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CptS 484: Software Requirements

WRS Evolution

Requirements Elicitation

Anthony Devito, Eli Lawrence,
Ivan Quintero, Jace Dunn, Riley
Nielsen, Shawn Will

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Revision History

Date	Version	Changes	Editor
9/26/2025	1.0	Initial Draft	Anthony Devito, Eli Lawrence, Ivan Quintero, Jace, Dunn, Riley Nielson, Shawn Will
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[1] Introduction

1.1.Purpose

The purpose of Theia is to help those who are blind or visually impaired to navigate specific buildings more easily, with less assistance from seeing companions. Indoor navigation presents challenges such as complex floor layouts, unsafe and irregular obstacles, and the frequent use of stairs, doors, or other building architecture. With our app, a primary user should be able to go from Point A to Point B safely without having to randomly navigate or remember the route. Theia aims to provide this functionality using voice commands, haptic feedback, and obstacle detection.

1.2.Scope

The scope of the project is to create an application on smart phones that supports both “Blind” (Voice Command) and “Companion” (Settings) modes. The application provides turn-by-turn indoor voice navigation calculated via Dijkstra’s algorithm, real-time location updates, and a safety system that includes fall detection simulation with a verification countdown to prevent false alarms. It will detect obstacles such as walls, pillars, or steps with a camera sensor to prevent falls and injuries.

1.3.Objectives and Success Criteria

1. A verbal navigation mode for the app.
2. A visual/physical navigation mode for the app.
3. Detects physical obstacles using camera which can prevent following navigation.
4. Identifies user’s location from GPS or other positioning system.
5. Companion settings interface to configure user details and emergency contacts.
6. Fall detection system to contact someone in an emergency.
7. Can receive voice commands from user for accessibility.

1.4.Definitions, Acronyms, and Abbreviations

N/A

1.5.Overview

This document aims to provide detailed information on the planning, requirements, and implementation of our navigation app. It also includes some basic prototypes of the implementation to give a general idea of what we are aiming for. As we progress with the project, this document will be updated to reflect any changes that we feel would make an impact on the app.

[2] Preliminary Definition

2.1. Preliminary Domain

PD_ID	Preliminary Domain Description
PD1	The app navigates users within buildings that have multiple floors, hallways, classrooms, offices, bathrooms, lounges, elevators, etc.

2.2.Preliminary Functional Requirements

P FR_ ID	Preliminary FR Description
PFR1	Accepting from the user the destination location to go. It might even be able to suggest or confirm a possible destination location, utilizing the user's routine schedule or habit.
PFR2	Figuring out the routes to reach the destination, informing the user of the options (if there are more than one), and accepting user's preference.
PFR3	Telling the user to walk a distance (e.g., 2 minutes before turning, or walk for 30 steps, etc.)
PFR4	Telling the user to stop at the right place to turn.
PFR5	Detecting obstacles and telling the user what to do in order to avoid collision.
PFR6	Placing emergency calls and messages, possibly after detecting a fall or when the system has lost its current location.
PFR7	Figuring out what the next action(s) would be, based on the user's schedule or habit, and suggesting/accepting the user's choice.

2.3.Preliminary Non-Functional Requirements

PNFR_ ID	Preliminary NFR Description
PNFR1	The system shall help the user safely navigate indoors.
PNFR2	The system shall lead the user through the fastest route.
PNFR3	The system shall lead the user through the route that the user would feel the most comfortable with.
PNFR4	The system shall be usable for blind people.
PNFR5	The system shall be ubiquitous.
PNFR6	The system shall be customizable to every user: e.g. volume, the interval of instructions, etc.
PNFR7	The 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.

[3] Issues with the Preliminary Definition Given

3.1.Domain Issues

Domain Issue ID	Domain Issue Description	
DI1	PD_ID	PD1. The domain is “indoors,” allowing navigation in the same or different buildings that are connected to each other.
	Ambiguous or incomplete: The terms “indoor” and “connected buildings” are too broad. This ambiguity makes it difficult to scope the project. For example, an airport is a very different indoor environment than a university building. The method of connection between buildings (open courtyard, covered walkway, etc.) is also undefined.	
	Option 1	Attempt to support all types of indoor environments and connections from the start.
	Option 2	Scope the initial domain to a specific environment, like university buildings, and define “connected” as having a physically accessible indoor path.
	Option 3	Limit the initial scope to single, unconnected buildings to avoid the complexity of in-building navigation.
	Choice	Option 2
	Rationale	Option 2 provides a focused, achievable scope for the initial project phases. It allows the team to develop and test the app in a known environment, which is a key use case for a blind student on campus. It is more practical than the overly broad option 1 and more useful than option 3 since it is more restrictive.
Satisfied by	NFR4	

3.2.Functional Requirements Issues

FR Issue ID	Description	
FRI1	PFR_ID	PFR1. Accepting from the user the destination location to go. It might even be able to suggest or confirm a possible destination location, utilizing the user's routine schedule or habit
	Incomplete and Ambiguous: It is unclear how the system is supposed to access or learn a user's schedule or habits. The mechanism for gathering this data is not defined.	
	Option 1	Require the user to manually enter their class/work schedule into the app during setup.
	Option 2	Use passive machine learning to observe user navigation patterns over time to predict likely destinations.
	Option 3	Allow for explicit schedule input for high reliability, and supplement this with passive learning for situational suggestions.
	Choice	Option 3
	Rationale	This hybrid approach is the most robust and user-friendly. Explicit input provides immediate, reliable suggestions, while passive learning adds convenience by adapting to non-scheduled, repeated trips over time.
Satisfied by	FR4	

FR Issue ID	Description	
FRI2	PFR_ID	PFR2. Informing the user of the options.
	Incomplete: The requirement does not specify how to present multiple, potentially complex routes to a blind user via audio in a way that is clear and not overwhelming.	
	Option 1	Verbally describe each route in full detail, one after another.
	Option 2	Present only the key factors to simplify the choice.
	Option 3	Automatically select the fastest or safest route based on terrain and the user's settings, and only announce that other options are available if the user asks.
	Choice	Option 2
	Rationale	This method is the most efficient. It provides the essential information needed for an informed decision without the cognitive load of memorizing multiple sets of detailed instructions, making it much more usable for the primary stakeholder.
Satisfied by	FR6	

FR Issue ID	Description	
FRI3	PFR_ID	PFR3. Telling the user to walk a distance.
	Ambiguous: The units for measuring distance are not consistently defined. User preference for these units can vary greatly.	
	Option 1	Standardize all instructions to be time-based.
	Option 2	Standardize all instructions to be distance-based.
	Option 3	Allow the user to select their preferred unit of measurement in the app settings.
	Choice	Option 3
	Rationale	This choice directly supports the non-functional requirement for the system to be customizable. It allows the users to select the unit they are most comfortable with.
Satisfied by	FR1	

FR Issue ID	Description	
FRI4	PFR_ID	PFR4. Telling the user to stop at the right place.
	Safety: The user may overrun the stop command by the time it takes for the system to fully say the command. The user may have already passed their stopping point.	
	Option 1	Use haptic feedback to immediately notify the user to stop.
	Option 2	Issue commands on a countdown. For example, “you have reached your destination in 3, 2, 1.”
	Option 3	Issue commands with a countdown and use haptic feedback to notify the user.
	Choice	Option 3
	Rationale	This option provides the greatest combination of alerting the user. By having two ways to communicate, the user has an increased chance of not overrunning their destination.
Satisfied by	FR1, FR2, FR7	

FR Issue ID	Description	
FRI5	PFR_ID	PFR5. Detecting obstacles and telling the user what to do in order to avoid collision.
	Incomplete and Ambiguous: This requirement does not specify what qualifies as an obstacle. It also doesn't define the nature of the avoidance instructions ("move left", or "stop").	
	Option 1	Detect only large, static obstacles (walls, doors, etc.) and issue a generic "Obstacle ahead" warning.
	Option 2	Use the phone's camera and machine learning to identify a broader range of obstacles and provide more specific directional guidance. Commands consist of describing the obstacle in advance and how to avoid it.
	Option 3	Focus detection only on tripping hazards below waist level, providing simple avoidance commands.
	Choice	Option 2
	Rationale	This option provides the greatest safety benefit, a top priority for the application. Using advanced smartphone features like the camera aligns with the project goals and offers a more useful solution than the other options.
Satisfied by	FR7	

FR Issue ID	Description	
FRI6	PFR_ID	PFR6. Placing emergency calls and messages, possibly after detecting a fall or when the system has lost its current location.
	Incomplete: The protocol for an emergency is not defined. It is unclear if the system calls 911 or a caretaker, and there is no mention of a mechanism to prevent false alarms.	
	Option 1	Immediately call 911 upon detecting a fall.
	Option 2	After a fall is detected, start an audible countdown, giving the user time to provide a verbal “cancel” command. If no command is given, the app calls and messages a pre-configured emergency contact with the user’s last known location.
	Option 3	Simply sound a loud alarm from the phone to get the attention of people nearby.
	Choice	Option 2
	Rationale	This is the safest and most practical option. It prevents false alarms while ensuring that a designated person is contacted in a real emergency, which is more appropriate than simply making noise.
Satisfied by	FR3, FR5	

FR Issue ID	Description	
FRI7	PFR_ID	PFR7. Figuring out what the next action(s) would be, based on the user's schedule or habit, and suggesting/accepting the user's choice.
	Data Privacy: Analyzing user's habits to predict actions can be considered invasive and unethical.	
	Option 1	Disregard habit learning and only use explicit commands.
	Option 2	Only track user habits if the user explicitly gave permission to do so. User is notified of what information will be tracked.
	Option 3	Store behavioral data only on local device.
	Choice	Option 2
	Rationale	This option ensures the most privacy and caters to the user's preferences. It does not cross ethical boundaries while maintaining the option for increased safety and functionality.
Satisfied by	FR1, FR2	

FR Issue ID	Description	
FRI8	PFR_ID	PFR8. More that you can think of
	Missing: There is no functional requirement stating how the blind person will start the app and learn of its functions	
	Option 1	Audio user manual is built into the app.
	Option 2	Integrating a visual UI for seeing companions to assist with setting up the impaired user.
	Option 3	Focus detection only on tripping hazards below waist level, providing simple avoidance commands.
	Choice	Option 2
	Rationale	Any solution that involves just the user themselves will be difficult to manage. This option allows for a companion to assist the user what will inevitably be difficult for them.
Satisfied by	FR4	

FR Issue ID	Description	
FRI9	PFR_ID	PFR8. More that you can think of
	Missing: There is no functional requirement stating how the app will handle network connection loss which can result in the ability to call emergency services	
	Option 1	Simply notify the user they have lost internet connection.
	Option 2	Notify the user and switch the emergency protocol to sound a loud alarm from the phone instead of calling emergency services.
	Option 3	Lead the user back to where they were before they lost connection via audio commands.
	Choice	Option 2
	Rationale	This option allows for a backup plan to perform instead of calling emergency services, while still informing the user of the situation.
Satisfied by	FR3	

FR Issue ID	Description	
FRI10	PFR_ID	PFR8. More that you can think of
	Missing: There is no functional requirement stating how the app will handle network connection loss which can result in a loss of map navigation.	
	Option 1	Always hold a downloaded version of any current maps being used to allow navigation to continue in the case of network loss.
	Option 2	Tell the user to stay put and wait for connection to resume.
	Option 3	Lead the user back to where they were before they lost connection via audio commands.
	Choice	Option 1
	Rationale	Option 2 allows the user to not be completely halted by a network loss while maintaining safety. Option 3 does not ensure network activity will resume when moving back to past locations.
Satisfied by	FR2	

3.3.Non-Functional Requirements(NFR) Issues

NFR Issues ID	Description	
NFRI1	PNFR_ID	PNFR1. The system shall help the user safely navigate indoors
	Ambiguity: Safe is subjective and can mean to avoid stairs, or crowds, or construction.	
	Option 1	Define safe as “collision avoidance”.
	Option 2	Define safe as “traffic avoidance”.
	Option 3	Define safe as “collision and stairs/escalator avoidance”
	Choice	Option 3
	Rationale	It is not enough to just avoid collisions but also avoid areas that are unsafe for the visually impaired such as stairs and escalators.
Satisfied By	NFR2	

NFR Issues ID	Description	
NFRI2	PNFR_ID	PNFR2. The system shall lead the user through the fastest route. PNFR3. The system shall lead the user through the route that the user would feel the most comfortable.
	Inconsistent: These two requirements can conflict. The “fastest” route may not be the “most comfortable” and vice versa.	
	Option 1	Default to the “fastest” route and only consider “comfort” as a tiebreaker.
	Option 2	Default to the “most comfortable” route and only consider “comfort” as a tiebreaker.
	Option 3	Allow the user to select a navigation preference in the settings. The system will then generate routes based on that choice.
	Choice	Option 3
	Rationale	This approach resolves the inconsistency by letting the user define their own priorities. It directly supports the NFR that the system must be customizable to the user and provide the most user-friendly experience.
Satisfied by	NFR5	

NFR Issues ID	Description	
NFRI3	PNFR_ID	PNFR3. The system shall lead the user through the route that the user would feel the most comfortable.
	Ambiguous: What is “most comfortable” is subjective and not clearly defined. Does it mean “shortest distance”, “safest”, “familiarity”, or “widest hallways”?	
	Option 1	Define comfort by “safest”.
	Option 2	Define comfort by “familiarity”
	Option 3	Define comfort by “shortest distance.”
	Choice	Option 2
	Rationale	The other two options bring up a similar issue to NFRI2 that conflict safety with fastest route. The most familiar route will be the route that users feel more comfortable.
Satisfied by	NFR5	

NFR Issues ID	Description	
NFRI4	PNFR_ID	PNFR4. The system shall be usable for blind people.
	Ambiguous: “Usable” is a subjective term and not a measurable requirement. To be effective, it must be broken down into specific criteria.	
	Option 1	Define “usable” as the app being compatible with the phone’s built-in screen reader.
	Option 2	Define “usable” as requiring that all primary features can be completed using only voice commands and that all system feedback is provided audibly and with haptics.
	Option 3	Define usability through user testing, requiring a success rate of 95% for core tasks performed by blind users.
	Choice	Option 2
	Rationale	This option provides a clear and testable definition of usability that is directly tied to the app’s core functionality. We can implement this option without ambiguity.
Satisfied by	NFR3	

NFR Issues ID	Description	
NFRI5	PNFR_ID	PNFR5. The system shall be ubiquitous.
	Ambiguous and unrealistic: “Ubiquitous” is an unrealistic goal for a project of this scope, as it implies the app will work in any building, anywhere. This is outside our current scope and must be turned into something more achievable.	
	Option 1	Interpret “ubiquitous” to mean the app must be available on both iOS and Android.
	Option 2	Ignore the requirement as it may not be feasible.
	Option 3	Change “ubiquitous” to “map extensibility and scalability” to support the idea as an architectural principle. The system should support the addition of new building maps without requiring a fundamental rewrite of the application.
	Choice	Option 3
	Rationale	This option changes an unrealistic goal into a sound software engineering principle. It aligns with the requirement for the system to be extensible and ensures the project is built on a scalable foundation.
Satisfied by	NFR4	

NFR Issues ID	Description	
NFRI6	PNFR_ID	PNFR6. The system shall be customizable to every user: e.g. volume, the interval of instructions, etc.
	Accessibility: If we were to accommodate full customizability, that would further complicate menus that are difficult to navigate for impaired readers	
	Option 1	Voice only settings menu
	Option 2	Companion mode for configuration of settings
	Option 3	Simplify or remove some customize options
	Choice	Option 2
	Rationale	By implementing a companion mode, the user can involve a seeing companion to help. This way the user can still access all the customize options without running into complex audio menus
Satisfied by	NFR5	

NFR Issues ID	Description	
NFRI7	PNFR_ID	PNFR7. The 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.
	Unrealistic. Being easily extensible for new and varying hardware requires not only a modular codebase but a modular hardware framework and may require full app rewrites.	
	Option 1	Monolithic code structure
	Option 2	Modular “plugin” architecture and hardware for sensor
	Option 3	Making custom systems for different users.
	Choice	Option 2
	Rationale	The abstract “hardware” term should initially accommodate for current hardware in the system architecture, and allow swapping from one input to another without need for code rewrite.
Satisfied by	NFR4	

NFR Issues ID	Description	
NFRI8	PNFR_ID	None
	Missing: No non-functional requirement for system latency.	
	Option 1	All instructions given at the beginning to remove chance of late instructions.
	Option 2	Routing calculations and instructions delivered in less than 1 second from being triggered by improving speed with GPU acceleration
	Option 3	Start calculating instructions for predictions of the user's position and then give instructions at the moment the user enters that position, removing any latency involved.
	Choice	Option 2
	Rationale	Only the second option does not rely on thinking about where the user will be. It gives instructions based on what the user does, which is more reliable and user-oriented.
Satisfied by	NFR2	

NFR Issues ID	Description	
NFRI9	PNFR_ID	None
	Missing: No non-functional requirement for data security	
	Option 1	Encrypt all user specific data and can only be accessed by user authentication.
	Option 2	Keep all user data locally; upload no private information to the cloud.
	Option 3	Do not allow users to enter private data to prevent it from being lost or stolen.
	Choice	Option 1
	Rationale	Encrypting all data allows for protection of data but also gives the user the choice to allow company to use data to improve the app.
Satisfied by	NFR1	

[4] WRS

4.1.W

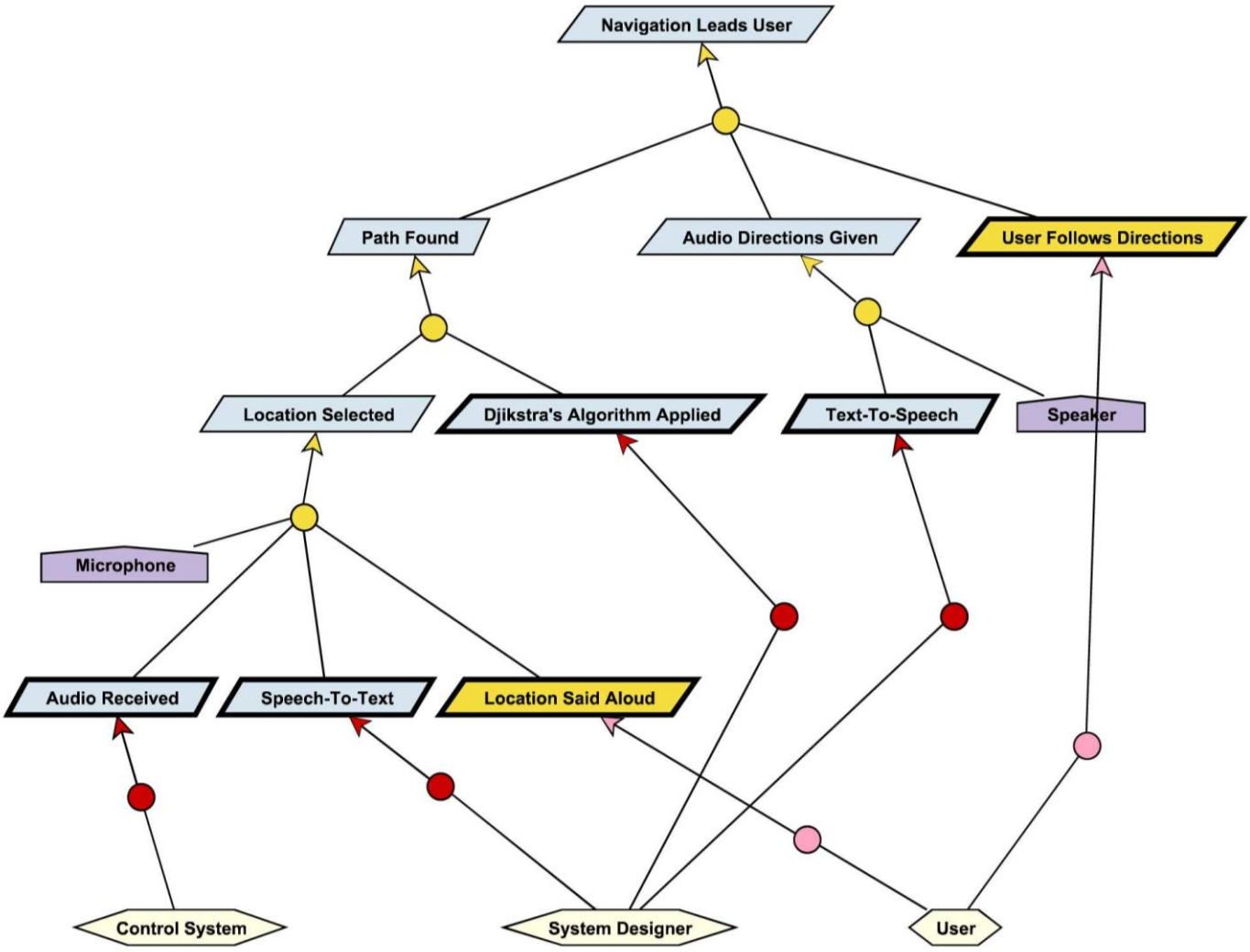
4.1.1. Problem

Problem ID	Problem Description	Corresponding Goals
P1	Blind and visually impaired people must rely on canes, animals, or human assistance to navigate buildings	G1, G2
P2	Users might face obstacles such as open doors, furniture, or misplaced objects which could make navigation stressful and dangerous	G3
P3	Users might face issues setting up and configuring the tools without visual assistances	G5
P4	If the user drops their phone, it might be an issue to find it or call for help	G2, G4
P5	If the user falls and injures themselves, they need to have someone to help them	G2, G4
P6	Blind people might want to take the fast or slow route depending on preference, but do not get to make that choice in most circumstances.	G5

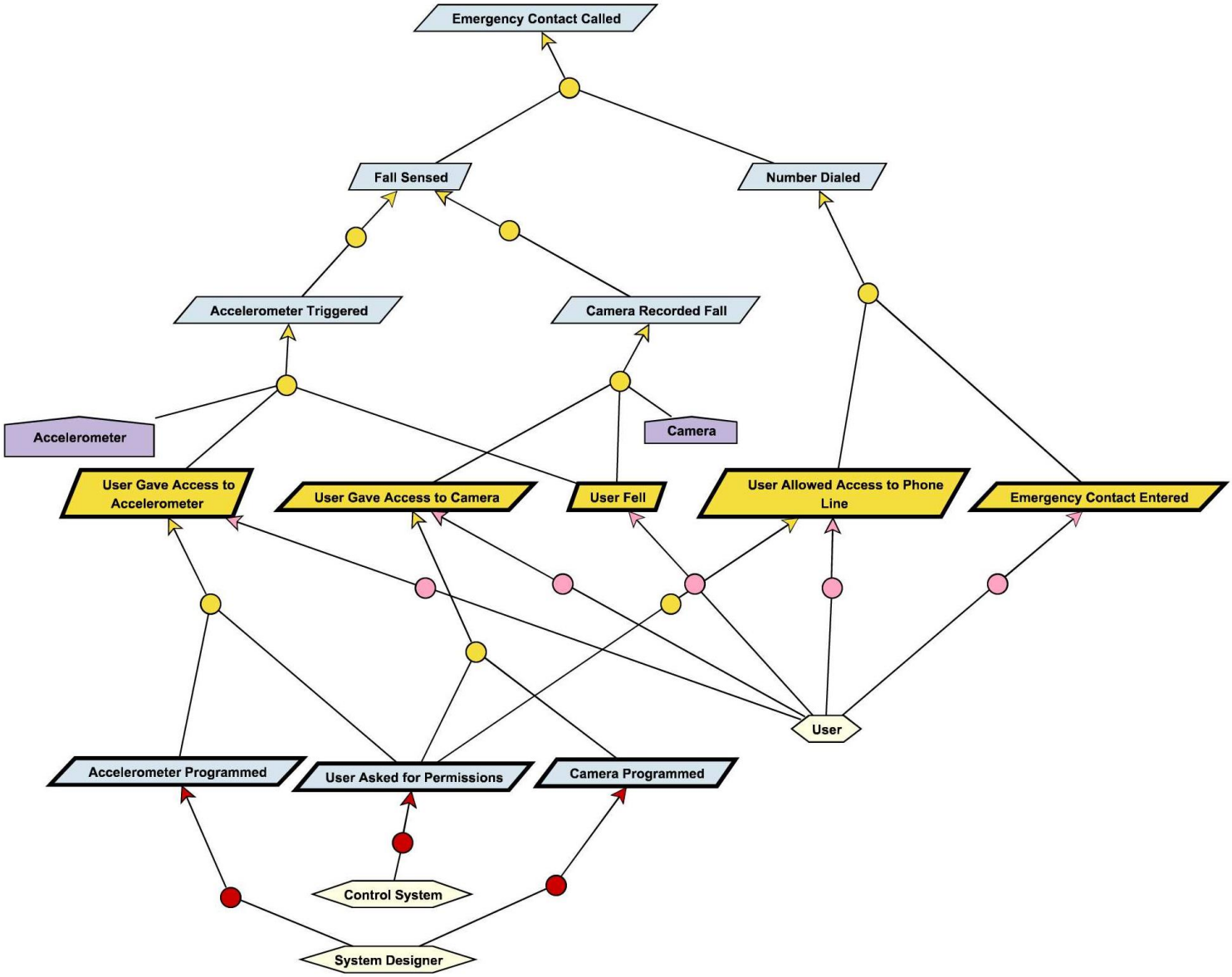
4.1.2. Goals

Goal ID	Goal Description	Backward Traceability	Forward Traceability
G1	Communicate with users using audio and haptic feedback to relay important information	P1	IFRO1
G2	Navigate users within buildings	P1, P4, P5	IFRO2
G3	Use phone sensors to detect obstacles and then inform and reroute the user	P2	IFRO3
G4	Prevent falls by implementing fall detection and emergency contact alert	P4, P5	IFRO4
G5	Allow secondary users to assist with setting up the app and enter user preferences	P3, P6	IFRO5

On the next two pages are two goal diagrams, illustrating the sub-requirements of the Navigation (G2) and the Emergency Contact (G4) goals.



Goal Diagram (Navigation)



Goal Diagram (Emeregency Contact)

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	The domain of this app focuses on assisting visually impaired individuals navigate buildings. The app will use voice commands and haptic feedback to help users move safely around buildings
ID2	The app will allow secondary users to assist with the setup and calibration of the app.
ID3	The app will have fall detection, and emergency contact features to help make accidents such as falling less of a big deal

4.1.3.2. Stakeholders

Name	Description
Primary user	The main user who is visually impaired who uses the app to help navigate buildings
Secondary User	The secondary user who is not visually impaired who will help setup the app for the primary user
Developers	The team responsible for building the app

4.1.3.3. Improved Functional Objectives

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

Improved FR Objective ID	Objective Description	Alleviates Problems	Achieves Goals
IFRO1	The app will translate text directions into speech and relay that as audio to the user for directions	P1	G1
IFRO2	The app will provide indoor navigation routes by calculation using Djikstra's algorithm and GPS	P1, P4, P5	G2
IFRO3	The app will use phone camera and sensor to detect obstacles	P2	G3
IFRO4	The app will push alerts about obstacles to the user in real time	P2	G3
IFRO5	The app will include a companion mode that allows a secondary user to setup the app for the primary user	P3, P6	G5
IFRO6	The system shall detect if the users' trips or drops their phone and it will alert an emergency contact with the user's location	P4, P5	G4

4.1.3.4. Improved Non-Functional Objectives

Improved NFR Objective ID	Objective Description	Alleviates Problem	Achieves Goal
INFRO1	The app will provide timely responses to ensure user safety	P1	G1
INFRO2	The app will be reliable and produce almost zero false positive falls (using a countdown)	P4, P5	G4
INFRO3	The app will be accurate in where it positions the users (using GPS)	P1, P4, P5	G2
INFRO4	The app will use multiple phone sensors to be accurate in how it detects obstacles	P2	G3
INFRO5	The interface should be WCAG compliant and be fully compatible with screen readers	P3, P6	G5
INFRO6	User data such as emergency contact and fall location will be encrypted and transmitted securely	P4, P5	G4

4.2.RS

4.2.1. Functional Requirements

FR ID	Description
FR1	The system shall accept voice commands starting with “Room” followed by a number (e.g., “Room 103”) or “Hallway” followed by a number/word (e.g., “Hallway One”) to set a destination.
Satisfies Functional Requirement Issue	FRI7
Satisfies Objectives	IFRO1
Satisfied by prototype feature	Voice command feature that takes the info and puts it into the backend for route setting

FR ID	Description
FR2	If the user moves to a node not on the current path (simulated via manual movement buttons), the system shall automatically recalculate the shortest path to the original destination and voice the new instructions.
Satisfies Functional Requirement Issue	FRI2
Satisfies Objectives	IFRO2
Satisfied by prototype feature	Dynamic Route Calculation (Dijkstra’s Algorithm)

FR ID	Description
FR3	Upon detecting a fall, the system shall initiate a 20-second countdown. It must visually display the countdown and audibly ask “Are you okay?”. The system shall accept “Yes”, “Ok”, or “Okay” voice commands to cancel the alert.
Satisfies Functional Requirement Issue	FRI6
Satisfies Objectives	IFRO6
Satisfied by prototype feature	Fall Detection Simulation and Timer

FR ID	Description
FR4	The system shall allow a secondary user (companion) to update the User Name, Emergency Contact Name, Emergency Phone, and Preferred Language.
Satisfies Functional Requirement Issue	FRI8
Satisfies Objectives	IFRO5
Satisfied by prototype feature	Graphical UI that has settings that will setup the app for the primary user

FR ID	Description
FR5	If the countdown expires during the fall sequence, the system shall call the specified emergency contact immediately
Satisfies Functional Requirement Issue	FRI6
Satisfies Objectives	IFRO6
Satisfied by prototype feature	Countdown timer

FR ID	Description
FR6	The system converts text directions to speech audio directions to guide the user
Satisfies Functional Requirement Issue	FRI3, FRI4
Satisfies Objectives	IFRO1
Satisfied by prototype feature	Text-to-speech system

FR ID	Description
FR7	The system uses the rear facing camera to detect non-moving objects (walls, pillars, steps, etc.) and issues a command such as “Stop” to keep the user safe.
Satisfies Functional Requirement Issue	FRI5
Satisfies Objectives	IFRO3, IFRO4
Satisfied by prototype feature	Obstacle identification algorithm, connection to rear camera (not yet implemented)

4.2.2. Non-Functional Requirements

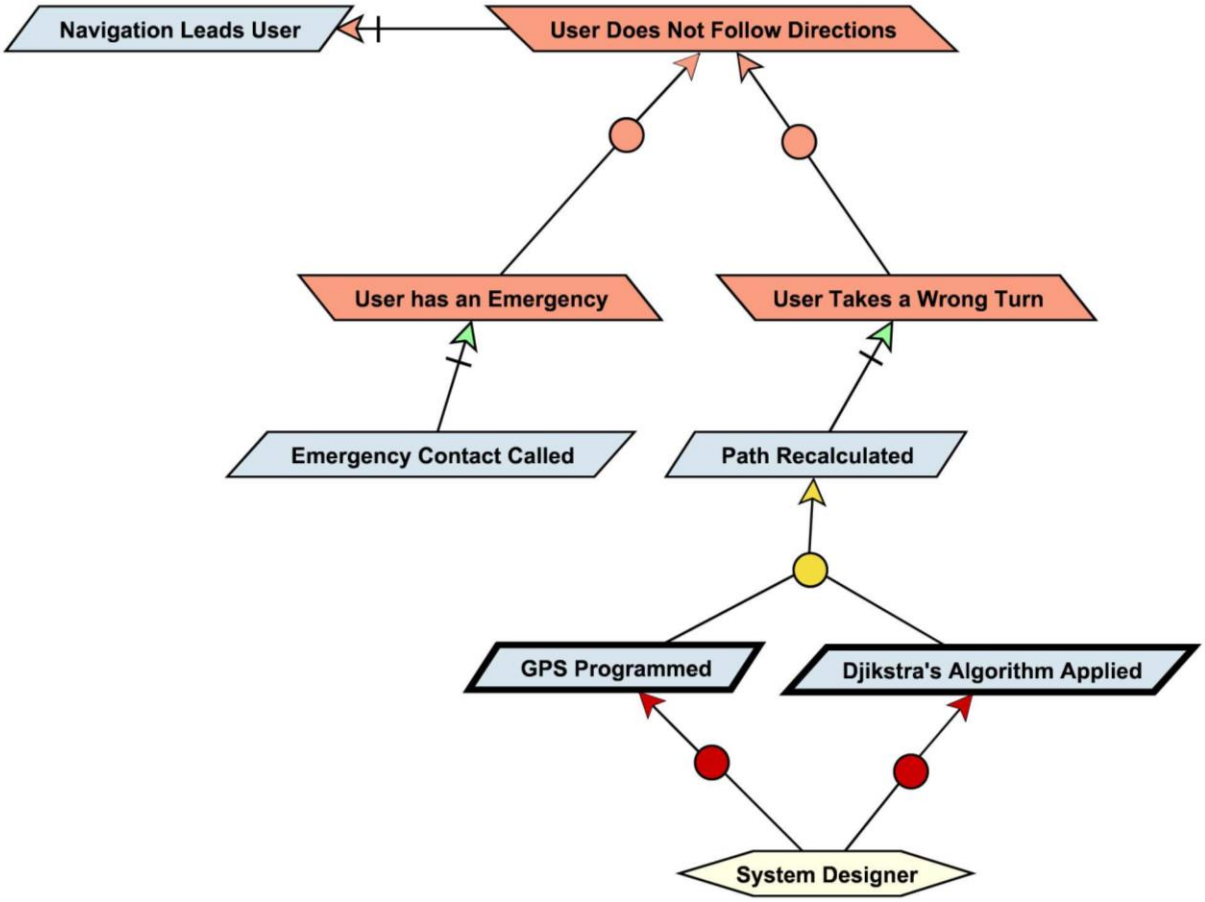
NFR ID	Nonfunctional Requirement 1
NFR1	The system shall be secure, which means location and emergency contacts are encrypted
Operationalized Functional Requirements	FR5
Satisfies Nonfunctional Requirement Issue	NFRI9
Satisfies Non-functional Objective	INFRO6
Constrains	P3, P4
Satisfied by prototype feature	Emergency contact alert

NFR ID	Nonfunctional Requirement 2
NFR2	The app will give reliable and fast feedback to ensure user's safety while navigating
Operationalized Functional Requirements	FR2, FR3, FR6, FR8
Satisfies Nonfunctional Requirement Issue	NFRI4, NFRI8
Satisfies Non-functional Objective	INFRO1, INFRO2, INFRO3, INFRO4
Constrains	P1, P2, P4, P5
Satisfied by prototype feature	Djistra's Algorihtm, Fall Detection, Text-to-speech System, Obstacle Detection Algorithm

NFR ID	Nonfunctional Requirement 3
NFR3	The interface should comply with WCAG 2.1 AA standards for screen reader compatibility
Operationalized Functional Requirements	FR4
Satisfies Nonfunctional Requirement Issue	NFRI7
Satisfies Non-functional Objective	INFRO5
Constrains	P1, P3
Satisfied by prototype feature	Graphical UI that has settings that will setup the app for the primary user

NFR ID	Nonfunctional Requirement 4
NFR4	The system should be scalable to allow for new maps and destinations, but still be safe for these new areas.
Operationalized Functional Requirements	FR2, FR8
Satisfies Nonfunctional Requirement Issue	NFRI5
Satisfies Non-functional Objective	INFRO3
Constrains	P2, P6
Satisfied by prototype feature	Djikstra's Algorithm, Obstacle identification algorithm

NFR ID	Nonfunctional Requirement 5
NFR5	The system should conform to the user's needs and preferences to allow for comfortable but also safe use.
Operationalized Functional Requirements	FR4
Satisfies Nonfunctional Requirement Issue	NFRI2, NFRI3, NFRI6
Satisfies Non-functional Objective	INFRO5, INFRO6
Constrains	P6
Satisfied by prototype feature	Graphical UI that has settings that will setup the app for the primary user



Obstacle Analysis (Navigation)

Above is an Obstacle Analysis diagram, going through the possibility of the user failing to follow given directions.

4.2.3. Specifications

Functional Specification ID	Functional Requirement
FS1	The system shall use Djikstra's algorithm to calculate the shortest path from point A (current location) to point B (destination).
Satisfies Functional Requirement	FR2
Satisfies Objectives	IFRO2
Satisfied by prototype feature	Djikstra's Algorithm

Functional Specification ID	Functional Requirement
FS2	The system connects to the device's microphone and listens in for voice commands from the user. These will be fed into a speech-to-text model to produce computer readable commands
Satisfies Functional Requirement	FR1, FR6
Satisfies Objectives	IFRO2
Satisfied by prototype feature	Text-to-speech system

Functional Specification ID	Functional Requirement
FS3	The phone accelerometer detects sudden changes in the phones movement, signaling the app that there is a fall occurring.
Satisfies Functional Requirement	FR3
Satisfies Objectives	IFRO6
Satisfied by prototype feature	Fall Detection Simulation

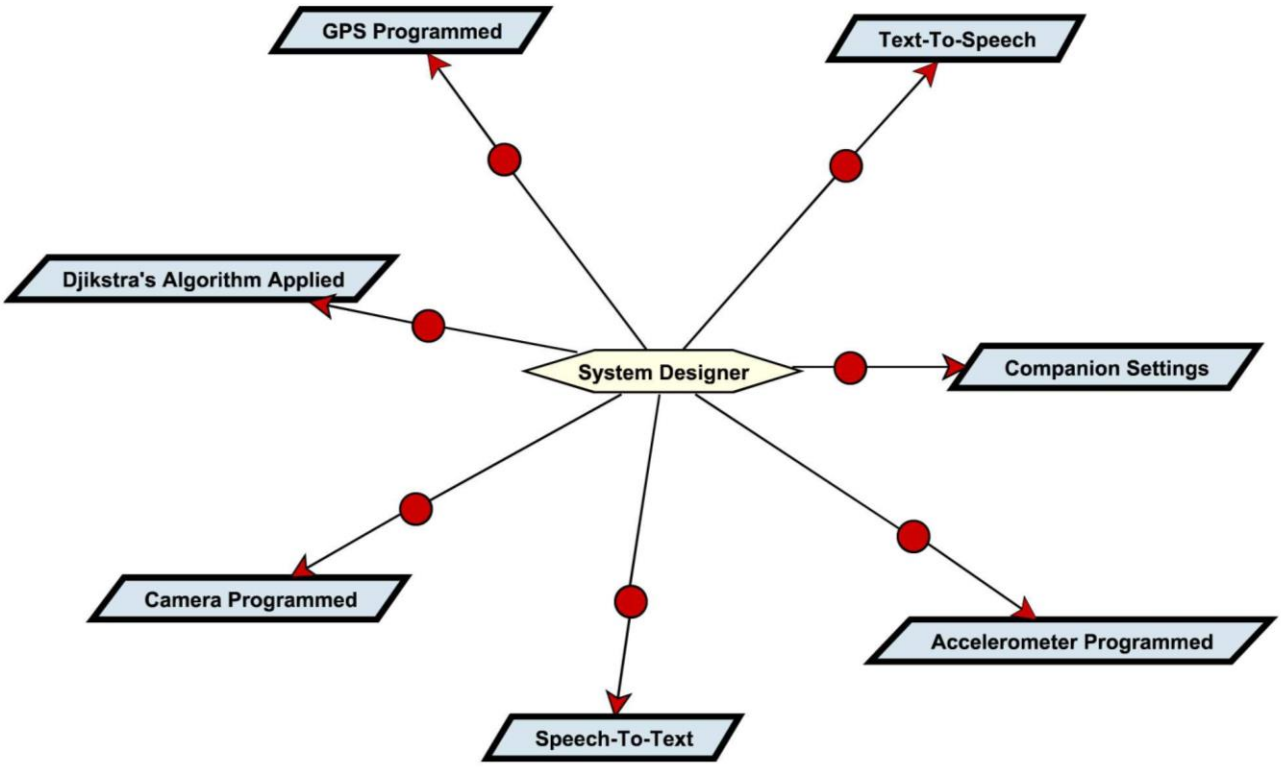
Functional Specification ID	Functional Requirement
FS4	The system uses global positioning system connected to the satellite to receive precise location updates of the current user. This information helps the app determine navigation.
Satisfies Functional Requirement	FR1, FR2
Satisfies Objectives	IFRO2
Satisfied by prototype feature	Voice command feature, Djikstra's Algorithm

Functional Specification ID	Functional Requirement
FS5	The rear facing camera identifies a wall based on different shadows and visuals that covers most of the field of view. The app sees this as a wall and alerts the user saying "Stop."
Satisfies Functional Requirement	FR7
Satisfies Objectives	IFRO3, IFRO4
Satisfied by prototype feature	Obstacle identification algorithm

Functional Specification ID	Functional Requirement
FS6	The app uses a text-to-speech model which converts the text commands into audible commands. This model may contain settings that change based on user preference.
Satisfies Functional Requirement	FR6
Satisfies Objectives	IFRO1
Satisfied by prototype feature	Text-to-speech system

Functional Specification ID	Functional Requirement
FS7	The system shall call the emergency contact when the countdown timer finishes. This is done through the device's telephone service.
Satisfies Functional Requirement	FR5
Satisfies Objectives	IFRO6
Satisfied by prototype feature	Countdown Timer

Functional Specification ID	Functional Requirement
FS8	All user data is stored locally on the user's device using an encrypted SQLite database
Satisfies Functional Requirement	FR4
Satisfies Objectives	IFRO5
Satisfied by prototype feature	Graphical UI that has settings that will setup the app for the primary user



Responsibility Model (System Designer)

The above responsibility model lists the responsibilities of the system designer, which is the developer team.

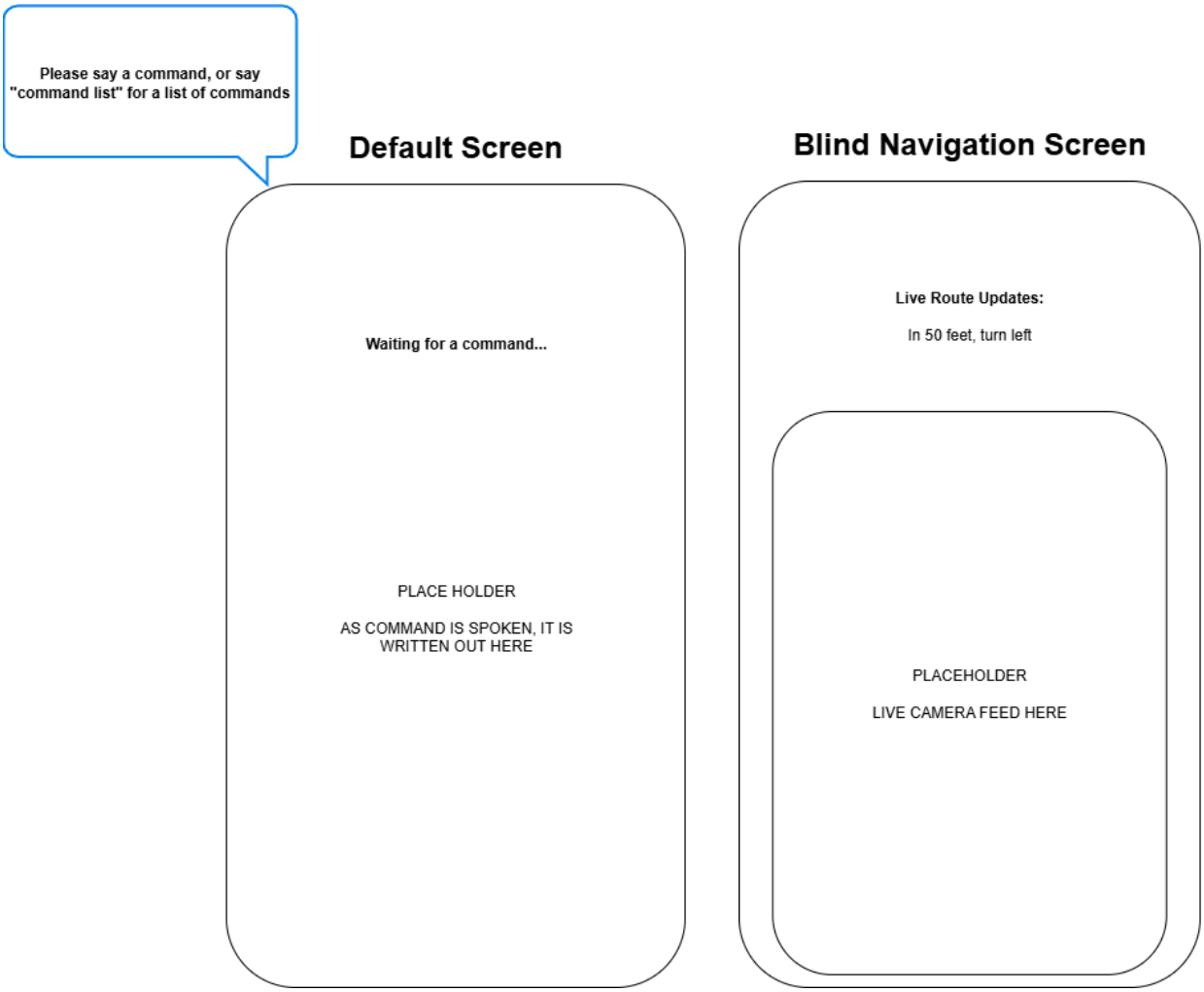
[5] Preliminary Prototype

Component	Route Navigation
Input	A destination given either verbally or textually.
Output	A list of directions that make up the route from the current location to the destination.
Implementation	This will be implemented by taking the floorplan of the building(s), creating the easiest route (the route with the least number of directions, stairs, etc.), and creating both a visual and auditory route list.
Validation	This will be simply validated by the app successfully getting the user to their destination, and if there are multiple possible paths, the app chooses the best path for the user.

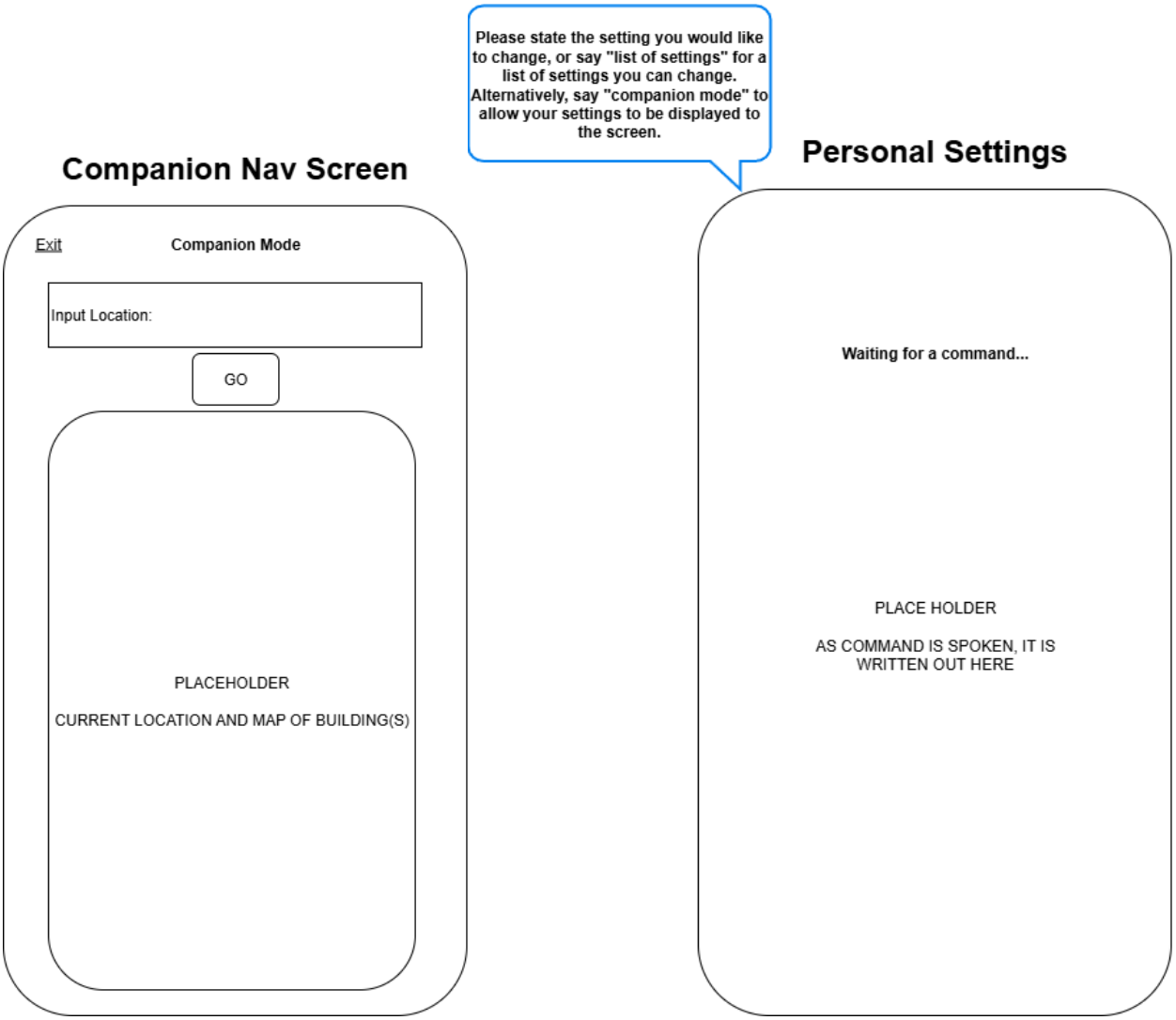
Component	Fall Detection
Input	Sensor inputs that could be a fall
Output	Verbal confirmation from the user if they are okay, or a call to their emergency contact (we won't do 911 because that would be impossible to test legally)
Implementation	This will be implemented by having the app check for harsh sensor readings that could be a fall, then appropriately dealing with the situation
Validation	This will be simply validated by the app successfully detecting a fall and acting on the detection appropriately.

Component	Companion Mode
Input	Verbal activation of the companion mode.
Output	A visual/physical screen setup that allows a seeing companion to navigate the app.
Implementation	After companion mode is activated, the user's companion will be able to navigate a visual version of the app. This includes personal settings and the basic navigation system.
Validation	This will simply be tested by having a functioning physical interface that a user can interact with after swapping to companion mode.

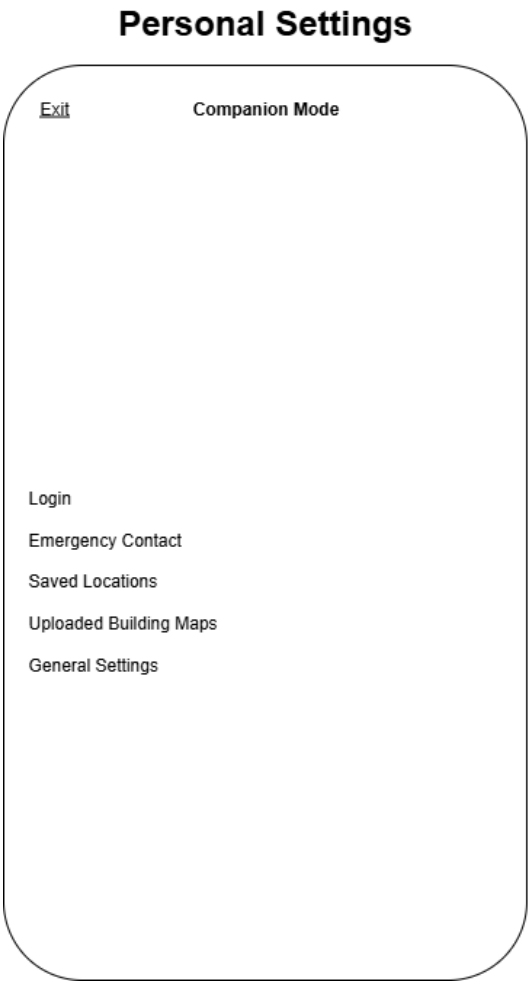
[6] Prototype Interface Mock-ups



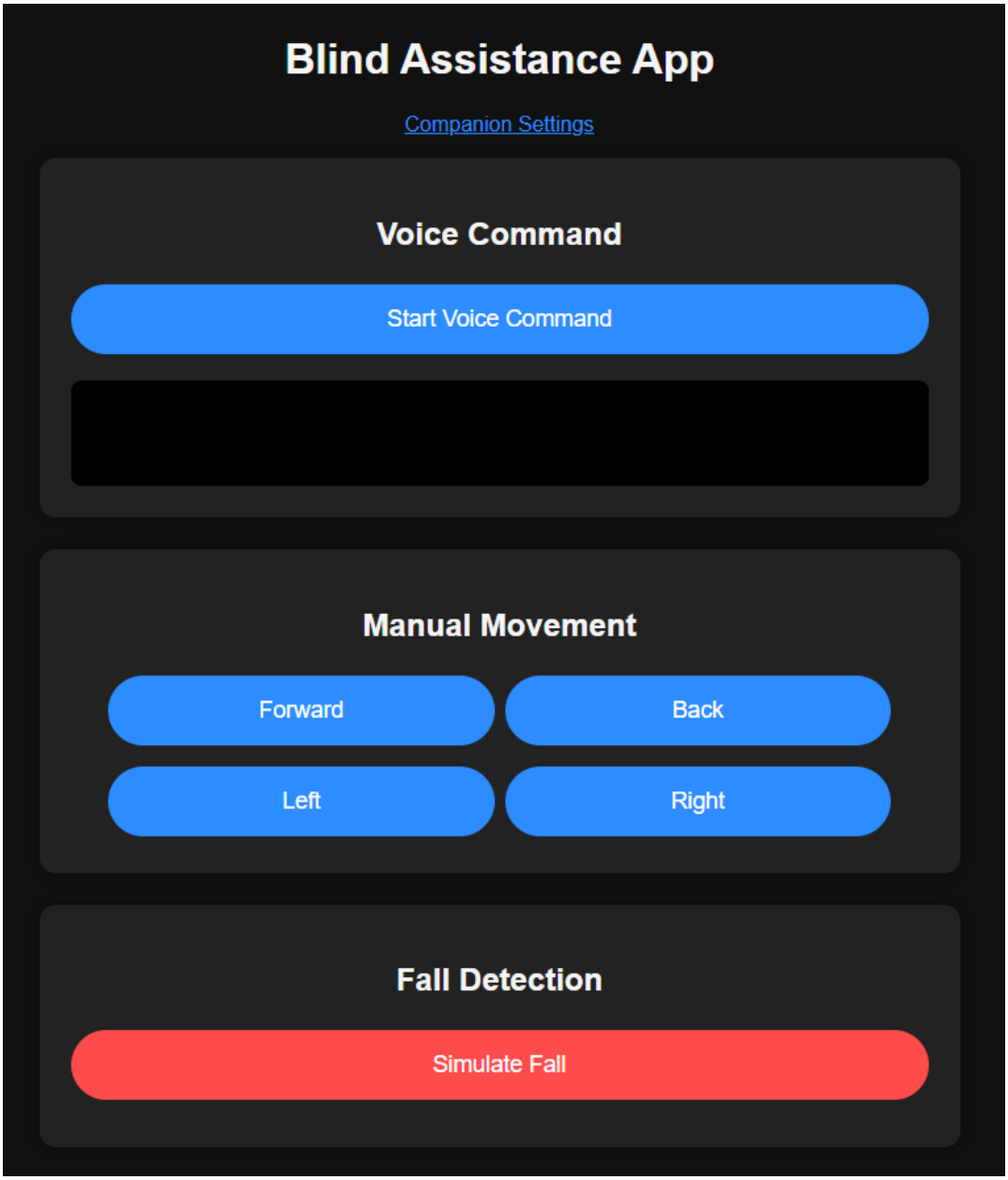
6.1. Prototype Interface Mock-ups cont.



6.2. Prototype Interface Mock-ups cont.



6.3. Final Prototype Interface



6.4. Final Prototype Interface cont.