WRS Evolution

Requirements Elicitation

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Team TBH Gitlab Repository

https://gitlab.eecs.wsu.edu/dniterek/cpts_484-project.git

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CptS 484 - Phase 2: WRS Evolution - Theia

Table of Contents

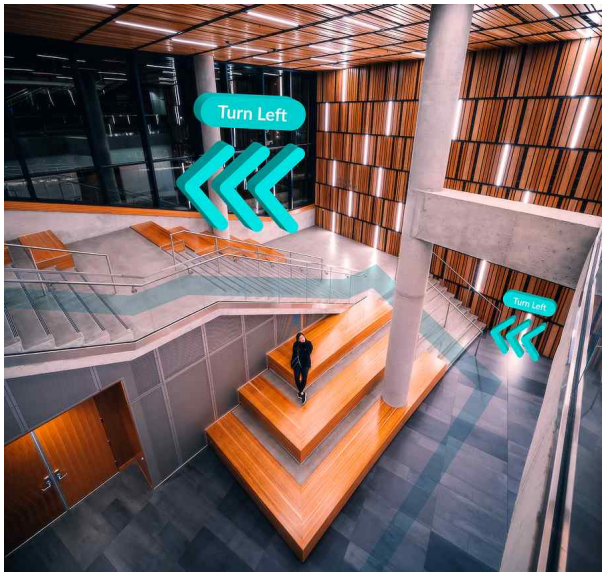
Revision History

Date	Version	Changes	Editor

1 Introduction

1.1 Purpose of System

The project Theia aims to develop software that assists visually impaired persons in navigating a building/structure safely and soundly using GPS software and auditory software systems to guide the user. The problem persists because buildings are changing structures, given that rooms can be obstructed, closed, or under construction. This system uses sensors and structural knowledge of the building to create audio cues when to make particular turns or directions that the system can detect. It can also provide real-time updates on closures of rooms or events that may cause route changes. The role of this system is to help the user(impaired/non-impaired) make it to their destination in any building with a structure that the system recognizes.



1.2 Scope of System

The Theia application system uses several systems for navigation. The system uses Google/Apple location services to pinpoint user location quickly. The auditory system utilizes the GPS to convert directions to spoken commands from within the building. The structure mapping system can gather information from databases to get the correct building data and translate the user to a precise location within the building, whether they are trying to leave or enter and find a specific room/location.

The scope of the Theia application is to allow all types of users to navigate buildings they are in once or multiple times. The application will use Google location services to pinpoint the user's location. The main functionalities of this application are:

- Save data on building structure and user information for impaired users to use
- Get GPS data of users and translate a quick route for users to follow.
- Give auditory building directions that allow for the quickest arrival time based on GPS data
- Detect emergencies, obstructions, and local events(closures).
- Allow secondary users to upload data, such as mapping data that
- Listen for user-spoken commands and utilize commands.

1.3 Objectives and Success Criteria

The following objectives present success criteria for the Theia application:

- Provide directions to a user
- Upload and download building structure specifications

- Track movement, including location and physical movements
- Save user contact information such as default emergency services and close contacts
- Detect obstructions of different types, whether the sensor detects or event data detects
- Give real-time turn directions using a compass-like system that allows users to move through turns precisely
- Secondary-user configuration
- Save building structure
- User-friendly for blind users
- Have quick response/direction time
- Consistent
- Navigate app UI without having visuals

1.4 Definitions, Acronyms, and Abbreviations

Term	Definition
WRS	Work Requirements Specification for Theia application
AI	Artificial Intelligence
iOS	Apple's mobile operating system
Android	Google's mobile operating system
GPS	Global Positioning System
Stakeholder	Individuals or entities with an interest or involvement in the project
Obstacle Detection	The capability to identify physical obstacles in the user's path
Collision Detection	The ability to guide the user around obstacles to prevent collisions
Navigation Instructions	Directions and guidance provided to the user for safe navigation
User Preference	Customizable settings tailored to individual user needs
Prototype	A preliminary version of the Theia app used for testing and evaluation
Emergency Contacts	Predefined contacts for immediate assistance in case of emergencies

Secondary-user Configuration	Secondary users from the primary user can store certain important data
(Add more if needed)	

1.5 Overview

Below sections cover requirements of the Theia application as well as the W, RS, as well as mockups and prototype features.

Specifically, section 2 and 3 is the preliminary domain, preliminary functional, and non-functional requirements(section 2), given these all include things like ambiguities, incompleteness, inconsistencies, and conflicts(section 3). Section 4 covers the W and the RS in two parts. Section 4.1 will cover the W, including the problem, goal, and improved understanding. Section 3.2 will cover the RS portion, which gives Functional RS(4.2.1) and Non-functional RS(4.2.2). Section 4 covers the prototype and User Manual. Section 5 provides the prototype interface mock-up such as diagrams and other useful documents to help provide a visual depiction of the Theia application.

2 Preliminary Definition

2.1. Preliminary Domain

PD_ID	Preliminary Domain Description
PD1	The Theia app will be developed through an agile management and software development tool such as Jira or Asana.

2.2. Preliminary Functional Requirements

P FR_ ID	Preliminary FR Description
PFR1	The app shall utilize GPS to determine the user's location and maintain positioning data accuracy.
PFR2	The app shall provide guidance and direction to the user based on their location in the building. These will be provided through the use of auditory cues.

PFR3	The app shall offer live updates on events, room closures, or any other obstructions that may impede the route for the user.
PFR4	The app shall have a structural mapping system incorporated in order for building information to be accessed and for precise indoor navigation to be provided.
PFR5	The app shall allow personal preferences to be specified by users and customization of settings to allow for enhanced experience.

2.3. Preliminary Non-Functional Requirements

PNFR_ ID	Preliminary NFR Description
PNFR1	The app must ensure the security and privacy of data for users guaranteeing the protection of sensitive data such as user profiles and navigation data history.
PNFR2	The app shall be user-friendly, ensuring individuals who have visual impairments are able to have an intuitive and accessible experience.
PNFR3	The app must ensure usability by users without the aid of a specialized domain, giving them straightforward navigation.
PNFR4	The app shall have auditory cues and navigation instructions provided with quick response time.
PNFR5	The app shall ensure cross-platform compatibility and accessibility through its design.

3 Issues with the preliminary Definition Given

3.1. Domain issues

Domain Issue ID	Domain Issue Description
PD1	The Theia app will be developed through an agile management and software development tool such as Jira or Asana.

	Ambiguous. Jira is implemented partially into many other Atlassian products while also having a dedicated platform.
Option 1:	Support the dedicated Jira platform
Option 2:	Support all platforms Jira is implemented into, along with the dedicated platform.
Choice:	Option 1
Rationale:	Due to the deadline associated with the project submission and the requirements associated with the project, the dedicated Jira platform will be the only platform support while the project stays within the competition scope.
Satisfied by	NFR6

3.2. Functional Requirements Issues

FR Issue ID	**FRI Description**
FRI1	**PFR_ID:** PFR1. Provide effective location positioning for visually impaired user.
	1. The problem that arises is determining the user's location and the path to their destination.
Option 1:	Use GPS to determine the user's location.
Option 2:	Use camera or local location technology to determine user location.
Choice:	Option 1
Rationale:	Using GPS would require less time to develop the application, and would make the application usable in other locations.
Satisfied by:	FR1

FR Issue ID	**FRI Description**
FRI2	**PFR_ID:** PFR2. Provide users with auditory

	navigational directions.
	1. The problem that arises is having an accurate communication medium. 2. Using text to speech or meaningful sounds can give the user necessary information.
Option 1:	Use generated speech by the app to read navigational instructions to the user.
Option 2:	Use pre-recorded sounds to give user directions.
Choice:	Option 1
Rationale:	Text to speech directions would give the user more specific and informative directions.
Satisfied by:	FR2

FR Issue ID	**FRI Description**
FRI3	**PFR_ID:** PFR3. The user will be informed of live changes to room closures and obstructions.
	The problem that arises is how to detect such changes.
Option 1:	Have changes to room obstruction be detected with a sensor, such as the camera.
Option 2:	Have users who are not visually impaired update obstructions on the app.
Choice:	Option 1
Rationale:	There likely will not be many users who are not visually impaired, there will likely not always be helpers available. Therefore, using sensors is the only option.
Satisfied by:	FR3

FR Issue ID	FRI Description
FRI4	**PFR_ID:** PFR4. Precise indoor navigation will be provided.
	1. The problem that arises is how to include this information in the app. 2. And how to utilize it for navigation.
Option 1:	The indoor navigation system downloads mappings from an online source when needed.
Option 2:	All mappings are pre-downloaded, and loaded when needed.
Choice:	Option 2
Rationale:	An online system for mappings would necessitate the creation of a database, which is out of our scope.
Satisfied by:	FR4

FR Issue ID	FRI Description
FRI5	**PFR_ID:** PFR5. Personal preferences and settings can be set and saved for a user.
	The problem that arises is how to implement a UI for visually impaired users.
Option 1:	The visually-impaired user can use a text to speech system and a microphone to change settings.
Option 2:	The visually-impaired user will be dependent on helpers to make settings changes.
Choice:	Option 1
Rationale:	Other users will not always be available to help visually impaired users. Therefore users should be able to make changes to settings through voice inputs.
Satisfied by:	FR5

3.3. Non-Functional Requirements (NFR) Issues

NFR Issue ID	NFR Description
NFRI1	**PNFR ID:** PNFR1: Ensure the security and privacy of user data.
	What kind of vulnerable data could be stolen? What kind of vulnerabilities could the app be susceptible to?
Option 1:	Have user location only accessed while using the app. And have user location not be stored when the app is no longer in use.
Option 2:	Have the app be secure so that stored data cannot be stolen.
Choice:	Option 1
Rationale:	If it is not necessary to store data, it is easier to simply not store it, rather than ensure that it is protected.
Satisfied by:	NFR1

NFR Issue ID	NFR Description
NFRI2	**PNFR ID:** PNFR2: User friendly UI for visually impaired users.
	1. How will the user interact with the application? 2. How will the visual-impairment of the user be a non-issue in interacting with the application?
Option 1:	Have the application always listening for user input, and have no buttons on the application.
Option 2:	Have two or three large buttons on the application that the user can press regardless of visual-impairment that allow the user to interact without always needing to use voice commands for the application.
Choice:	Option 2
Rationale:	A minimal number of large buttons will be easy for the user to interact with even if they

	are visually impaired, and not constantly interacting through voice commands would make the app more usable.
Satisfied by:	NFR2

NFR Issue ID	NFR Description
NFRI3	**PNFR ID:** PNFR3: Application is usable without aid of specialized domain.
	How can all application functionality be encapsulated within the app without external dependencies?
Option 1:	Have all application functionality be included in the app by default.
Option 2:	Have application functionality be loaded onto the app for specific use cases beforehand by the user.
Choice:	Option 2
Rationale:	For the application to be useable across a variety of locations, having the map information be externally loaded keeps the application self contained while being flexible.
Satisfied by:	NFR3

NFR Issue ID	NFR Description
NFRI4	**PNFR ID:** PNFR4: Auditory aid and instruction provided with quick response time.
	1. What would lead to auditory feedback having performance issues. 2. How can we implement the feedback in a way that it performs well?
Option 1:	Have feedback be simple pre-recorded directions.
Option 2:	Have feedback be generated text to speech.
Choice:	Option 2

Rationale:	Generated responses would provide the user with more information and would not be computationally too expensive.
Satisfied by:	NFR4

NFR Issue ID	**NFR Description**
NFRI5	**PNFR ID:** PNFR5: The application should be cross platform compatible.
	What platforms should the application be compatible with? How should we implement the application so that it can be cross-compatible?
Option 1:	Build an application that can be downloaded from the IOS and Android app stores.
Option 2:	Have the app be a web application that can be used by any system's browser.
Choice:	Option 2
Rationale:	Having the application be a web app means that more devices will be able to use it while minimizing developer workload.
Satisfied by:	NFR5

4 WRS

4.1 W

4.1.1. Problem

Problem ID	**Problem Description**	**Corresponding Goals**
P1	How can we provide effective navigation options for visually impaired individuals in indoor spaces?	G1, G6
P2	Strategies that can address unpredictable obstacles or changes in indoor environments for safe navigation	G2, G3

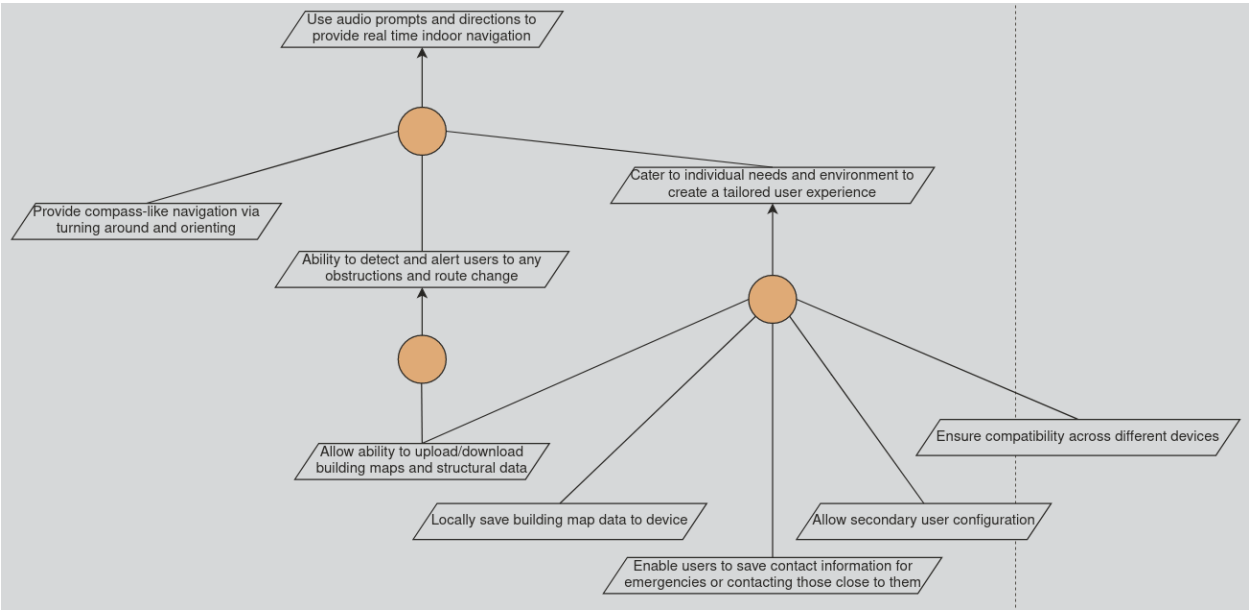
P3	Difficulty providing real-time navigation assistance for indoor spaces with structures that change.	G1, G3, G4
P4	How can we consistently update the app based on a changing landscape	G3, G4, G6
P5	Determining mapping information for accessible buildings	G2, G8
P6	How to create an enhanced, user-tailored experience that accounts for individual unique needs	G4, G7
P7	What can we do to protect sensitive user information	G5
P8	How can we ensure it works for all users regardless of devices	G9

4.1.2. Goals

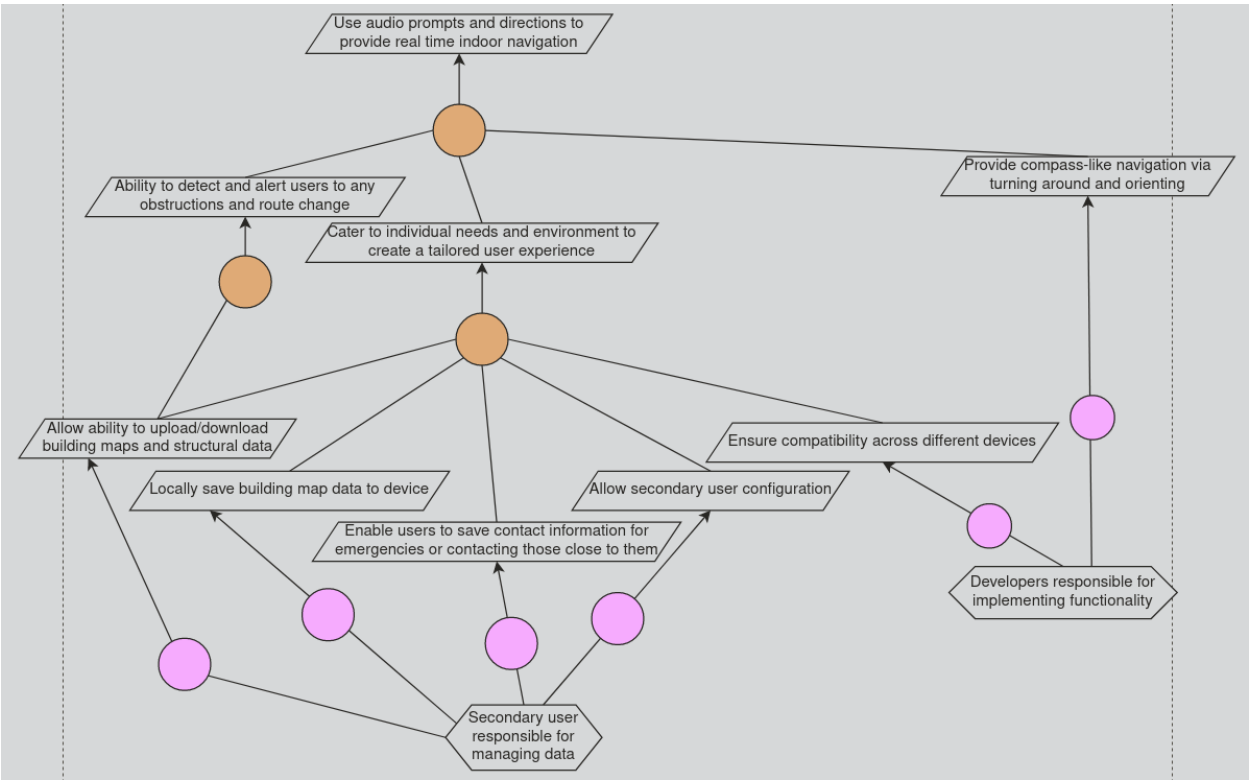
Goal ID	Goal Description	Backward Traceability	Forward Traceability
G1	Use audio prompts and directions to provide real time indoor navigation	P1, P3, P4	IFRO1, INFO1
G2	Allow ability to upload building maps and structural data	P2	IFRO2, INFO4
G3	Ability to detect and alert users to any obstructions and route change	P3, P4	IFRO3, INFO5
G4	Cater to individual needs and environment to create a tailored user experience	P6	IFRO1, INFO3

G5	Enable users to save contact information for emergencies or contacting those close to them	P1, P7	IFRO4
G6	Provide compass-like navigation via turning around and orienting	P4	IFRO1
G7	Allow secondary user configuration	P6	IFRO1
G8	Locally save building map data to device	P2, P5	IFRO2, INFO2, INFO4
G9	Ensure compatibility across different devices	P8	INFO3

Goal KAOS Model



Responsibility Model



4.1.3 Improved understanding of Domain, Stakeholders, Functional, and Non-Functional Objective

4.1.3.1 Improved Domain

Improved Domain ID	Improved Domain Description
ID1	Indoor navigation and wayfinding for individuals with visual impairments
ID2	Real time mapping and localization throughout indoor facilities
ID3	Obstacle alert and detection system to assist with navigation

4.1.3.1 Stakeholders

- Sponsors
    - Government agencies working to create and promote accessibility tech
- Project Mentor

    - Lead project manager
- Volunteer Faculty
    - Academic advising providing expertise
- Potential Users of Theia
    - Visually impaired
    - Blind users
    - Those with low/poor vision
    - Elderly who have navigational challenges

4.1.3.1 Improved Functional Objectives

Improved FR Objective ID	Objective Description	Alleviates Problems	Achieves Goals
IFRO1	Use and develop customized audio cues, based on user profile, to provide real time navigation guidance	P1, P3, P4, P6	G1, G4
IFRO2	Enable users to upload: route maps, building structural data and floor plans to provide navigation assistance	P2, P5	G2
IFRO3	Utilize sensors and input data to notify user of changes to route in real time and accurately identify any obstructions	P3, P4	G3
IFRO4	Give users the ability to store contacts' information and ability to contact emergency services for quick access during navigation	P1, P7	G5

4.1.3.1 Improved Non-Functional Objectives

Improved Non-Functional Objectives

Improved NFR Objective ID	Objective Description	Alleviates Problem	Achieves Goal

INFO1	Provide auditory navigation cues to Theia users	P1, P3, P4	G1, G3
INFO2	Incorporate GPS for location accuracy	P4, P5	G8
INFO3	Ensure cross-platform compatibility	P6, P8	G4, G9
INFO4	Detect user location within buildings	P2, P5	G2
INFO5	Give real-time closure and obstructions notifications and updates	P3, P4	G3

4.2. RS

4.2.1. Functional Requirements

FR ID	**Description**
FR1	GPS will be utilized to determine the user's location and maintain data accuracy positioning.
Satisfies Functional Requirement Issue	FRI1
Satisfies Objectives	IFRO1

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FR ID	**Description**
FR2	Guidance and direction will be provided to the user based on their location in the building. These will be provided through the use of auditory cues.

Satisfies Functional Requirement Issue	FRI2
Satisfies Objectives	IFRO2

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FR ID	**Description**
FR3	Live updates on events, room closures, or any other obstructions will be offered to negate any impediments.
Satisfies Functional Requirement Issue	FRI3
Satisfies Objectives	IFRO3

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FR ID	**Description**
FR4	A structural mapping system will be incorporated in order for building information to be accessed and for precise indoor navigation to be provided.
Satisfies Functional Requirement Issue	FRI4
Satisfies Objectives	IFRO4

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FR ID	**Description**
FR5	Personal preferences will be specified by users and customization of settings to allow for enhanced experience.
Satisfies Functional Requirement Issue	FRI5
Satisfies Objectives	IFRO5

4.2.2. Non-Functional Requirements

NFR ID	Nonfunctional Requirement 1
NFR1	Ensure security and privacy of data for users guaranteeing the protection of sensitive data.
Operationalized Functional Requirements	FRI1
Satisfies Nonfunctional Requirement Issue	PNFR1
Satisfies Non-functional Objective	INFRO1
Constraints	P7

NFR ID	Nonfunctional Requirement 2
NFR2	User-friendly interactive experience for individuals who have visual impairments.
Operationalized Functional Requirements	FRI2
Satisfies Nonfunctional Requirement Issue	PNFR2
Satisfies Non-functional Objective	INFRO2
Constraints	P6

NFR ID	Nonfunctional Requirement 3
NFR3	Usability by users without aid of a specialized domain.

Operationalized Functional Requirements	FRI3
Satisfies Nonfunctional Requirement Issue	PNFR3
Satisfies Non-functional Objective	INFRO3
Constraints	P8

NFR ID	**Nonfunctional Requirement 4**
NFR4	Auditory cues and navigation instructions provided with quick response time.
Operationalized Functional Requirements	FRI4
Satisfies Nonfunctional Requirement Issue	PNFR4
Satisfies Non-functional Objective	INFO1
Constraints	P1, P2, P3

NFR ID	**Nonfunctional Requirement 5**
NFR5	Cross-platform compatibility and accessibility throughout app design.
Operationalized Functional Requirements	FRI5
Satisfies Nonfunctional Requirement Issue	PNFR5
Satisfies Non-functional Objective	INFO3

Constraints	P8

4.2.3. Specifications

Functional Specification ID	**Functional Requirement**
FS1	Develop a system that accurately detects the user's location within a building and provides real-time updates on closures, obstructions, or events that may affect the user's route.
Satisfies Functional Requirement	FRI1, FRI2
Satisfies Objectives	IFRO1, IFRO3, INFO1, INFO2, INFO5

Functional Specification ID	**Functional Requirement**
FS2	Implement a GPS system that pinpoints user location effectively and accurately.
Satisfies Functional Requirement	FRI1, FRI2
Satisfies Objectives	IFRO1, IFRO2,IFRO3, INFO2

Functional Specification ID	**Functional Requirement**
FS3	Develop an auditory system that converts directions and guidance based on the user's GPS location into spoken commands, ensuring clarity and effectiveness.
Satisfies Functional Requirement	FRI1, FRI2
Satisfies Objectives	IFRO1, IFRO3, INFO1

Functional Specification ID	Functional Requirement
FS4	Create a system that utilizes sensors and structural knowledge of the building to provide audio cues for making specific turns or directions based on the user's real-time location within the building.
Satisfies Functional Requirement	FRI3, FRI4
Satisfies Objectives	IFRO3, INFO5

Functional Specification ID	Functional Requirement
FS5	Enable systems to detect various types of obstructions in the user's path, whether through sensors or event data, and guide the user around them to prevent collisions.
Satisfies Functional Requirement	FRI5
Satisfies Objectives	IFRO3, INFO5

Functional Specification ID	Functional Requirement
FS6	Allow for user-spoken commands to interact with the system, enabling users to provide input and receive information through voice commands.
Satisfies Functional Requirement	FRI5
Satisfies Objectives	IFRO4

Functional Specification ID	Functional Requirement
FS7	Implement a system for secondary users to upload building structure data and mapping information, enhancing the accuracy and coverage of the system.

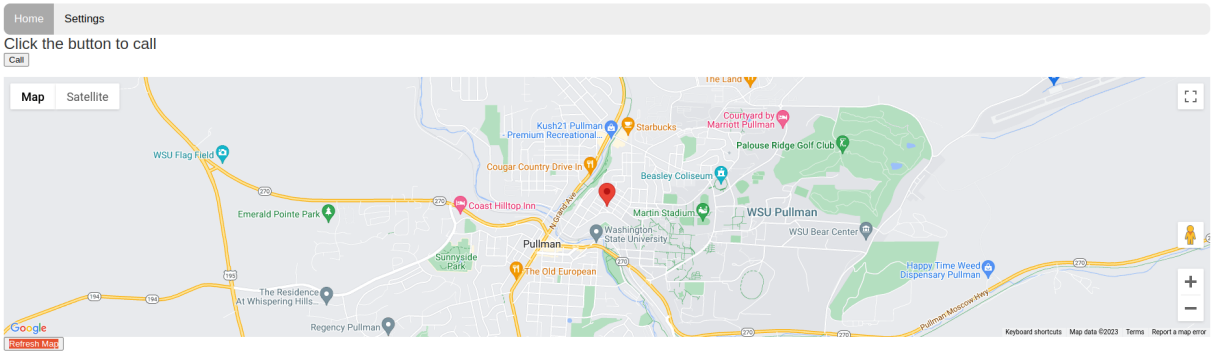
Satisfies Functional Requirement	FRI2, FRI4
Satisfies Objectives	IFRO2

Functional Specification ID	**Functional Requirement**
FS8	Provide a user-friendly interface that allows visually impaired users to navigate the application without relying on visuals.
Satisfies Functional Requirement	FRI5
Satisfies Objectives	IFRO4

Functional Specification ID	**Functional Requirement**
FS9	Ensure quick response and direction time to assist users in navigating buildings efficiently.
Satisfies Functional Requirement	FRI2, FRI3
Satisfies Objectives	IFRO1

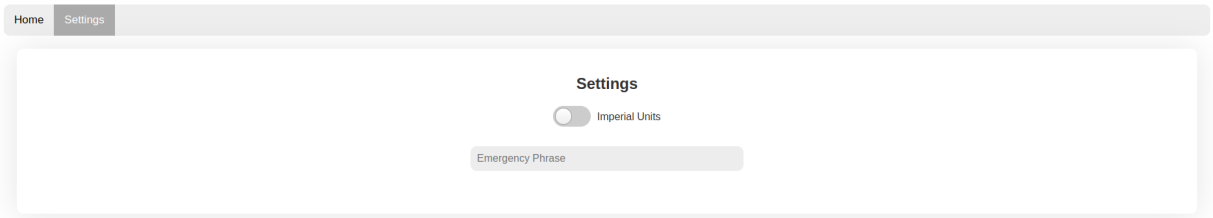
5 Prototype Interface Mock-ups

Home Page:



Home page includes the map to route so that the user can follow the commands to get to their destination. It also includes a button to test the emergency calling feature and a button to get to the settings page.

Settings page:



The settings page has a toggle that allows the user to set the units and the emergency phrase.

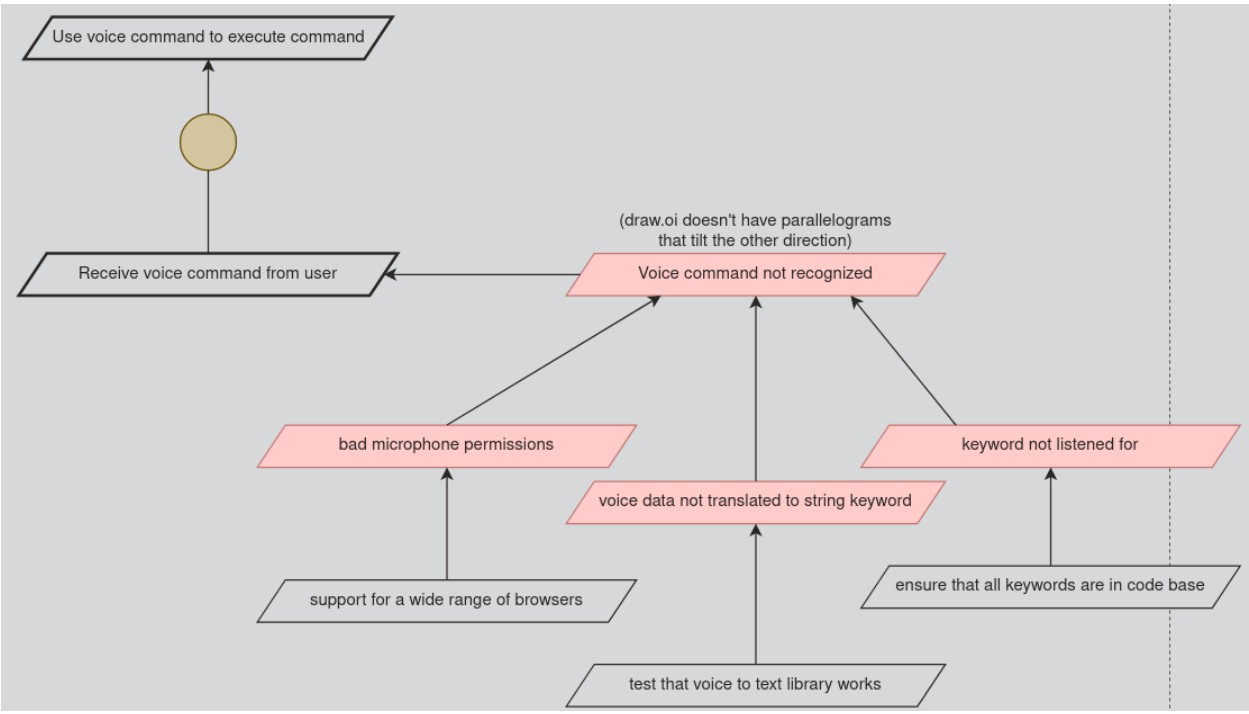
6 Usage Manual

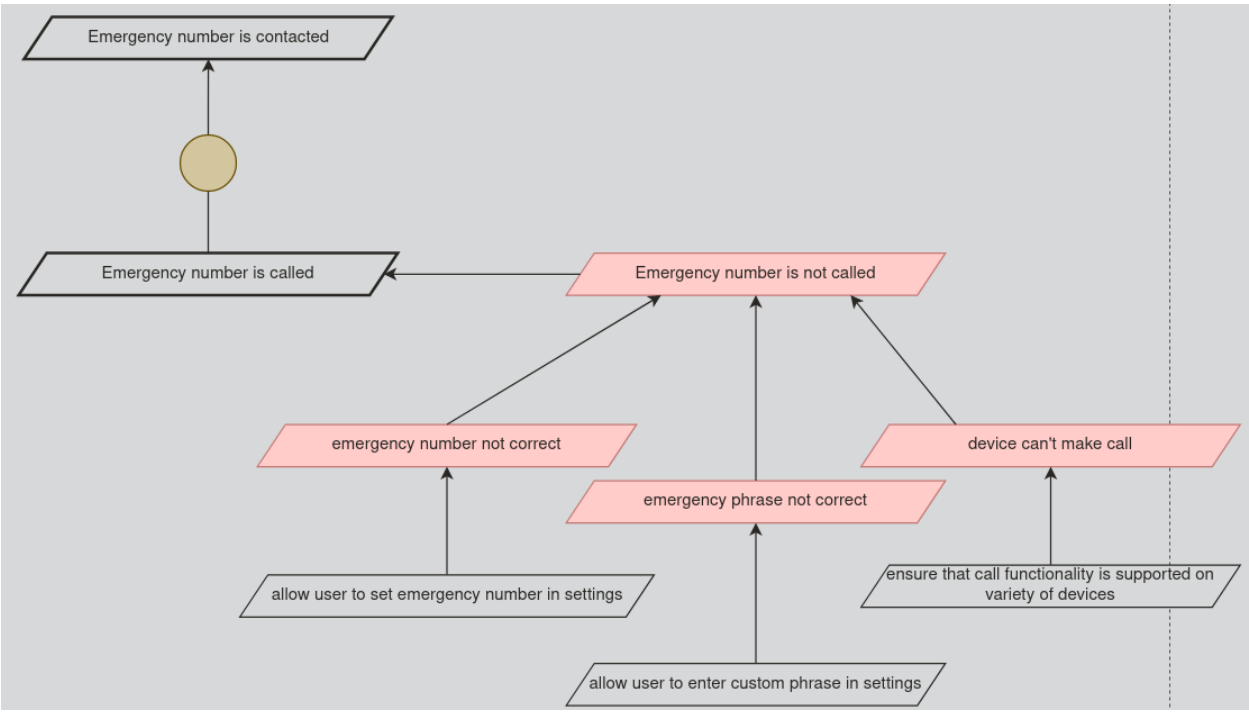
The primary user uses the application by giving voice commands to enter the intended route. The app then finds the route and gives audio commands to the user so that they can get to their destination. This is accomplished by the user saying “destination”. The app will then prompt the user to say the name of the location. The user will then say the destination, and then say “done”. The app will then find the route to the location and give commands to the user.

The user can also set an emergency number in case of a fall or other emergency. When the user says “help”, the app will make a call to the emergency number.

A secondary user can assist the primary user in changing settings and verifying the location is set through the user interface. The secondary user can use the buttons at the top of the app to navigate between the main and settings pages. On the settings page the secondary user can change the units or emergency phrase manually.

7 Obstacle Models





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