments, including corridors, hallways, and rooms.
- Integration with Smartphone Sensors: The app should effectively utilize smartphone sensors, such as GPS and cameras, to enhance navigation accuracy.
- Customizable Preferences: Users should be able to customize settings such as walking speed, preferred voice, and distance notifications.

2.3. Preliminary Non-Functional Requirements

- Accessibility: The app interface must be accessible and navigable for users with various levels of visual impairment, including support for screen readers and voice commands.
- Reliability: Theia should operate reliably in various indoor environments, regardless of network connectivity or GPS signal availability.
- Performance: The app should respond promptly to user inputs and provide real-time guidance without significant delays.
- Security: User data, including location information, must be securely stored and transmitted to protect user privacy.
- Usability: The app interface should be intuitive and easy to understand, with clear audio instructions and minimal cognitive load for users.
- Compatibility: Theia should be compatible with both Android and iOS operating systems to ensure broad accessibility.

3. Issues With Preliminary Definition Given

3.1. Domain Issues

Indoor Environments Complexity: The variety of environments might lead to inaccuracy in mapping every type of indoor space. Specialized layouts or areas with outdated or inaccurate signage can pose significant challenges.

3.2. Functional Requirements Issues

- Real-Time Audio Guidance Limitations: There may be scenarios where real-time audio guidance could be less effective due to environmental noise or the user's hearing impairments.
- Obstacle Detection Accuracy: Utilizing a smartphone's sensors for obstacle detection may not always be reliable, especially for new or temporary obstacles.
- Route Optimization Complexity: Route optimization based on the user's preferences requires a very special made algorithm that may be hardware intensive for a smartphone.
- Sensor Integration Challenges: GPS, while a great tool, is not as effective when it comes to indoor environments, relying on it could lead to inaccuracies. Alternative methods would need to be explored.
- Customizable Preferences Scope: Ensuring custom preferences are easy to set and adjust without cluttering the UI or those(users) who might not be tech-savvy.
- Voice Command Processing: The processing of voice commands can be a challenge due to the wide range of possible inputs and defining the mapping of those inputs to a narrow set of possible outputs.

3.3. Non-Functional Requirements Issues

- Accessibility Variances: Different levels of visual impairment require a multi-layer app design, which can make the design process more complex.
- Reliability in Diverse Conditions: Ensuring app reliability in environments with varying network connectivity or infrastructure limitations, like metal structures that interfere with signals.
- Performance Optimization: With limited processing power and the battery life of a smartphone, it may require significant optimization.
- Security Measures: Developing and Implementing security protocols to protect sensitive user data, regarding location is crucial but also complex.
- User Interface Design: Creating a hybrid UI that responds to voice commands and audio feedback, while also supporting screen readers, is yet another design challenge.
- Cross-Platform Compatibility: Ensuring full functionality and a consistent user experience such as a caretaker being able to view a live route being taken on another device requires extensive testing and development resources.

4. WRS

4.1. W

4.1.1. Problem

Problem ID	Problem Description	Corresponding Goals
P1	The visually impaired are faced with challenges when navigating indoor spaces. Such challenges include avoiding collisions with obstacles, hazards, and getting to their destination in an optimal amount of time.	G1, G2, G4, G7, G8
P2	The visually impaired are in need of an aid that can see, think, hear, and speak.	G1, G4, G5, G8
P3	To navigate to their destination, visually impaired people must be aware of their starting location.	G3
P4	Indoor spaces may hinder the signal connectivity of the user's mobile device.	G6
P5	Visually impaired must navigate through outdoor spaces to get from building to building, increasing the number of factors to be taken into consideration.	G7
P6	In case of an emergency, the visually impaired may encounter challenges when it comes to efficiently contacting emergency services or emergency contacts.	G9
P7	Needs and preferences differ among the visually impaired.	G10
P8	With the application storing and handling sensitive data such as location of the user, security should be a concern.	G11

4.1.2. Goals

Goal ID	Goal Description	Backward Traceability	Forward Traceability
G1	The designed app must be aware of the user's surroundings using cameras and sensors already embedded in mobile devices.	P1, P2	FRO3
G2	While also detecting, the application must also determine safe paths around obstacles and hazards.	P1	FRO3, FRO4
G3	Design an app with the capability of knowing the layout of indoor spaces and awareness of the user's location in relation to such layout.	P3	FRO6, FRO7
G4	Based on the user's surroundings it must be able to make decisions and provide safe guidance through voice/speakers.	P1, P2	FRO5
G5	The user must be able to interact with the app through voice commands.	P2	FRO1
G6	The mobile app navigation system must have the capability of storing routes as it cannot fully rely on signal connectivity and GPS to provide safe guidance.	P4	FRO7
G7	The mobile app must actively use the device microphone to detect possible hazards.	P1, P5	FRO3
G8	Using the starting location, destination, and users' current location, the application must build a route that can be accurately dictated to the user through voice/speaker.	P1, P2	FRO2, FRO8, FRO9
G9	The application shall make emergency contacts easily accessible through the use of voice commands.	P6	FO10

G10	The application shall allow for account creation and personalization of the user experience through preference customization.	P7	
G11	The application shall employ a robust email and password authentication system to access the application.	P8	

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	Users of the application include those who are visually impaired as well as those who may be assisting them.
ID2	The application shall provide the option of selecting the starting location and destination for which navigation shall be provided. <ul style="list-style-type: none"> • Starting location can be explicitly selected or provided by using localization services provided by the mobile device. • Destination must be explicitly selected.
ID3	Interaction with the application through voice commands shall be prioritized to increase accessibility for the visually impaired.
ID4	Navigation between buildings shall be limited to proximate distances, ensuring navigational guidance is provided within the immediate vicinity.
ID5	Initial application installation and setup should be done with the assistance of a family member, friend, or caretaker.
ID6	Mobile device should be held in an orientation that will allow the back-facing camera to see the user's path.

4.1.3.1. Stakeholders

For:

- Visually impaired people
- Family, friends, and caretakers (assistants) of the visually impaired

Of:

- Team Visionaries (TV)
- Investors

By:

- TV Requirements Engineers
- TV Software Architects
- TV Software Developers

4.1.3.2. Improved Functional Objectives

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

Improved FR Objective ID	Objective Description	Alleviates Problems	Achieves Goals
IFRO1	<p>The application shall take user input through voice commands. User input includes:</p> <ul style="list-style-type: none"> • Starting location • Destination • Application navigation 	P1, P2	G5
IFRO2	The application shall build an optimal route from starting location to destination.	P1	G8
IFRO3	The application shall actively use camera, sensors, and microphone to detect obstacles and hazards in the user's path.	P1, P2, P5	G1, G7
IFRO4	The application shall determine a safe path around obstacles and hazards using gathered data.	P1, P2, P5	G2, G4

IFRO5	The application shall use voice/speakers to accurately communicate navigation path to user.	P1, P2	G4, G8
IFRO6	The application shall use localization services to obtain the user's location.	P3	G3
IFRO7	The application shall store layouts of buildings and routes within these buildings.	P3, P4	G6
IFRO8	The application shall track user's movements in real time.	P1, P3	G3, G8
IFRO9	The application must be able to provide an ETA for a created route.	P1	G8
IFRO10	The application shall maintain a directory/list of emergency contacts which shall include emergency services by default. Additional emergency contacts can be added.	P6	G9
IFRO11	The application shall create a user account through the use of an email address and user provided password. This includes the action of logging-in.	P7, P8	G10, G11
IFRO12	The application shall have customizable preferences that include but not limited to: <ul style="list-style-type: none"> • Preference of stairs or elevators • Disabling active microphone • Type and tone of voice synthesis 	P7	G10
IFRO13	The application shall have the option to remain logged into account after closing of application.	P7	G10

4.1.3.3. Non-Functional Objectives

Based on the above information and our goals, the non-functional objectives are:

Improved NFR Objective ID	Objective Description	Alleviates Problem	Achieves Goal

INFRO1	The application shall be able to respond to voice commands within 2 seconds.	P2	G5
INFRO2	The application's key functionality shall be fully accessible through voice commands.	P2	G5
INFRO3	The application shall provide localization/GPS accuracy within 3 feet.	P1, P3	G8
INFRO4	The application shall save frequently used routes for easy access.	P2, P4	G6
INFRO5	The application shall be reliable.	P4	G6
INFRO6	The application shall notify the user of an obstacle or hazard within 1 second after being detected.	P1, P2	G4
INFRO7	The application shall detect an obstacle or hazard when it is within a range of 5 feet.	P1, P2	G2

4.2. RS

4.2.1. Functional RS – Improved Understanding of Software System Requirements: Functional Requirements

FR ID	Description
FR1	The application shall recognize and process user input via voice commands for functions including specifying starting location, destination, and as well as application interface navigational commands
Satisfies Functional Requirement Issue	Voice Command Processing
Satisfies Objectives	IFRO1
Satisfied by prototype feature	Voice Command Activation
FR ID	Description
FR2	The application shall employ an algorithm to calculate and propose the most optimal route between the starting location and destination.

Satisfies Functional Requirement Issue	Route Optimization Complexity
Satisfies Objectives	IFRO2
Satisfied by prototype feature	Navigation
FR ID	Description
FR3	The application shall integrate the use of camera, sensors, and microphone functionalities to continuously scan the user's surroundings and identify obstacles and hazards in real time.
Satisfies Functional Requirement Issue	Sensor Integration Challenges
Satisfies Objectives	IFRO3
Satisfied by prototype feature	Navigation - Obstacle Alerts
FR ID	Description
FR4	Based on the data collected from the environment, the application shall analyze and determine alternate routes around obstacles and hazards while ensuring user safety and time efficiency.
Satisfies Functional Requirement Issue	Obstacle Detection Accuracy
Satisfies Objectives	IFRO4
Satisfied by prototype feature	Navigation - Obstacle Alerts
FR ID	Description
FR5	The application shall use voice synthesis to audibly and clearly relay navigation instructions to user, facilitating guidance.
Satisfies Functional Requirement Issue	Real-Time Audio Guidance Limitations
Satisfies Objectives	IFRO5
Satisfied by prototype feature	Navigation - Step-by-Step Guidance
FR ID	Description
FR6	The application shall integrate localization services to accurately determine and continuously update the user's position in real-time, ensuring precise navigation assistance.
Satisfies Functional Requirement Issue	Sensor Integration Challenges
Satisfies Objectives	IFRO6
Satisfied by prototype feature	Navigation

FR ID	Description
FR7	The application shall maintain a repository containing detailed floor plans and navigation routes within buildings, enabling efficient indoor navigational assistance.
Satisfies Functional Requirement Issue	Customizable Preference Scope
Satisfies Objectives	IFRO7
Satisfied by prototype feature	Navigation; My Routes
FR ID	Description
FR8	The application shall monitor and record the user's movements with high precision and real-time updates, facilitating accurate positioning.
Satisfies Functional Requirement Issue	Sensor Integration Challenges
Satisfies Objectives	IFRO8
Satisfied by prototype feature	Navigation
FR ID	Description
FR9	The application shall calculate and notify the user of the ETA for a created route.
Satisfies Functional Requirement Issue	Route Optimization Complexity
Satisfies Objectives	IFRO9
Satisfied by prototype feature	Navigation; Destination Alert
FR ID	Description
FR10	A list of emergency contacts shall be maintained by the application. List shall be populated with emergency services by default.
Satisfies Functional Requirement Issue	Customizable Preferences Scope
Satisfies Objectives	IFRO10
Satisfied by prototype feature	Emergency Contacts
FR ID	Description
FR11	The application shall have the capability of creating and maintaining user accounts.
Satisfies Functional Requirement Issue	Customizable Preferences Scope
Satisfies Objectives	IFRO11
Satisfied by prototype feature	

FR ID	Description
FR12	The application shall give the user to customize their experience and store the preferences in the maintained user account.
Satisfies Functional Requirement Issue	Customizable Preferences Scope
Satisfies Objectives	IFRO12
Satisfied by prototype feature	
FR ID	Description
FR13	The application shall maintain the hashed/encrypted user password to facilitate user login while maintaining security integrity.
Satisfies Functional Requirement Issue	Customizable Preferences Scope
Satisfies Objectives	IFRO11
Satisfied by prototype feature	
FR ID	Description
FR14	The application shall have the capability of keeping the user logged in after closing the application.
Satisfies Functional Requirement Issue	Customizable Preferences Scope
Satisfies Objectives	IFRO13
Satisfied by prototype feature	

4.2.2. Non-Functional RS - Improved Understanding of Software System Requirements: Non-Functional Requirements

NFR ID	Nonfunctional Requirement 1	
NFR1	The system shall exhibit responsiveness in all key functionalities to voice commands by executing the requested actions within a maximum latency of 2 seconds.	
Operationalized Functional Requirements	OFR1	The voice recognition system shall use an optimized algorithm to process voice commands.
Satisfies Nonfunctional Requirement Issue	Performance Optimization	

Satisfies Non-functional Objective	INFRO1	
Constrains	FR1	
Satisfied by prototype feature	Voice Command Activation	
NFR ID	Nonfunctional Requirement 2	
NFR2	The application shall ensure that all key functionalities be accessible and operable through the use of voice commands.	
Operationalized Functional Requirements	OFR1	The application shall provide a wide array of voice commands.
Satisfies Nonfunctional Requirement Issue	User Interface Design	
Satisfies Non-functional Objective	INFRO2	
Constrains	FR1	
Satisfied by prototype feature	Voice Command Activation	
NFR ID	Nonfunctional Requirement 3	
NFR3	The application shall deliver precise localization and GPS accuracy within a margin of error not exceeding 3 feet.	
Operationalized Functional Requirements	OFR1	GPS and localization service provided by mobile device shall be used to provide precise user location.
Satisfies Nonfunctional Requirement Issue	Performance Optimization	
Satisfies Non-functional Objective	INFRO3	
Constrains	FR6, FR8	
Satisfied by prototype feature	Navigation	
NFR ID	Nonfunctional Requirement 4	

NFR4	The application shall implement a feature to store and retrieve frequently used routes, enhancing user convenience.	
Operationalized Functional Requirements	OFR1 OFR2	The application shall maintain a repository of frequented routes by the user. The application shall use an optimized algorithm to retrieve stored routes based on the provided starting location or destination, or a combination of both.
Satisfies Nonfunctional Requirement Issue	Accessibility Variances	
Satisfies Non-functional Objective	INFRO4	
Constrains	FR2, FR7	
Satisfied by prototype feature	My Routes	
NFR ID	Nonfunctional Requirement 5	
NFR5	The application shall display reliability by providing a seamless user experience.	
Operationalized Functional Requirements	OFR1	Latency between user request and application response shall be minimized through optimized process handling.
Satisfies Nonfunctional Requirement Issue	Performance Optimization	
Satisfies Non-functional Objective	INFRO5	
Constrains	FR1, FR2, FR9	
Satisfied by prototype feature	*	
NFR ID	Nonfunctional Requirement 6	
NFR6	The application shall promptly alert the user of any detected obstacle or hazard with a notification latency not exceeding 1 second.	

Operationalized Functional Requirements	OFR1 OFR2	The application shall use a well structured model for merging the different data streams (sensors, camera, microphone, etc.) An optimized detection model shall be used to quickly respond to obstacles and hazards.
Satisfies Nonfunctional Requirement Issue		Reliability in Diverse Conditions
Satisfies Non-functional Objective		INFRO6
Constrains		FR3, FR4
Satisfied by prototype feature		Navigation - Obstacle Alerts
NFR ID	Nonfunctional Requirement 7	
NFR7	The application shall efficiently use sensors, cameras, and microphone to identify the presence of obstacles or hazards within a proximity of 5 feet of the user.	
Operationalized Functional Requirements	OFR1	The chosen detection model shall be optimized to prioritize objects within the chosen boundary.
Satisfies Nonfunctional Requirement Issue	Reliability in Diverse Conditions Performance Optimization	
Satisfies Non-functional Objective	INFRO7	
Constrains	FR3, FR4	
Satisfied by prototype feature	Navigation - Obstacle Alerts	

4.2.3 Specifications

Functional Specification ID	Functional Requirement
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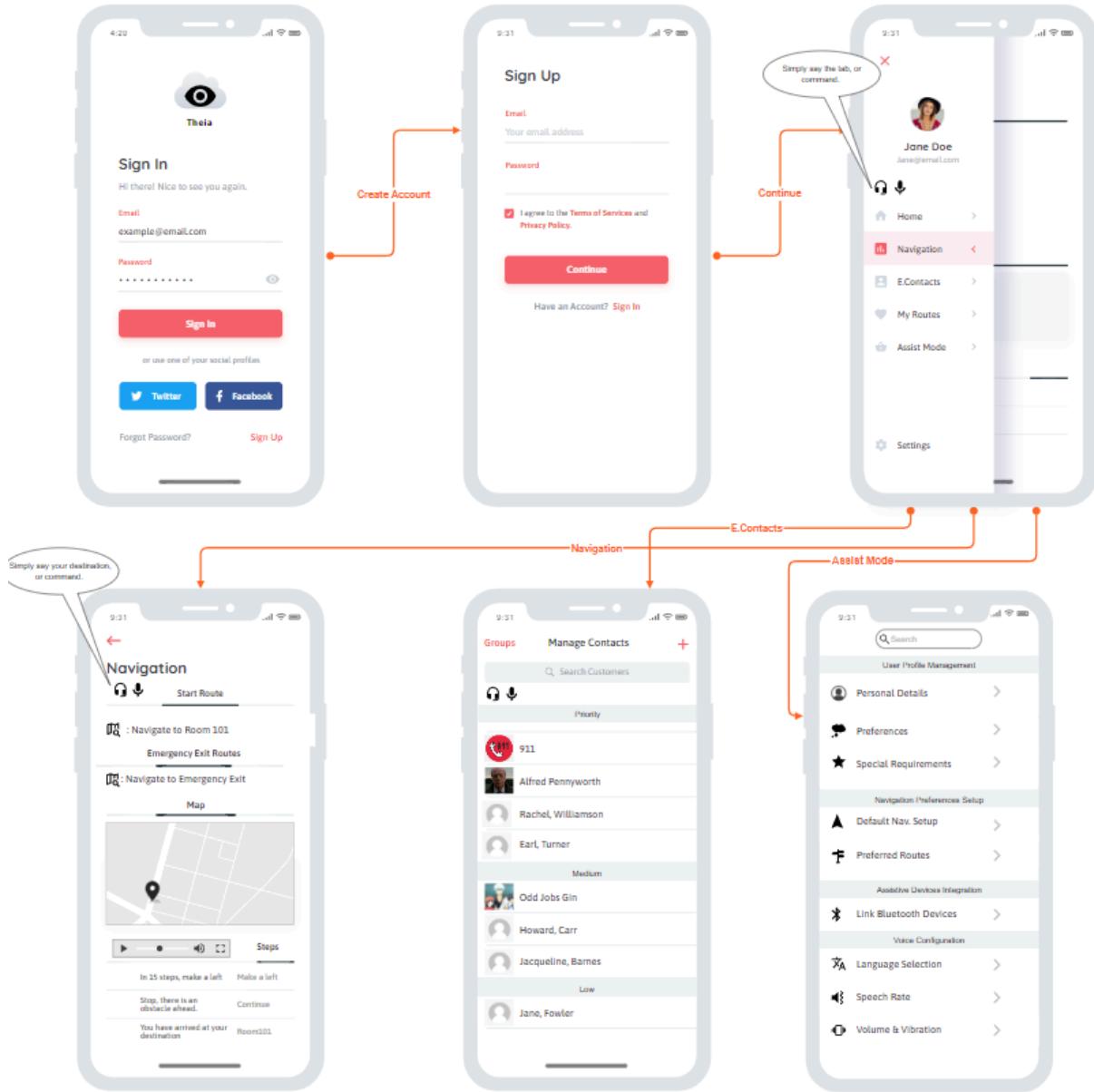
FS1	Given a voice command by the user through microphone, the application shall execute the proper command.
Satisfies Functional Requirement	FR1
Satisfies Objectives	FO1
Satisfied by prototype feature	Voice Command Activation
Functional Specification ID	Functional Requirement
FS2	With the provided starting location and destination, the application should provide the user with an optimal route.
Satisfies Functional Requirement	FR2
Satisfies Objectives	FO2
Satisfied by prototype feature	Navigation
Functional Specification ID	Functional Requirement
FS3	If an obstacle or hazard is to appear in the user's path, the application shall notify the user.
Satisfies Functional Requirement	FR3
Satisfies Objectives	FO3
Satisfied by prototype feature	Navigation - Obstacle Alerts
Functional Specification ID	Functional Requirement
FS4	If an obstacle or hazard is to be detected, the application shall provide the user with an alternate route guiding the user safely.
Satisfies Functional Requirement	FR4
Satisfies Objectives	FO4
Satisfied by prototype feature	Navigation - Obstacle Alerts
Functional Specification ID	Functional Requirement
FS5	With a navigation path in place, the application shall clearly and accurately dictate directions to the user through voice synthesis.
Satisfies Functional Requirement	FR5
Satisfies Objectives	FO5
Satisfied by prototype feature	Navigation - Step-by-Step Guidance
Functional Specification ID	Functional Requirement
FS6	When provided with GPS signal or localization service, the application shall be aware and make the user aware of their location in real time.
Satisfies Functional Requirement	FR6
Satisfies Objectives	FO6

Satisfied by prototype feature	Navigation
Functional Specification ID	Functional Requirement
FS7	If a route is frequented by the user, the application shall store the route in the repository.
Satisfies Functional Requirement	FR7
Satisfies Objectives	FO7
Satisfied by prototype feature	My Routes
Functional Specification ID	Functional Requirement
FS8	If the user moves from current location/position, the application must reflect the changes.
Satisfies Functional Requirement	FR8
Satisfies Objectives	FO8
Satisfied by prototype feature	Navigation
Functional Specification ID	Functional Requirement
FS9	When providing a starting location and destination, the application must provide the user with an ETA for the created route.
Satisfies Functional Requirement	FR9
Satisfies Objectives	FO9
Satisfied by prototype feature	Navigation; Destination Alerts
Functional Specification ID	Functional Requirement
FS10	Given a list of phone numbers, the application shall create a directory of emergency contacts easily accessible by the user.
Satisfies Functional Requirement	FR10
Satisfies Objectives	FO10
Satisfied by prototype feature	Emergency Contacts
Functional Specification ID	Functional Requirement
FS11	Given an email address and password, the application shall create a user account and provide the capability of user login.
Satisfies Functional Requirement	FR11
Satisfies Objectives	FO11
Satisfied by prototype feature	Account Creation
Functional Specification ID	Functional Requirement
FS12	Provided with an user account, the application shall provide the user with the ability of setting preferences.
Satisfies Functional Requirement	FR12

Satisfies Objectives	FO12
Satisfied by prototype feature	Assistive Mode
Functional Specification ID	Functional Requirement
FS13	Given a user password, the application system shall hash/encrypt it and store for future user authentication
Satisfies Functional Requirement	FR13
Satisfies Objectives	FO11
Satisfied by prototype feature	Account Creation
Functional Specification ID	Functional Requirement
FS14	If chosen by the user, the application shall keep the user logged in even after closing the application.
Satisfies Functional Requirement	FR14
Satisfies Objectives	FO13
Satisfied by prototype feature	Account - Remain Logged-in

5. Preliminary (Mockup) & Prototype and User Manual

5.1. Theia App



5.2. User Manual

5.2.1. Intro to Theia App

Welcome to Theia, the smartphone application designed to transform indoor navigation for the visually impaired. Our app is named after the Greek goddess of sight, symbolizing the vision and guidance we aim to provide to our users. The purpose of Theia is to offer a reliable and intuitive navigation assistant that empowers blind and visually impaired individuals to navigate indoor spaces with confidence and independence.

Theia is tailored for blind and visually impaired users seeking greater autonomy in indoor environments such as schools, offices, malls, and public buildings. It is also a valuable tool for caregivers and family members who support individuals with visual impairments.

It can be challenging when it comes to navigating indoor spaces for those without sight. Guide dogs and traditional canes have limitations, especially when it comes to a foreign environment. Theia attempts to address this problem by providing audio-guided navigation, obstacle detection, and emergency assistance through a user's smartphone, by using existing technology to create a more accessible world.

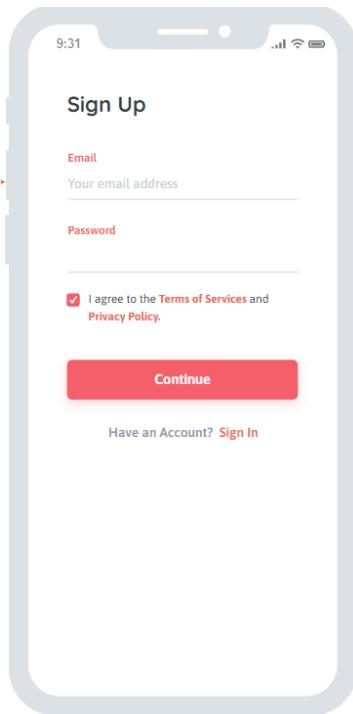
5.2.2. Getting Started

Downloading the App:

1. Open the App Store or Google Play Store
2. Search for “Theia Indoor Navigation” in the stores search bar
3. Select “Download” or “Install” to begin downloading the app
4. Once installed, click on “Open” to launch Theia

5.2.3. Features Expanded

Sign Up

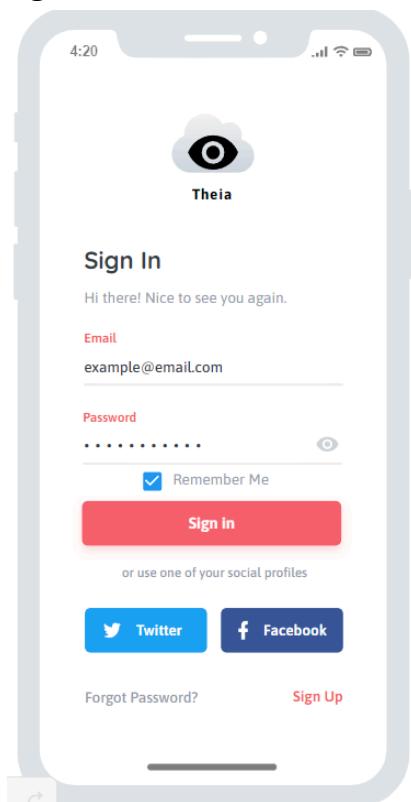


Creating a New Account:

1. Open Theia App: launch the app on your device
2. Navigate to Sign Up: On the welcome screen, click the “Signup” button if you are a new user.

3. Enter Email Address: Type your email in the “Email” field. Ensure that it is a valid and accessible email, as it will be used for communication purposes.
4. Set Password: Choose a strong password.
5. Terms & Services: Read the ToS and Privacy Policy by clicking on the links provided.
6. Complete Sign Up: Once all information is filled in and you’ve agreed to the terms, tap the continue button to create your account.
7. Account Verification: Check your email and verify your account, a message should be sent to you from Theia.

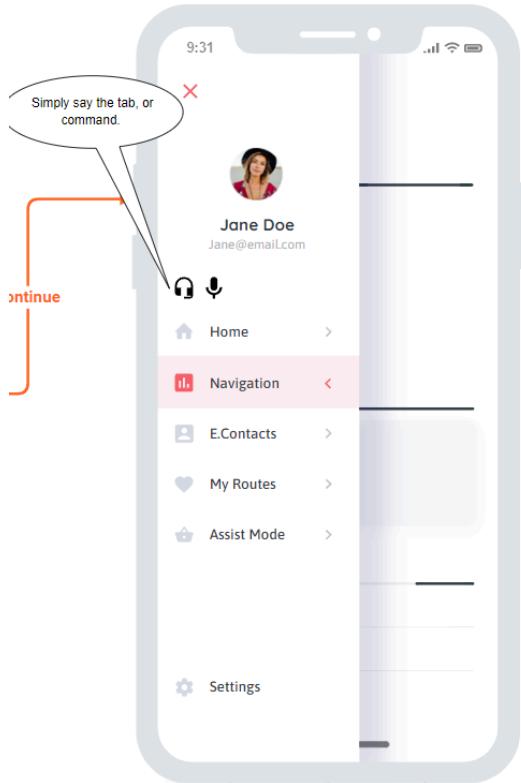
Sign-In



Accessing Your Account:

1. Open Theia App: If you have closed the app, open it again.
2. Navigate to Sign In: Tap on the “Sign In” button if you are an existing user
3. Enter Email and Password: Fill in your registered information from the previous step
4. Remember Me: For an ease of access, check the box next to the “Remember Me” text.
5. Sign In: Tap the “sign In” button to login in.
6. Social Media Sign In: Optionally, you can sign in using one of your social media accounts.
7. Trouble Signing In: If you are having trouble logging into your account, tap “Forgot Password?” link. You’ll be guided through the steps to reset your password.

Sidebar Menu

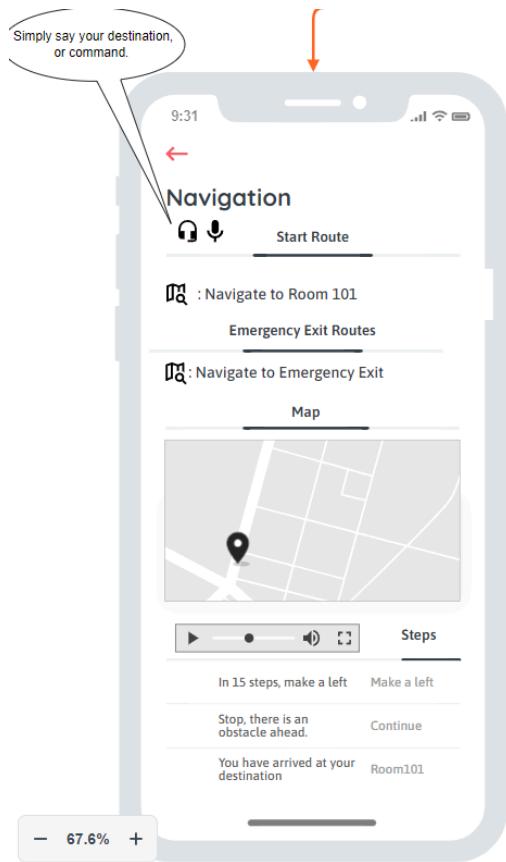


Accessing the Side Bar:

1. Voice Command Activation: To open the sidebar, use the voice command feature by simply saying “Open Menu” or tap the menu icon at the top left corner of the screen if manual interaction is preferred.
2. Profile Overview: At the top of the sidebar, your profile information is displayed, here you can see your name and email address. You can simply tap your profile picture to change it.
3. Navigation: Tap or say “Navigation” to access the navigation features of the app. This will take you to a screen where you can set a destination, select a route, and receive voice-guided navigation instructions.
4. Emergency Contacts (E.Contacts): Select this to view and manage your emergency contact list. This is where you can add or remove contacts and specify which contacts should be notified in case of an emergency.
5. My Routes: This option allows you to view your saved routes and access them quickly. It's handy for frequently visited destinations or pre-planned journeys.
6. Assist Mode: The “Assist Mode” is designed for caretakers or assistants. By selecting this, they can access special features that allow them to configure the app settings and navigation preferences for visually impaired users.
7. Settings: This is where you can customize app settings, such as navigation options, accessibility features, and any other app preferences.

8. Note: The sidebar menu is accessible at any point within the app. The voice command feature enhances accessibility by allowing users to navigate the menu without the need for visual cues.

Navigation Feature

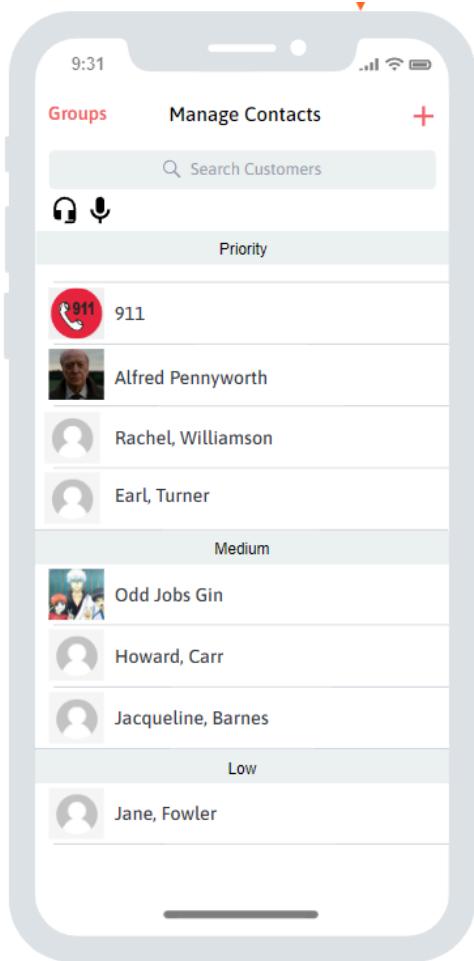


Accessing Navigations:

1. Voice Command Activation: To start navigation, say “Open Navigation” or select the “Navigation” tab from the sidebar menu.
2. Starting Your Route:
 - a. Voice Command for Destination: To enter your destination, use the voice command feature by saying, for example, “Navigate to Room 101”, or manually enter the destination by tapping the “Start Route” button and typing your destination.
 - b. Choosing Emergency Exit: For quick navigation to the nearest emergency exit, select “Navigate to Emergency Exit” from the list of quick options.
3. Map Overview:
 - a. Viewing the Map: Below the route options, the map provides a visual representation of your current location and chosen route, which can be viewed live by a caretaker.
4. Following Route Instructions:

- a. Step-by-Step Guidance: Once you've started the route, follow the audio instructions provided by Theia for step-by-step navigation. For example, you'll hear "In 15 steps, make a left" to guide you through the building.
 - b. Obstacle Alerts: If there is an obstacle on your path, Theia will alert you with a statement like "Stop, there is an obstacle ahead." The app will then offer instructions to safely navigate around the obstacle.
5. Receiving Destination Alerts: When you have arrived at your destination, Theia will notify you with a message such as "You have arrived at your destination, Room 101."

Contacts Feature

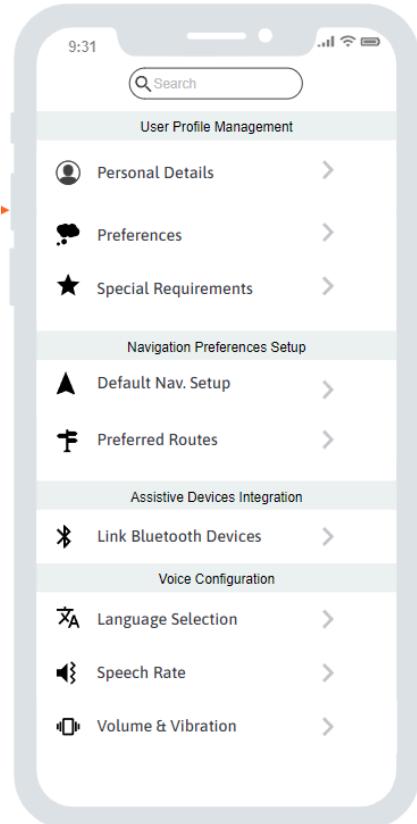


Accessing Contacts:

1. Voice Command Activation: Say "Open Contacts" or select the "E.Contacts" tab from the sidebar menu to view your contacts.
2. Managing Contacts:
 - a. Add New Contact: To add a new contact, tap the "+" icon at the top right corner. Enter the contact's information in the fields provided, and assign them a priority level if necessary.

- b. Search for a Contact: Use the search bar labeled “Search Customers” to quickly find a contact by typing their name.
3. Contact Priority Groups:
- a. Emergency Contacts: At the top, contacts designated for emergencies, such as ‘911’, are listed for quick access and are first in line to be contacted in case of emergency.
 - b. Priority Contacts: Below any emergency contacts, you’ll find your ‘Priority’ contacts. These are people to reach out to first, like family members or a close friend.
 - c. Medium & Low Priority Contacts: Further down, contacts are organized by ‘Medium’ and ‘Low’ priority. This can help in less urgent situations where assistance is still needed.
4. Editing or Deleting Contacts:
- a. To edit a contact's details or change their priority, simply say or tap their name along with ‘Edit’. The voice assistant app will ask you field by field what you want to change.
 - b. To remove a contact from the list, select or say the contact and choose or say ‘Delete’, will be asked to confirm if that's what you want.

Assistive Mode



Accessing Assist Mode:

1. Voice Command Activation: Say “Open Assistive Mode” or select the “Assist Mode” tab from the sidebar to enter the Assistive Mode designed for setting up and customizing the app for the user, usually done by the caretaker.
2. User Profile Management:
 - a. Personal Details: Tap on “Personal Details” to view and edit information like name, contact details, and any other personal identifiers.
 - b. Preferences: Select “Preferences” to set or change user preferences such as navigation voice, volume levels, and interface theme.
 - c. Special Requirements: Access “Special Requirements” to input any additional needs the user may have which the app could assist with, like alerting the specific types of obstacles more frequently.
3. Navigation Preferences Setup:
 - a. Default Nav. Setup: Choose “Default Nav. Setup” to establish default navigation settings such as starting point preferences or automatic route types.
 - b. Preferred Routes: Under “Preferred Routes,” save frequently used routes or set up routes with specific criteria like avoiding stairs.
4. Assistive Devices Integration:
 - a. Link Bluetooth Devices: In this section, pair assistive Bluetooth devices, like smart canes or hearing aids, to work in conjunction with the app for enhanced navigation support.
5. Voice Configuration:
 - a. Language Selection: Tap here to select the language used by the app for voice commands and navigation instructions.
 - b. Speech Rate: Adjust how fast the app speaks to the user, making sure it matches the user’s comfort level.
 - c. Volume & Vibration: Set the volume for audio feedback and the intensity of vibration alerts for a customized experience.

6. Traceability

6.1. Forward Traceability

World	
Problem ID	Goal ID
P1	G1, G2, G4, G7, G8
P2	G1, G4, G5, G8
P3	G3
P4	G6

P5	G7
P6	G9
P7	G10
P8	G11

Requirements (Goal to Objectives)		
Goal ID	IFRO ID	INFRO ID
G1	IFRO3	
G2	IFRO4	INFRO7
G3	IFRO6, IFRO8	
G4	IFRO4, IFRO5	INFRO6
G5	IFRO1	INFRO1, INFRO2
G6	IFRO7	INFRO4, INFRO5
G7	IFRO3	
G8	IFRO2, IFRO5, IFRO8, IFRO9	INFRO3
G9	IFRO10	
G10	IFRO11, IFRO12, IFRO13	
G11	IFRO11	

Requirements (Objective to FR)		Requirements (Objective to NFR)	
IFRO ID	FR ID	INFRO ID	NFR ID
IFRO1	FR1	INFRO1	NFR1
IFRO2	FR2	INFRO2	NFR2
IFRO3	FR3	INFRO3	NFR3
IFRO4	FR4	INFRO4	NFR4
IFRO5	FR5	INFRO5	NFR5

IFRO6	FR6	INFRO6	NFR6
IFRO7	FR7	INFRO7	NFR7
IFRO8	FR8		
IFRO9	FR9		
IFRO10	FR10		
IFRO11	FR11, FR13		
IFRO12	FR12		
IFRO13	FR14		

Specification (FR to FS)	
FR ID	FS ID
FR1	FS1
FR2	FS2
FR3	FS3
FR4	FS4
FR5	FS5
FR6	FS6
FR7	FS7
FR8	FS8
FR9	FS9
FR10	FS10
FR11	FS11
FR12	FS12
FR13	FS13
FR14	FS14

6.2. Backward Traceability

World (Goal to Problem)	
Goal ID	Problem ID
G1	P1, P2
G2	P1
G3	P3
G4	P1, P2
G5	P2
G6	P4
G7	P1, P5
G8	P1, P2
G9	P6
G10	P7
G11	P8

Requirements (Objective to Goal)		Requirements (Objective to Goal)	
IFRO ID	Goal ID	INFRO ID	Goal ID
IFRO1	G5	INFRO1	G5
IFRO2	G8	INFRO2	G5
IFRO3	G1, G7	INFRO3	G8
IFRO4	G2, G4	INFRO4	G6
IFRO5	G4, G8	INFRO5	G6
IFRO6	G3	INFRO6	G4
IFRO7	G6	INFRO7	G2
IFRO8	G3, G8		

IFRO9	G8
IFRO10	G9
IFRO11	G10, G11
IFRO12	G10
IFRO13	G10

Requirements (FR to Objective)		Requirements (NFR to Objective)	
FR ID	IFRO ID	NFR ID	INFRO ID
FR1	IFRO1	NFR1	INFRO1
FR2	IFRO2	NFR2	INFRO2
FR3	IFRO3	NFR3	INFRO3
FR4	IFRO4	NFR4	INFRO4
FR5	IFRO5	NFR5	INFRO5
FR6	IFRO6	NFR6	INFRO6
FR7	IFRO7	NFR7	INFRO7
FR8	IFRO8		
FR9	IFRO9		
FR10	IFRO10		
FR11	IFRO11		
FR12	IFRO12		
FR13	IFRO11		
FR14	IFRO13		

Specification (FS to FR)	
FR ID	FR ID
FS1	FR1

FS2	FR2
FS3	FR3
FS4	FR4
FS5	FR5
FS6	FR6
FS7	FR7
FS8	FR8
FS9	FR9
FS10	FR10
FS11	FR11
FS12	FR12
FS13	FR13
FS14	FR14

7. Theia Scenario

7.1. A Scenario for Theia

The user launches Theia app on their smartphone and inputs their destination within a public building, such as a meeting room on the third floor of an office building. The app utilizes its indoor navigation capabilities to guide the user from their current location to the specified destination, providing real-time audio instructions to navigate corridors, avoid obstacles, and utilize elevators if necessary. While navigating through a school hallway using Theia, the user encounters a large obstacle that wasn't detected by their cane. The app promptly notifies the user of the obstacle through audio cues and suggests an alternative route to bypass it, ensuring the user's safety and uninterrupted navigation.

7.2. Theia AS-IS and TO-BE Scenario

AS IS Scenario:

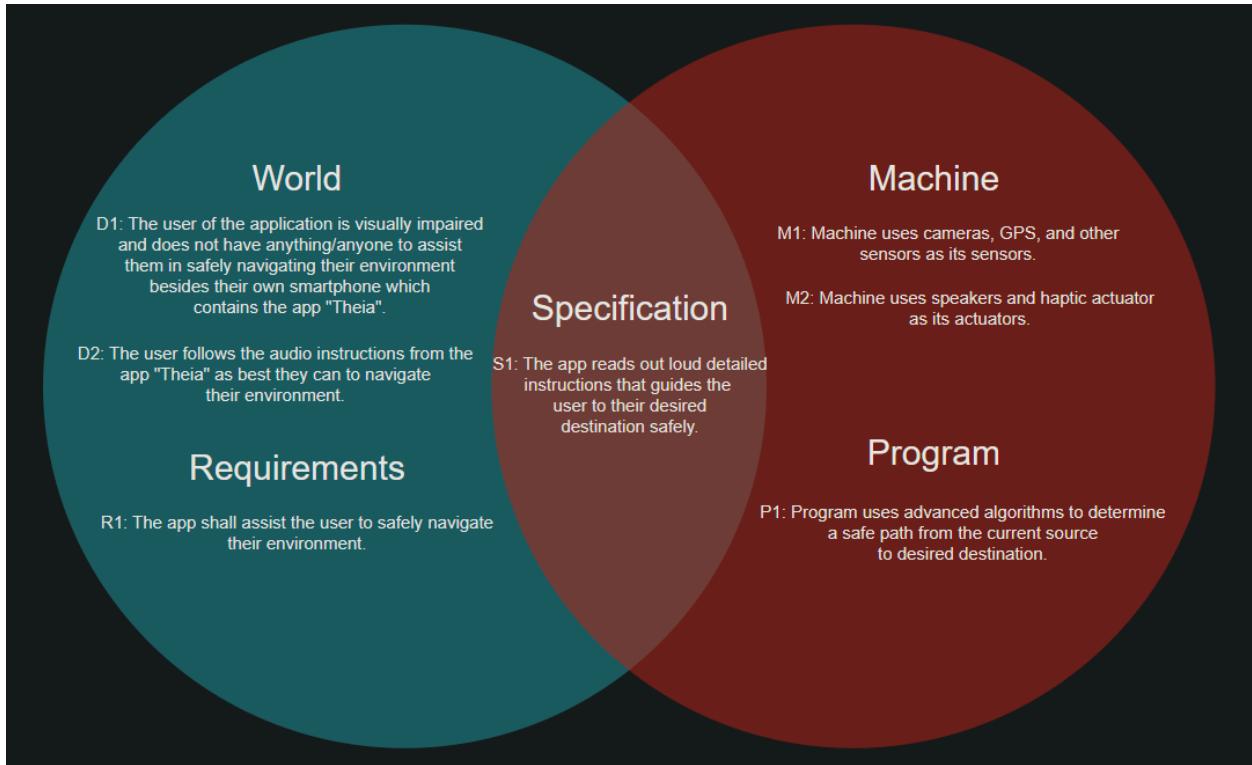


TO BE Scenario:



8. Additional Information

8.1. Reference Model Venn Diagram



8.2. Phase 1: How much Requirements Creeping Rate can our team handle?

Our team can handle limited requirements creeping due to the short-term nature of this assignment. We have about 21 total requirements which include both FR and NFRs. Based on that number, we believe we could handle the addition of an extra 4 requirements, which would be about 20% of our total requirements. Thus, our Requirements Creeping Rate is about 20%. Given the timeframe, it is important that we keep a tight schedule when it comes to requirements.

8.3. Phase 2: Was our estimation of the creeping rate reasonable?

For project phase 2, we did not add any more requirements. Therefore, our initial estimated creeping rate of 4 additional requirements is still reasonable, since 0 is close to 4.

8.4. Why our team's work is the best (or is at least as good as other teams' work)

Our project plan shows our organized and methodical approach to the Theia project. We are able to clearly determine what functional and non-functional requirements will be both necessary and feasible in the scope of this project. We have clear and detailed plans that determine the trajectory of the project.

9. References

- [1] L. Dandona and R. Dandona, “Revision of visual impairment definitions in the International Statistical Classification of Diseases,” BMC Medicine, vol. 4, no. 1, Mar. 2006, doi: <https://doi.org/10.1186/1741-7015-4-7>.