|  |
| --- |
| CptS 484: Software Requirements |
| WRS Evolution |
| Requirements Elicitation |

Samuel Gibson

Ahmed Mohamed

Brendan Crebs

Julie Rodriguez

Caden Oslund

10/15/2023

[Revision History 2](#_Toc284622741)

[[1] Introduction 4](#_Toc1711972602)

[1.1. Purpose 4](#_Toc1255661196)

[1.2. Scope 4](#_Toc766309183)

[1.3. Objectives and Success Criteria 4](#_Toc1405606461)

[1.4. Definitions, Acronyms, and Abbreviations 5](#_Toc934234089)

[1.5. Overview 5](#_Toc129936763)

[[2] Preliminary Definition 5](#_Toc759717214)

[2.1. Preliminary Domain 5](#_Toc75873567)

[2.2. Preliminary Functional Requirements 5](#_Toc1708083010)

[2.3. Preliminary Non-Functional Requirements 6](#_Toc772862948)

[[3] Issues with the Preliminary Definition Given 7](#_Toc72655980)

[3.1. Domain Issues 7](#_Toc850913642)

[3.2. Functional Requirements Issues 9](#_Toc347339402)

[3.3. Non-Functional Requirements(NFR) Issues 12](#_Toc299247678)

[[4] WRS 14](#_Toc7478217)

[4.1. W 14](#_Toc1681593250)

[4.1.1. Problem 14](#_Toc1266178888)

[4.1.2. Goals 15](#_Toc199329327)

[4.1.3. Improved Understanding of Domain, Stakeholders, Functional, and Non-Functional Objectives 16](#_Toc1712604238)

[4.1.3.1. Improved Domain 16](#_Toc954002079)

[4.1.3.2. Stakeholders 17](#_Toc1800370038)

[4.1.3.3. Improved Functional Objectives 17](#_Toc1474175179)

[4.1.3.4. Improved Non-Functional Objectives 17](#_Toc604285678)

[4.2. RS 18](#_Toc1068666943)

[4.2.1. Functional Requirements 18](#_Toc1997119824)

[4.2.2. Non-Functional Requirements 18](#_Toc1122991010)

[4.2.3. Specifications 19](#_Toc36428043)

[[5] Preliminary Prototype 20](#_Toc374178392)

[[6] Prototype Interface Mock-ups 20](#_Toc2037658420)

[[7] User Manual 20](#_Toc1014437731)

[[8] Traceability 21](#_Toc790341375)

[[9] References 21](#_Toc1297640567)

[Appendix I: Process Details 21](#_Toc1296542252)

# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| Date | Version | Changes | Editor |
| 10/14/2023 | 0.1 | Initial Draft | Samuel, Julie, Ahmed, Caden, Brenden |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

# Introduction

## Purpose

The objective of this project is to develop an application capable of providing a safe navigation solution for the vision impaired. The application should improve upon traditional navigation tools such as canes, taking into consideration obstacle detection, collision avoidance, timeliness, and familiarity.

## Scope

The scope of the application should be limited to only addressing the provided requirements. The application will function for indoor navigation, consisting of multi floored buildings and elements such as elevators, stairs, and bathrooms.

The application’s features will be built to accommodate the primary user, the blind and vision impaired, as well as a secondary caretaker user.

The core functionalities of the application are determined to be the following:

* Accepting a destination location from the user.
* Calculation of routes from the user’s location to the destination.
* Giving audible instructions to the user on where and how to move.
* Obstacle detection.
* Placing emergency calls or messages.

## Objectives and Success Criteria

The project objectives and success criteria are that the software must:

1. Help the user safely navigate indoors.
2. Lead the user through the fastest route.
3. Lead the user through the route that the user would feel the most comfortable with.
4. Useable for blind and vision impaired.
5. Be customizable by any user.
6. Extensible to accommodate variations.

## Definitions, Acronyms, and Abbreviations

|  |  |
| --- | --- |
| Term | Definition |
|  |  |

## Overview

Section 2 will describe the preliminary domain, functional, and non-functional requirements gathered from the initial project description. In section 3, issues determined from the preliminary definitions are laid out. The issues cover the domain, functional, and non-functional requirements, options, choice, and rationales.

Section 4 covers the topic of W and RS. The section for W describes the problems, goals, and relations between the two. Each goal has backwards traceability and forward traceability noted. Further on, an improvement on the preliminary domain, functional, and non-functional requirements are made and connected to relevant problems and goals. The RS section lists the functional, non-functional requirements and specifications. Satisfied functional requirement issues and objectives are also included.

# Preliminary Definition

## Preliminary Domain

|  |  |
| --- | --- |
| **PD\_ID** | **Preliminary Domain Description** |
| PD1 | Indoor locations, which can consist of multiple floors, each of which possibly hosts multiple rooms, bathrooms, elevators, etc. |
| PD2 | A blind or vision impaired person who needs to navigate indoors. |
| PD3 | A caretaker who sets the application configuration and comes to aid the primary user in case of emergencies. |

## Preliminary Functional Requirements

|  |  |
| --- | --- |
| **P FR\_ ID** | **Preliminary FR Description** |
| PFR1 | Accepting from the user the destination location. |
| PFR2 | Suggest or confirm a possible destination location based on the user’s routine. |
| PFR3 | Calculation of routes to a destination, informing the user of the route options, and accepting user’s preference. |
| PFR4 | Telling the user directions for walking, stopping, or turning. |
| PFR5 | Obstacle detection and telling the user how to avoid the obstacle. |
| PFR6 | Placing emergency calls and messages after detecting a fall or losing the current location. |
| PFR7 | Figuring out the user’s next action and suggesting or accepting the user’s choice. |

## Preliminary Non-Functional Requirements

|  |  |
| --- | --- |
| **PNFR\_ ID** | **Preliminary NFR Description** |
| PNFR1 | Help the user safely navigate indoors. |
| PNFR2 | Lead the user through the fastest route. |
| PNFR3 | Lead the user through the route that the user would feel most comfortable with. |
| PNFR4 | Usable for blind people. |
| PNFR5 | System shall be ubiquitous. |
| PNFR6 | System shall be customizable to every user. |
| PNFR7 | System shall 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. |

# Issues with the Preliminary Definition Given

## Domain Issues

|  |  |  |
| --- | --- | --- |
| **Domain Issue ID** | **Domain Issue Description** | |
| DI1 | PD\_1 | Indoor locations, which can consist of multiple floors, each of which possibly hosts multiple rooms, bathrooms, elevators, etc. |
| 1. Ambiguous or incomplete definition. Only some elements of ‘indoor locations’ are defined. | |
| Option 1 | Provide a proper definition for indoor locations that should be handled by the application. |
| Option 2 | Assume the application must be able to handle all locations, including indoors, outdoors, and other unique instances. |
| Choice | Option 1 |
| Rationale | Developing the application to work in all locations will result in tremendous scope creep. Refining the definition for workable locations will require less work. |
| Revised wording |  |  |
| DI2 | PD\_2 | A blind or vision impaired person who needs to navigate indoors. |
| 1. Ambiguous. Does the user only have to be blind or vision impaired, or can they have other disabilities? | |
| Option 1 | Assume blind or vision impaired users have no other disabilities. |
| Option 2 | Accommodate navigation of blind as well as other disabilities. |
| Choice | Option 1 |
| Rationale | Developing the application to accommodate additional disabilities will result in an ever-increasing scope creep. |
| Revised wording |  |  |
| DI3 | PD\_3 | A caretaker who sets the application configuration and comes to aid the primary user in case of emergencies. |
| 1. What if no caretaker user available? | |
| Option 1 | Assume application can only be configurable with the aid of a non-vision impaired. |
| Option 2 | Allow configuration of application for vision impaired users. |
| Choice | Option 1 |
| Rationale | Adding the ability for a vision impaired user to configure the application would also result in scope creep. |
| Revised wording |  |  |

## Functional Requirements Issues

|  |  |  |
| --- | --- | --- |
| **FR Issue ID** | **Description** | |
| FRI1 | PFR1 | Accepting from the user the destination location. |
| 1. How should the application receive this input? | |
| Option 1 | Keyboard text input. |
| Option 2 | User voice input. |
| Choice | Option 2 |
| Rationale | Since the primary user is blind or vision impaired, accepting the location via user voice input is the most accessible option. |
| Satisfied by | FR1 | |
| **FR Issue ID** | **Description** | |
| FRI2 | PFR2 | Suggest or confirm a possible destination location based on the user’s routine. |
| The problem is determining if the user is in hurry or have time to select route | |
| Option 1 | Always recommend best route to user |
| Option 2 | Allow user to disable recommendation in settings |
| Choice | Option 2 |
| Rationale | If the user does not want a recommendation from the app, then they can disable the option, otherwise the app will recommend the fastest safest route to the user. |
| Satisfied by | FR2 | |
| **FR Issue ID** | **Description** | |
| FRI3 | PFR3 | Calculation of routes to a destination, informing the user of the route options, and accepting user’s preference. |
| How to list options to user via voice command and accept correct user input | |
| Option 1 | Preface each voice command with enumrated wording as in “Route 1, route 2...route n” |
| Option 2 | Just list each route depending on user naming |
| Choice | Option 1 |
| Rationale | This will allow the user to select a preferred route and allow the system to double check user input. By having a universal system for route names. It will make communication much more consistent between all users of the application. |
| Satisfied by | FR3 | |
| **FR Issue ID** | **Description** | |
| FRI4 | PFR4 | Telling the user directions for walking, stopping, or turning. |
| How to time direction initiation. how to avoid miscommunication between user and app | |
| Option 1 | Create a secondary system that notifies user of wrong turns |
| Option 2 | Extensive communication system that counts for each step from the user with a secondary system in case for wrong turn |
| Choice | Option 2 |
| Rationale | The system needs to be extremely rigorous in communicating with the user to allow user to get a feel for how the app communicates. In addition, allow for fallback system in case a user turns too soon or skips a turn or a stare. |
| Satisfied by | FR4 | |
| **FR Issue ID** | **Description** | |
| FRI5 | PFR5 | Obstacle detection and telling the user how to avoid obstacles. |
| The issue is real time detection. Will the app be able to process objects and notify user in time before an accident occurs | |
| Option 1 | Use darknet technology for fastest real time image processing while in motion |
| Option 2 | Build a solution from scratch |
| Choice | Option 1 |
| Rationale | Using pretested open-source solutions is more practical and safer for. Taking on such an extensive task will over extent the scope and teams' ability to accomplish task |
| Satisfied by | FR5 | |
| **FR Issue ID** | **Description** | |
| FRI6 | PFR6 | Placing emergency calls and messages after detecting a fall or losing the current location. |
| In case of fall or phone drop how to act accordingly and in timely manner to minimize injuries | |
| Option 1 | Always assume the worst-case scenario. In case of fall detection immediately dial 911 |
| Option 2 | In case of fall detection, voice command ask user if they're ok. If there is no reply within 5 seconds dial 911. If user is ok and they dropped their phone,e guide the user to the phone by voice and volume. |
| Choice | Option 2 |
| Rationale | Option 2 does not hinder the user safety and unnecessary 911 calls. |
| Satisfied by | FR6 | |
| **FR Issue ID** | **Description** | |
| FRI7 | PFR7 | Figuring out the user’s next action and suggesting or accepting the user’s choice. |
| Recommending the most common action by users post navigation | |
| Option 1 | Ask the user if they have arrived to destination safley and if they are ready for their next navigation. |
| Option 2 | Automatically end trip once arrived at destination |
| Choice | Option 1 |
| Rationale | Allow user input regarding destination and option to reach a different location |
| Satisfied by | FR7 | |

## Non-Functional Requirements(NFR) Issues

|  |  |  |
| --- | --- | --- |
| **NFR Issues ID** | **Description** | |
| NFRI1 | PNFR1 | Help the user safely navigate indoors. |
| What defines safe navigation? | |
| Option1 | Navigation with no obstacles or obstructions. |
| Option2 | Navigation with no obstacles or obstructions that can directly harm the user |
| Option3 | Navigation that avoids any potential obstructions. |
| Choice | 1 |
| Rationale | Being able to detect the type of intent of an obstacle would be unfeasible by the application, therefore navigation that avoids any obstacles would be considered safe. |
| Satisfied by |  | |

|  |  |  |
| --- | --- | --- |
| **NFR Issues ID** | **Description** | |
| NFRI2 | PNFR2 | Lead the user through the fastest route. |
| What is considered the fastest route? | |
| Option1 | Shortest length from current location to destination out of all calculated routes. |
| Option2 | Shortest length from current location to destination out of all possible routes calculated or not. |
| Choice | 1 |
| Rationale | The application cannot determine the shortest path from routes not calculated or routes it is not aware of. Limited the fastest route to the shortest path from known routes is most realistic. |
| Satisfied by |  | |
| **NFR Issues ID** | **Description** | |
| NFRI3 | PNFR3 | Lead the user through the route that the user would feel most comfortable with. |
| How will the app know which route the user is comfortable with? | |
| Option1 | Provide the user with an option of routes. Chosen route is considered comfortable. |
| Option2 | Assume which route is comfortable by utilizing user configurations, past routes, or more data. |
| Choice | 1 |
| Rationale | Providing the user with the route options requires the least work while being more accurate to what is considered comfortable by the user. |
| Satisfied by |  | |
| **NFR Issues ID** | **Description** | |
| NFRI4 | PNFR4 | Usable for blind people. |
| To what extent is considered usable? | |
| Option1 | All features of the app should be usable by a blind user. |
| Option2 | Features intended to be used by a blind user. |
| Choice | 2 |
| Rationale | Considering a secondary user for the application is a caretaker, features developed for that user may not be useable by a blind user. Only features intended to be used by a blind user should be useable. |
| Satisfied by |  | |
| **NFR Issues ID** | **Description** | |
| NFRI5 | PNFR5 | System shall be ubiquitous |
| To what extent is considered ubiquitous? | |
| Option1 | The app will be aware of the visual surroundings at all times during navigation. |
| Option2 | The app will be aware of visual surroundings at all times. |
| Option3 | The app will be aware of visual and audio at all times during navigation. |
| Choice | 1 |
| Rationale | Considering the user is intended to be blind, the app should mainly be accounting for this and should be aware of visuals. Additionally, the app only needs this awareness during navigation when obstacle detection is important. |
| Satisfied by |  | |
| **NFR Issues ID** | **Description** | |
| NFRI6 | PNFR6 | System shall be customizable to every user. |
| Which features should customizable or not. | |
| Option1 | Only user preferences such as volume, audio type, location, information, etc. |
| Option2 | User preferences and feature settings such as obstacle detection. |
| Option3 | The app will be aware of visual and audio at all times during navigation. |
| Choice | 1 |
| Rationale | For safety purposes, only preferences not tied to integral features of the app should be customizable by every user. Allowing a blind user to change settings related to route or obstacle detection could result in danger and should only be changed by developers or other expert users. |
| Satisfied by |  | |
| **NFR Issues ID** | **Description** | |
| NFRI7 | PNFR7 | System shall 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. |
| How exposed should this extensibility be? | |
| Option1 | Only developers may add these variations to the app. |
| Option2 | Any user may add these variations to the app. |
| Choice | 1 |
| Rationale | Since extensibility comes from the design and architecture of the app, developers should be the ones primarily adding these variations. Allowing any user to do so would result in scope creep for creating a user-friendly way. |
| Satisfied by |  | |

# WRS

## W

### Problem

|  |  |  |
| --- | --- | --- |
| **Problem ID** | **Problem Description** | **Corresponding Goals** |
| P1 | How to help blind people navigate indoors? | G1 |
| P2 | How to recognize a user indoor location? | G2 |
| P3 | How to recognize the floor the user is on? | G2 |
| P4 | How to handle locations with semi outdoor connections? | G2 |
| p5 | Should we initialize communication with application to expect worst case scenario? | G3 |
| P6 | How to handle loss of internet connection? | G4 |
| P7 | How to communicate with a blind and deaf user? | G3 |
| P8 | How to receive information from a blind user? | G3 |
| P9 | How to allow the user to configure accessibility settings? | G5 |
| P10 | Calculation of route to destination? | G6 |
| P11 | How to inform the user of the route to their destination? | G3 |
| P12 | What is the best route possible? | G7 |
| P13 | What is the safest route possible? | G7 |
| P14 | Communicating with the user via sound and vibration while in route? | G8 |
| P15 | What will the app do in case of phone drop? | G9 |
| P16 | What will the app do if the battery is low? | G10 |
| P17 | How to contact emergency? | G11 |
| P18 | Is real-time object recognition the only option for navigation? | G12 |
| P19 | Can a blind user customize the app? | G13 |
| P20 | Can a caretaker customize the app? | G14 |

### Goals

|  |  |  |  |
| --- | --- | --- | --- |
| **Goal ID** | **Goal Description** | **Backward Traceability** | **Forward Traceability** |
| G1 | Decompose Indoor navigation into smaller subsystems | P1 |  |
| G2 | Use indoor location recognition API | P2 P3 P4 |  |
| G3 | Implement indoor level recognition | P5 P7 P8 P11 |  |
| G4 | Enable smooth transition between outdoor to indoor navigation with no interruption | P6 |  |
| G5 | Implement multiple fallback systems for emergency | P9 |  |
| G6 | Implement local data base | P10 |  |
| G7 | Develop multi modal communication system through visual and verbal communication | P12 P13 |  |
| G8 | Implement optimal route APIs | P14 |  |
| G9 | Implement drop and fall functionality | P15 |  |
| G10 | Develop conservation of battery mode system | P16 |  |
| G11 | Enable easy emergency contact | P17 |  |
| G12 | Explore real time object detection via camera systems | P 18 |  |
| G13 | Enable customization of app preferences for both blind and caretaker users | P19 P20 |  |

### Improved Understanding of Domain, Stakeholders, Functional, and Non-Functional Objectives

### Improved Domain

|  |  |
| --- | --- |
| **Improved Domain ID** | **Improved Domain Description** |
| ID1 | Indoor locations may consist of multiple floors, multiple rooms, bathrooms, elevators, stairs, etc. Indoor locations include buildings or structures containing an entrance, walls, and roof. |
| ID2 | Users who are blind or vision impaired and have no other disabilities. |
| ID3 | A required caretaker user who sets up the application configuration and comes to aid of primary user in case of an emergency. |

### Stakeholders

* Sponsors: Washington state University
* Faculty: Bolong Zeng
* Potential users: Development team, Visually Impaired People, Caretaker, Accessibility faculty members in workplaces, Police and security members and family members of blind person.

### 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 | Will acquire user location via current location APIs. Will figure out correct level of user. | P1 P2 P3 P4 | G1 G2 G3 |
| IFRO2 | The destination tab will keep a cache of frequent used destination to suggest possible destination | P10 | G6 |
| IFRO3 | Route API will calculate best routes and inform user of options available |  |  |
| IFRO4 | Provide real-time obstacle detection mechanism and notify users via voice, vibration and UI of expected and unexpected obstacles. | P18 | G12 |
| IFRO5 | Emergency system to place emergency calls in case of fall or malfunction. | P9 P15 P16 P 17 | G5 G11 G10 G9 |
| IFRO6 | Anticipating user action post successful trip | G6 | P10 |

### Improved Non-Functional Objectives

|  |  |  |  |
| --- | --- | --- | --- |
| **Improved NFR**  **Objective ID** | **Objective Description** | **Alleviates Problem** | **Achieves Goal** |
| INFRO1 | Navigation should be concluded without any injuries to the desired destination | P18 | G12 |
| INFRO2 | Show user variety of options regarding routes | P14 | G8 |
| INFRO3 | Allow user to select desired route | P12, P13 | G7 |
| INFRO4 | Text to voice and voice commands | P12, P13 | G7 |
| INFRO5 | App is able to process surrounding environment in real time. Detect falls or abnormality. Response to user input under any circumstances. | P9, P15, P17, P18 | G5, G9, G11, G12 |
| INFRO6 | Allow user to customize volume, favorite routes, font size, vibration and pre/post trip recommendation | P19, P20 | G13 |
| INFRO7 | Include settings for caretaker and users that are not familiar with application | P12, P13, P19, P20 | G7, G13 |

## RS

### Functional Requirements

|  |  |
| --- | --- |
| **FR ID** | **Description** |
| FR1 | Accepting a voice input of destination location from the user. |
| Satisfies Functional Requirement Issue | FRI1 |
| Satisfies Objectives | IFRO1 |
| Satisfied by prototype feature | Yes |

|  |  |
| --- | --- |
| **FR ID** | **Description** |
| FR2 | Suggest or confirm a possible destination location based on the user’s routine. |
| Satisfies Functional Requirement Issue | FRI2 |
| Satisfies Objectives | IFRO2 |
| Satisfied by prototype feature | YES |

|  |  |
| --- | --- |
| **FR ID** | **Description** |
| FR3 | Calculation of routes to a destination, informing the user of the route options, and accepting user’s preference. |
| Satisfies Functional Requirement Issue | FRI3 |
| Satisfies Objectives | IFRO3 |
| Satisfied by prototype feature | YES |

|  |  |
| --- | --- |
| **FR ID** | **Description** |
| FR4 | Perform real-time collision detection using the phone's camera to warn the user of objects in front of them. |
| Satisfies Functional Requirement Issue | FRI4 |
| Satisfies Objectives | IFRO4 |
| Satisfied by prototype feature | YES |

|  |  |
| --- | --- |
| **FR ID** | **Description** |
| FR5 | Calls emergency services upon user request. |
| Satisfies Functional Requirement Issue | FRI5 |
| Satisfies Objectives | IFRO5 |
| Satisfied by prototype feature | YES |

|  |  |
| --- | --- |
| **FR ID** | **Description** |
| FR6 | Collect user route data to more accurately determine future route suggestions. |
| Satisfies Functional Requirement Issue | FRI6 |
| Satisfies Objectives | IFRO6 |
| Satisfied by prototype feature | YES |

### Non-Functional Requirements

|  |  |
| --- | --- |
| **NFR ID** | **Nonfunctional Requirement 1** |
| **NFR1** | Help the user safely navigate indoors. |
| Operationalized Functional Requirements | FR4 |
| Satisfies Nonfunctional Requirement Issue | PNFR1 |
| Satisfies Non-functional Objective | INFRO1 |
| Constrains | Budget constraints may limit certain navigation features |
| Satisfied by prototype feature | YES |

|  |  |
| --- | --- |
| **NFR ID** | **Nonfunctional Requirement** |
| **NFR2** | Lead the user through the fastest route. |
| Operationalized Functional Requirements | FR2, FR3, FR6 |
| Satisfies Nonfunctional Requirement Issue | PNFR2 |
| Satisfies Non-functional Objective | INFRO2 |
| Constrains | Budget constraints may limit certain navigation features or certain phones not compatible with haptic feedback |
| Satisfied by prototype feature | YES |

|  |  |
| --- | --- |
| **NFR ID** | **Nonfunctional Requirement** |
| **NFR3** | Lead the user through the route that the user would feel most comfortable with. |
| Operationalized Functional Requirements | FR2, FR3, FR6 |
| Satisfies Nonfunctional Requirement Issue | PNFR3 |
| Satisfies Non-functional Objective | INFRO3 |
| Constrains | Budget constraints may limit certain navigation features or certain phones not compatible with haptic feedback |
| Satisfied by prototype feature | YES |

|  |  |
| --- | --- |
| **NFR ID** | **Nonfunctional Requirement** |
| **NFR4** | Usable for blind people |
| Operationalized Functional Requirements | FR1, FR4, FR5 |
| Satisfies Nonfunctional Requirement Issue | PNFR4 |
| Satisfies Non-functional Objective | INFRO4 |
| Constrains | Budget constraints may limit certain navigation features or certain phones not compatible with haptic feedback |
| Satisfied by prototype feature | YES |

|  |  |
| --- | --- |
| **NFR ID** | **Nonfunctional Requirement** |
| **NFR5** | System shall be ubiquitous |
| Operationalized Functional Requirements | FR4 |
| Satisfies Nonfunctional Requirement Issue | PNFR5 |
| Satisfies Non-functional Objective | INFRO5 |
| Constrains | Budget constraints may limit certain navigation features or certain phones not compatible with haptic feedback |
| Satisfied by prototype feature | YES |

|  |  |
| --- | --- |
| **NFR ID** | **Nonfunctional Requirement** |
| **NFR6** | System shall be customizable to every user. |
| Operationalized Functional Requirements | FR2, FR3, FR6 |
| Satisfies Nonfunctional Requirement Issue | PNFR6 |
| Satisfies Non-functional Objective | INFRO6 |
| Constrains | Budget constraints may limit certain navigation features or certain phones not compatible with haptic feedback |
| Satisfied by prototype feature | YES |

|  |  |
| --- | --- |
| **NFR ID** | **Nonfunctional Requirement** |
| **NFR7** | systems shall be easily extensible to accommodate typical variations: variations in interface, language, definitive needs of the user, new features, new sensors, and hardware, etc. |
| Operationalized Functional Requirements | FR3 |
| Satisfies Nonfunctional Requirement Issue | PNFR7 |
| Satisfies Non-functional Objective | INFRO7 |
| Constrains | Budget constraints may limit certain navigation features or certain phones not compatible with haptic feedback |
| Satisfied by prototype feature | YES |

### Specifications

|  |  |
| --- | --- |
| **Functional Specification ID** | **Functional Requirement** |
| FS1 | Accepting a voice input of destination location from the user. |
| Satisfies Functional Requirement | FRI1 |
| Satisfies Objectives | IFRO1 |
| Satisfied by prototype feature | Yes |

|  |  |
| --- | --- |
| **Functional Specification ID** | **Functional Requirement** |
| FS2 | Suggest or confirm a possible destination location based on the user’s routine. |
| Satisfies Functional Requirement | FRI2 |
| Satisfies Objectives | IFRO2 |
| Satisfied by prototype feature | Yes |

|  |  |
| --- | --- |
| **Functional Specification ID** | **Functional Requirement** |
| FS3 | Calculation of routes to a destination, informing the user of the route options, and accepting user’s preference. |
| Satisfies Functional Requirement | FRI3 |
| Satisfies Objectives | IFRO3 |
| Satisfied by prototype feature | Yes |

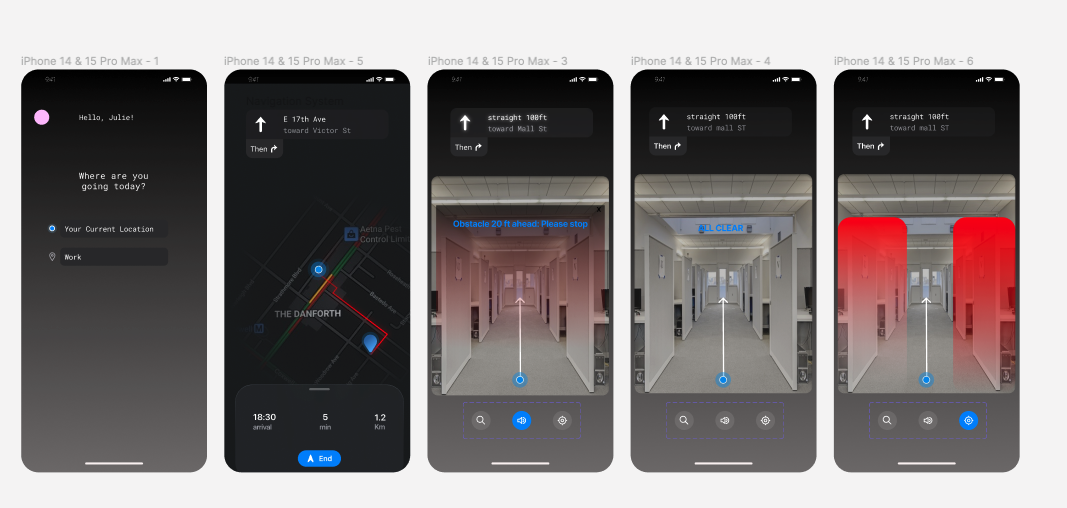
|  |  |
| --- | --- |
| **Functional Specification ID** | **Functional Requirement** |
| FS4 | Perform real-time collision detection using the phone's camera to warn the user of objects in front of them. |
| Satisfies Functional Requirement | FRI4 |
| Satisfies Objectives | IFRO4 |
| Satisfied by prototype feature | Yes |

|  |  |
| --- | --- |
| **Functional Specification ID** | **Functional Requirement** |
| FS5 | Calls emergency services upon user request. |
| Satisfies Functional Requirement | FRI5 |
| Satisfies Objectives | IFRO5 |
| Satisfied by prototype feature | Yes |

|  |  |
| --- | --- |
| **Functional Specification ID** | **Functional Requirement** |
| FS6 | Collect user route data to more accurately determine future route suggestions. |
| Satisfies Functional Requirement | FRI6 |
| Satisfies Objectives | IFRO6 |
| Satisfied by prototype feature | Yes |

# Preliminary Prototype

## Prototype Interface Mock-ups



In navigation scenarios: user inputs destination via voice command or via text. Navigate safely through route until reaching destination.

## User Manual

* Installation

1- Launch app store

2- search for Theia

3-click on install

* Initial customization

1- Create user profile

2-grant access to camera, microphone, location

3-test microphone and voice commands

4-set preferences

* Using Theia

1- Use voice command to set a destination or use keypad to enter destination

2- Choose Favorite route

* Navigation:

1- app will guide you through route by voice commands.

2- notification if there is an obstacle in the way

* Emergency

1-in case of fall, app will dial 911 automatically

2-user can use voice command to activate emergency contact or dial 911

3- User can change volume using voice command

* Customization menu

1-User can set favorite route using voice commands or UI in customization menu

2-user can adjust default volume levels

3-user can add emergency contacts

# Appendix I: Process Details