CPTS 484 Software Requirements (Fall 2019)

WRS Evolution

Requirements Elicitation

Submitted to:

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Version: 1.0 **Date: 10/13/2019**

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Revision History

Date	Version	Changes	Editor
09/23/2019	1.0	Initial Creation	All members
10/13/2019	2.0	Updated for Phase I	All members

1. Introduction

1.1. Purpose

This document is designed to record the results of the development team's understanding of the Preliminary Requirements Document that was provided by the product owner. In addition, it aims to capture the rationales behind design choices of the project, and backward and forward traceability from a feature to a requirement.

The audience of this document is the product owner. The product owner will be able to use its contents to ensure the correctness of the development team's understanding of project specifications, and makes comments on the design decision choices.

1.2. Scope

The project described within this document is an Android Application (Android 7.0 and up) designed with the specific goal of helping visually impaired people (VIP). The application is designed to assist in navigating between rooms inside buildings having been given a map.

1.3. Objectives and Success Criteria

The objective of this project is to build a ubiquitous smartphone application that helps visually impaired people get around indoors of a building.

For this project to be considered successfully developed, the phone application must have the following features:

- Accept user's starting and destination location input.
- Give user's both text and speech directions.
- Get user from their input starting location to inputted destination.
- Allow user to add a floor map.
- Allow user to add emergency contact.

1.4. Definitions, Acronyms, and Abbreviations

Android: a mobile operating system based on a modified version of the Linux kernel and other open source software, designed primarily for touchscreen mobile devices such as smartphones and tablets.
VIP: Visually Impaired
Assistant/Caretaker: a person who assists the visually impaired person.

API: APIs are most commonly expressed as a set of operations, associated data definitions, and the semantics of the operations on some underlying system.
Cyclops: the name of the application.

1.5. Overview

The first section of this document provides an introduction to the project and covers the scope at which the team is focusing on, basic definitions, acronyms, abbreviations, and the document overview. The second section defines the required functionality of the android application, Cyclops and the customers it affects. The third section covers any issues with the definition from section two and gives options to address them. The fourth section covers the goals and needs of the team and the stakeholders of the project, along with the requirements that the team has gathered and refined. The fifth section shows the mock prototype of the UI along with the user manual.

2. Preliminary Definition

2.1. Preliminary Domain

PD_ID	Preliminary Domain Description
PD1	Visually impaired person (Moderate visual impairment combined with severe visual impairment are grouped under the term “low vision”: low vision taken together with blindness represents all visual impairment)
PD2	Caretaker who assists the visually impaired person. (caretakers help individuals who need assistance. They can help their patients get dressed, eat, bathe and complete light housekeeping duties, such as dishes or folding laundry. Caretakers plan and prepare meals.)
PD3	Passerby who is familiar with the use of a smartphone application.

2.2. Preliminary Functional Requirements

PFR_ ID	Preliminary FR Description
PFR1	Detecting obstacles and telling the user what to do in order to avoid collision.
PFR2	Figuring out the routes to reach the destination
PFR3	Accepting user’s input for starting point and destination to start the navigation.
PFR4	Placing emergency calls/messages after user has fallen or when the system has lost its current location.
PFR5	Inform the user of alternative routes if there are multiple routes to navigate from the starting point to the destination, then accept the user’s preference.

2.3. Preliminary Non-Functional Requirements

PNFR_ ID	Preliminary NFR Description
PNFR1	Generate the fastest route through the building.
PNFR2	Generate a route that would be easy for a blind person to follow.
PNFR3	The system can be usable by voice only.
PNFR4	The system is customizable for users.
PNFR5	The system is easily extensible to add new features and languages.
PNFR6	The system will navigate users safely indoors.
PNFR7	The system is ubiquitous.

3. Issues with the Preliminary Definition Given

3.1. Domain Issues

Domain Issue ID	Domain Issue Description	
DI1	PD_ID	PD1. Visually impaired people
	1. Ambiguous or incomplete. Each category can cover a wide range of disabilities resulting in widely varying levels of impairment. 2. The use of the word “visually impaired” is imprecise. The term covers many subsets of people such as completely blind people, or people who can see to a certain degree where glasses do not help with their sight.	
	Option 1	Consider which categories of disability cyclops can easily support with the minimum number of functional requirements and prioritize functional requirements to target those first.
	Option 2	Consider which categories of disability have the most sufferers and prioritize the requirements that target those first.
	Option 3	For each category of disability, research characteristics that define levels of minimal, moderate, and severe disability. Identify requirements that will aid each category and level, and determine if there are levels of disability that the team cannot realistically support.
	Choice	Option 3
	Rationale	Option 3 provides the most complete domain knowledge of the listed options. It also provides greater granularity when conducting traceability of requirements to problems within the domain.
Revised wording		

Domain Issue ID	Domain Issue Description	
DI2	PD_ID	PD2. Caretaker
	1. Ease of use 2. Unclear how much interaction the caretaker has with the visually impaired person. If the caretaker is full time,it would not be necessary to have this product.	
	Option 1	Consider that if they are using this app their caretaker must not be full time. Assume the person who did the setup is not there.
	Option 2	Consider if voice activated is the easiest method for the visually impaired without a caretaker.
	Option 3	If they have a full time caretaker would they just input the directions for the client and then give them the phone so they can find their way.
	Choice	Option 1
	Rationale	Most likely someone using this app had a family member set it up for them. Assume no caretaker is the option that will cover the most potential clients.
Revised wording		

Domain Issue ID	Domain Issue Description	
DI3	PD_ID	PD3. Passerby who is familiar with the use of a smartphone application.
	1. In case of emergency, a passerby can find the emergency contact for the visually impaired person.	
	Option 1	When a fall is detected, make sure there are two clearly marked emergency buttons. When pressed, one button will automatically call the primary emergency contact. The second button will show all emergency contacts stored.
	Option 2	Have the emergency contacts on screen at all times.
	Choice	Option 1
	Rationale	Having an emergency button call the primary contact will leave less responsibility to the passerby. Passerby will have the option to contact the VIP’s emergency contact if needed.
Revised wording		

3.2. Functional Requirements Issues

FR Issue ID	Description	
FRI1	PFR_ID	PFR1. Detecting obstacles and telling the user what to do in order to avoid collision.
	1. Objects are assumed to be static.	
	Option 1	Assume it is real time object detection, and that the user’s phone is equipped with decent quality camera. In such case, Then it would utilize the phone camera to detect incoming object in the selected route.
	Option 2	Assume that it is required to avoid objects that is available on the given map (such as study pods, vending machines etc.). In such case, cyclops would route the path simply by finding path avoiding such objects directly from the given map.
	Choice	Option 2
	Rationale	Real time detection requires the use of Object detection API from tensorflow, which requires android phones to have Camera2 API support. Since the application has to be ubiquitous, the real time detection would not be a feasible feature because those whose phones does not support Camera2 API would not be able to use the application.
Satisfied by	FR4	

FR Issue ID	Description	
FRI2	PFR_ID	PFR5. Inform the user alternative routes if there are multiple routes to navigate from the starting point to the destination, then accept the user’s preference.
	When to give the option to change direction?	
	Option 1	When the user first inputs the directions.
	Option 2	When you arrive at the point of the alternate path.
	Option 3	If the client asks for the option of an alternate route.
	Choice	Option 3
	Rationale	Option 3 gives the client control over the option to search for a different route. If they walk the same route everyday having either option 1 or option 2 will most likely get annoying if they are asked every time they take the route. Giving them an option to look for it seems like the most useful choice.
Satisfied by	FR1	

FR Issue ID	Description	
FRI3	PFR_ID	PFR4. Placing an emergency calls/messages after user has fallen or when the system has lost its current location.
	How would the app tell if the user has fallen?	
	Option 1	Have a 3-clicks on volume-up button for the user to click to trigger the emergency calls/messages.
	Option 2	Use accelerometer sensor on the phone to automatically detect a fall, then place emergency prompt.
	Option 3	Have the application actively listen for emergency commands, once detected it will automatically placing emergency calls/messages.
	Choice	Option 2.
	Rationale	This is the simplest way to detect a fall without having to worry about the owner’s voice recognition or accidentally show an emergency prompt every time the user turns up the volume.
Satisfied by	FR2	

FR Issue ID	Description	
FRI4	PFR_ID	Figuring out the routes to reach the destination
	Do two buildings connected by an external route considered indoors navigation?	
	Option 1	Consider that to be indoors and support navigation from one room in a building to one room in another building.
	Option 2	Do not consider that to be indoors, and support both navigation indoors and outdoors. User has to input starting point and destination again once reached the other building.
	Option 3	Do not consider that to be indoors, and support only indoors.
	Choice	Option 3
	Rationale	There is no available library for navigating between indoors and outdoors. Thus, that means the team must implement such functionality from scratch. Since there is limited allocated time for completing the project, the team has chosen to implement functionality that required fully tested library that assist with indoor navigation.
Satisfied by	FR1	

3.3. Non-Functional Requirements(NFR) Issues

NFR Issues ID	Description	
NFRI1	PNFR_ID	PNFR1. Generate the fastest route through the building.
	What is the definition of fastest?	
	Option1	Always use the elevators, elevators are faster than stairs.
	Option2	Use whatever is closer, stairs or elevator.
	Option3	If destination is closer to elevator or is 2 or more floors away,use the elevator, use the stairs.
	Choice	Option 1.
	Rationale	Elevators are faster and safer for the VIP.
Satisfied by	NFR1	

NFR Issues ID	Description	
NFRI2	PNFR_ID	PNFR2. Generate a route that would be easy for a blind person to follow.
	What makes a route easy?	
	Option1	Use only the large main hallways
	Option2	Avoid stairs
	Option3	Clear directions/distances
	Choice	1, 2, and 3
	Rationale	All three of these are easy to implement and should be used
Satisfied by	NFR2	

NFR Issues ID	Description	
NFRI3	PNFR_ID	PNFR4. System is customizable by user
	What should be able to be customized?	
	Option1	Stairs or elevator only toggle
	Option2	Custom schedule
	Option3	Interval of directions
	Choice	1 and 3
	Rationale	These two are very easily implemented.
Satisfied by	NFR2	

4. WRS

4.1. World Assumptions (W)

4.1.1. Problem

Problem ID	Problem Description	Corresponding Goals
P1	Due to limited vision, a VIP cannot examine a building map to determine a route from their current location to a destination.	G1
P2	Due to limited vision, a VIP will not be able to use common smartphone app layout.	G2
P3	A VIP is prone to collisions since they cannot determine the location of static objects.	G3
P4	If a VIP were to fall or an accident occurred to a VIP, they would not be able to request for emergency assistance for themselves.	G4

4.1.2. Goals

Goal ID	Goal Description	Backward Traceability	Forward Traceability
G1	Navigate through a building independently.	P1	FO1
G2	Easy to use smartphone app for a VIP (voice commands & navigation).	P2	FO2
G3	Avoid static objects.	P3	FO3
G4	If injured, a VIP would get the necessary assistance they need.	P4	FO4

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	Visually impared people have heightened senses (besides vision).
ID2	Assistant is there to set up the device. After the setup, they are no longer needed.
ID3	Scheduled routes are determined by a user’s habit.

4.1.3.2. Stakeholders

Stakeholder List:

- Bolong Zeng
- Visually impaired users
- Assistants
- Families of VIP
- Help desk clerks

4.1.3.3. Improved Functional Objectives

Based on the above information and the teams goals, the functional objectives of Cyclops are:

Improved FR Objective ID	Objective Description	Alleviates Problems	Achieves Goals
IFRO1	Cyclops shall send out users location and calls their emergency contact once the app has detected that the user has fallen.	P4	G4
IFRO2	Cyclops shall provide navigation functionality that allow a VIP to augment their ability to navigate indoors in order to better conduct their daily activities.	P1	G1
IFRO3	Cyclops shall use the map to determine obstacle and help the user avoid them.	P3	G3
IFRO4	Cyclops shall provide speech to text functionality in order for VIP to utilize the smartphone app.	P2	G2

4.1.3.4. Improved Non-Functional Objectives

Improved NFR Objective ID	Objective Description	Alleviates Problems	Achieves Goal
INFRO1	Cyclops will provide the fastest routes from current location to destination, as defined in 3.3.	P1	G1
INFRO2	Cyclops shall provide safe routes from current location to destination.	P1, P3	G1,G3
INFRO3	Cyclops shall generate easy to follow step-by-step directions for VIP.	P1	G1

4.2. Requirement Specifications (RS)

4.2.1. Functional Requirements

FR ID	Description
FR1	If a user input starting point and destination, Cyclops would provide an option to generate a route with easy to follow step-by-step directions.
Satisfies Functional Requirement Issue	FRI2, FRI4
Satisfies Objectives	FO2
Satisfied by final product	

FR ID	Description
FR2	If a user is detected to have fallen, then Cyclops will enter into emergency mode, which emergency call/message can be deployed.
Satisfies Functional Requirement Issue	FRI3
Satisfies Objectives	FO4
Satisfied by prototype feature	

FR ID	Description
FR3	If a user types in a destination and starting point, user will be given the fastest route in text or speech.
Satisfies Functional Requirement Issue	FRI2
Satisfies Objectives	FO1
Satisfied by final product	

FR ID	Description
FR4	Avoid static objects in the generated route
Satisfies Functional Requirement Issue	FRI1
Satisfies Objectives	FO3
Satisfied by final product	

FR ID	Description
FR5	Accept user’s input from both voice and text
Satisfies Functional Requirement Issue	FRI2
Satisfies Objectives	FO1, FO2
Satisfied by final product	

4.2.2. Non-Functional Requirements

NFR ID	Nonfunctional Requirement	
NFR1	The system shall provide fastest routes available from current location to destination, given the users selected settings.	
Operationalized Functional Requirements	OFR1	The system shall provide a route that would take the least amount of time to travel, as described above.
Satisfies Nonfunctional Requirement Issue	NFRI1	
Satisfies Non-functional Objective	INFRO1, INFRO3	
Constrains	FO3, FO4	
Satisfied by prototype		

NFR ID	Nonfunctional Requirement	
NFR2	Cyclops shall give directions in a step-by-step interval where each step is atomic and clear (i.e requires user to do only one thing such as ‘Turn Left’ or ‘Turn Right’)	
Operationalized Functional Requirements	OFR1	The system shall provide instruction to the users based on the set route.
Satisfies Nonfunctional Requirement Issue	NFRI2	
Satisfies Non-functional Objective	INFRO1, INFRO2, INFRO3	
Constrains	FO4	
Satisfied by prototype feature		

4.2.3. Specifications

Functional Specification ID	Functional Requirement
FS1	If a starting point and destination is either entered text or speech, then the directions will be given.
Satisfies Functional Requirement	FR1, FR4
Satisfies Objectives	FO1, FO3
Satisfied by prototype feature	Navigation

Functional Specification ID	Functional Requirement
FS2	If a user’s phone has shaken vigorously, then an emergency mode will be triggered.
Satisfies Functional Requirement	FR2
Satisfies Objectives	FO4
Satisfied by prototype feature	Emergency mode

Functional Specification ID	Functional Requirement
FS3	if a user enters uses one the following voice commands shown below in Voice commands, then the system will respond accordingly.
Satisfies Functional Requirement	FR3, FR5
Satisfies Objectives	FO2
Satisfied by prototype feature	Text to Speech

5. Preliminary Prototype and Manual

At this stage, the preliminary prototype consists of mock ups shows in section 5.1. These mockups will give the patrons an overview of how the prototype would look.

5.1. Prototype Interface Mock-ups

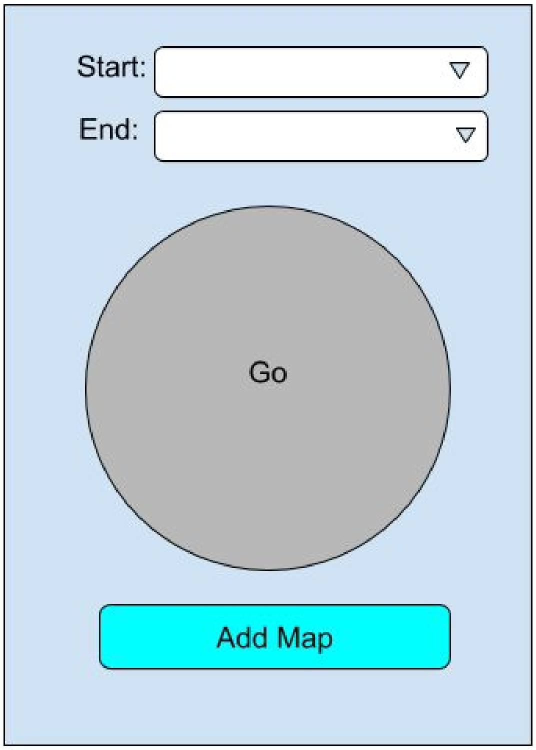


Figure 1. Initial State (Never been used)

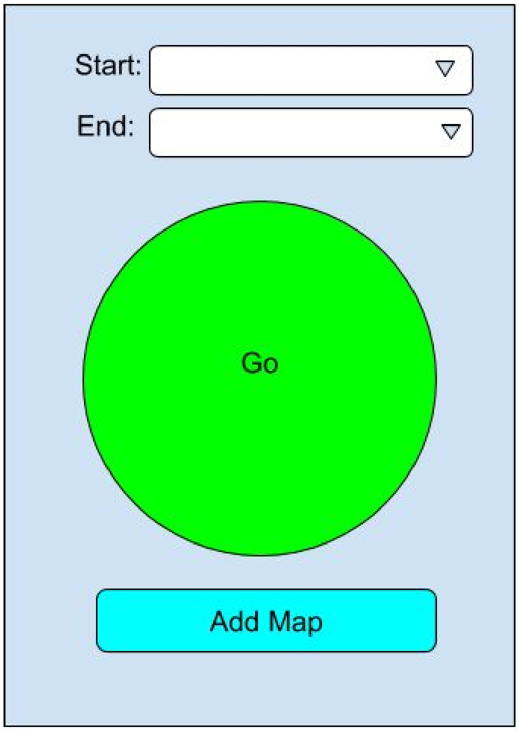
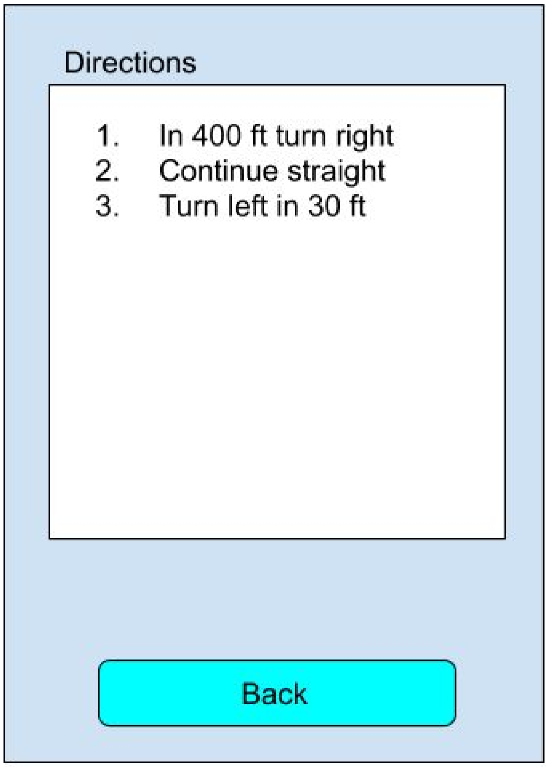


Figure 2. State after at least a floor map has been added



1. In 400 ft turn right
2. Continue straight
3. Turn left in 30 ft

Figure 3. Sample Direction View

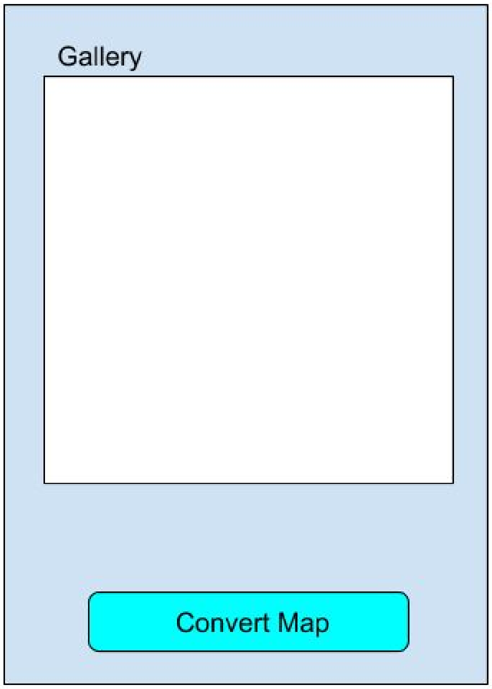


Figure 4. Adding Map UI View (assuming a picture of a map is selected && not one of the existing converted ones)

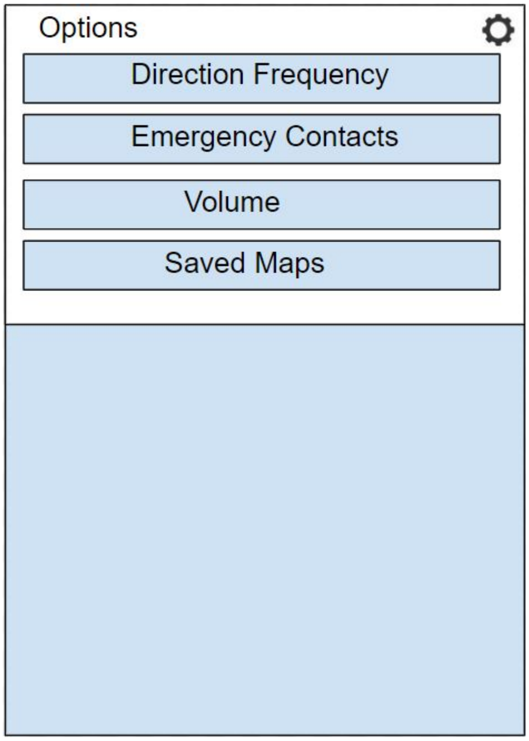


Figure 5. Settings dropdown menu with the available options to customize the app

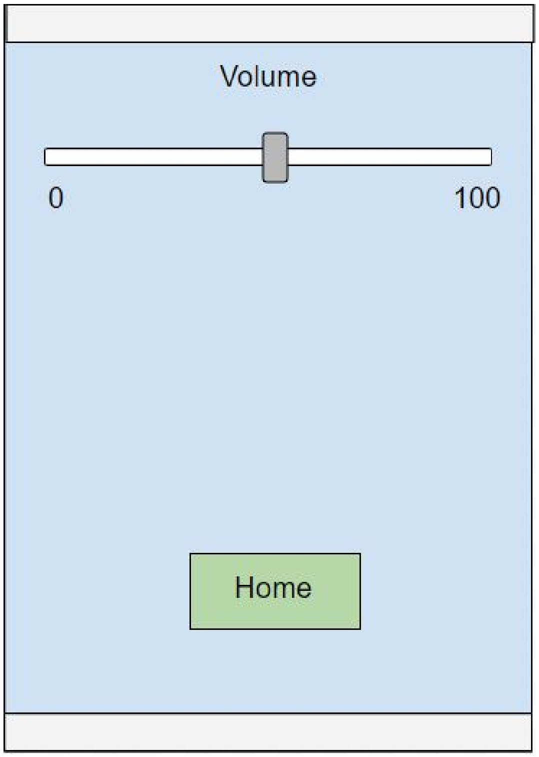


Figure 6. Settings for Volume, slide left to decrease volume or slide right to increase volume

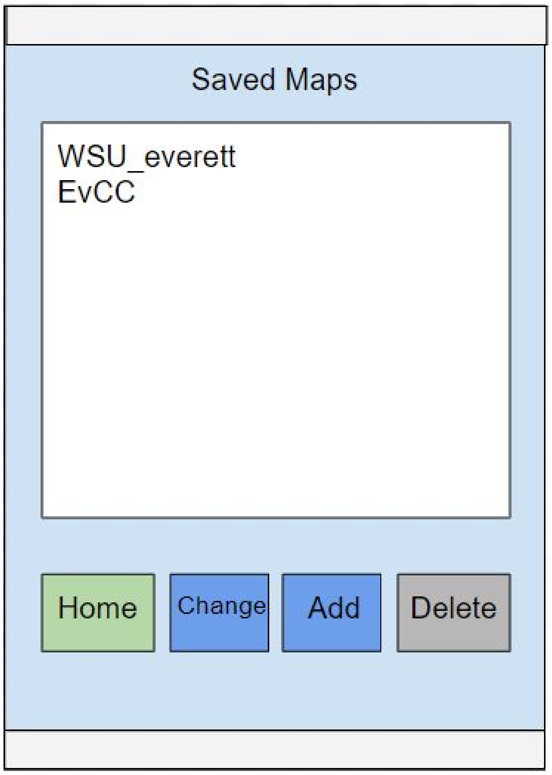


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Figure 7. User can access saved maps. Default state

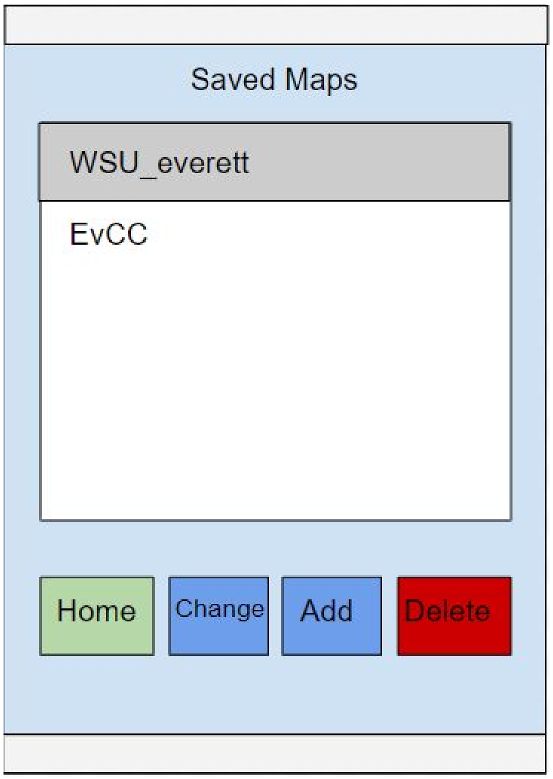


Figure 8: selected map

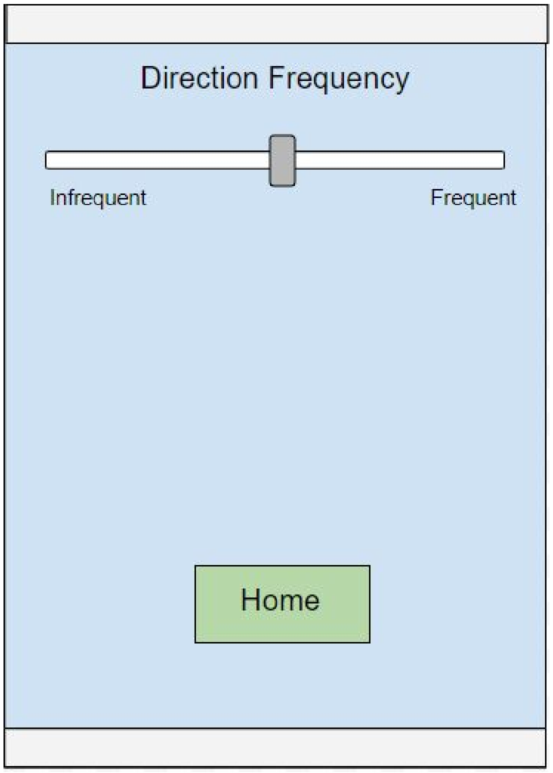


Figure 9: User set the interval they can receive instructions.

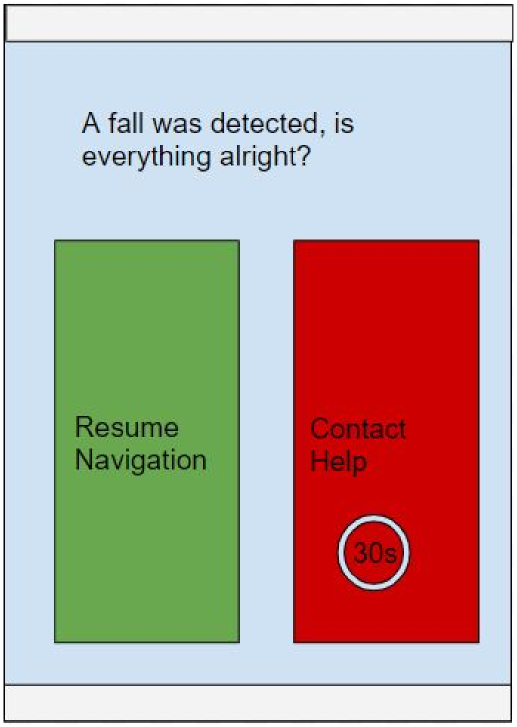
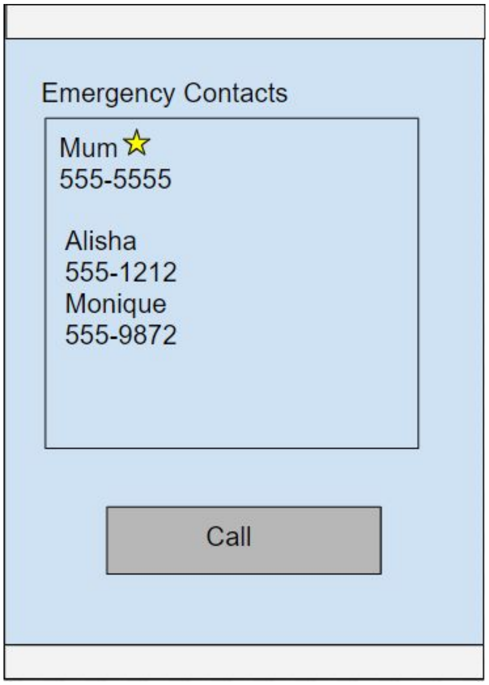

A fall was detected, is everything alright?

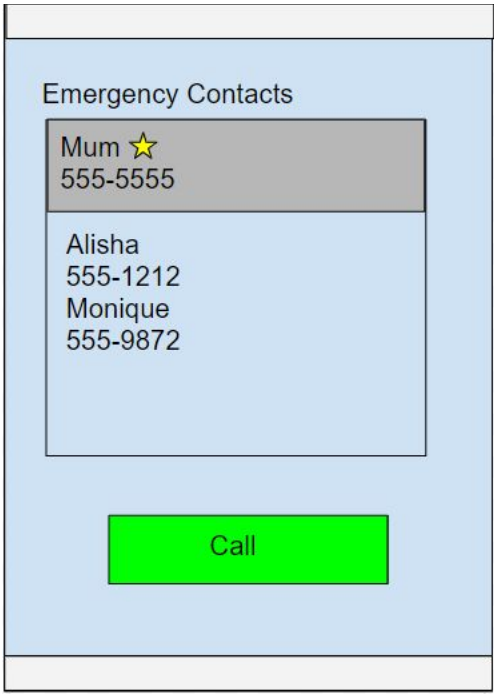
Figure 10: The emergency screen will display when the user has fallen.



Mum ☆
555-5555

Alisha
555-1212
Monique
555-9872

Figure 11: The emergency contact screen when the user pressed contact help from the emergency screen. Default state.



Emergency Contacts

Mum ☆
555-5555

Alisha
555-1212
Monique
555-9872

Figure 12. Once the user selects a contact, a call can be made.

5.2. User Manual

Getting started

After the user/assistant has entered the user's emergency contact information, the user will be able to begin using the software by the following steps: (Note: "Blind Mode" would act very similar

1. User will be given the initial state shown in Figure 1. Either the user uses voice commands or touch the "Add map button" to import a map.
2. User will be given the state shown in Figure 4. The user will take a picture of the building map to convert to a usable map to navigate.
3. After steps 2 & 3, the user will have the state shown in Figure 2. Users will now be able to enter a starting point and a destination either vocally or by typing it in.
4. Once a valid starting point and destination has been entered, the user will be able to click on the "Go" button or say the vocal command.
5. The user will be given the state shown in Figure 3. Cyclops would then give directions via speech/text for the user step by step as the user moves towards the destination.
6. If a user has detected to have fallen, then the user will have two options (shown in Figure 7):
    a. Resume navigation. This option will resume the navigation.

    b. Contact help. This option will contact one of your emergency contacts for help shown in Figure 8.The user will select or say which contact to reach and the call action would be enabled (shown in Figure 9). If no action is taken within 30 seconds, then the first emergency contact is automatically contacted.

7. Once the user has reached their destination, Cyclops will let the user know they had reached their destination.

5.3. Switch between blind and assistant mode

1. To switch to blind mode the user can simply say “switch to blind mode”
2. To go back to assistant mode the user or assistant can say “switch to assistant mode” or simply double tapping the screen to switch to assistant mode from blind mode.

5.4. Voice commands

The following list will be valid voice commands to use the software.

- Take me to - using users current location, vocally enters a destination
- Enter starting point - vocally enters users starting point
- Enter destination - vocally enters users destination.
- Switch to assistant mode - changes to assistant mode
- Switch to blind mode - changes to blind mode
- Volume up - slightly increases volume
- Volume down - slightly decreases volume
- Change Frequency - changes frequency of when directions are emitted to user, only available when on the options page
- Increase Frequency - Increases frequency of directions. Must have called “Changed Frequency” first.
- Decrease Frequency - Decreases frequency of directions. Must have called “Changed Frequency” first.
- Open options - open options menu
- Close options - closes options menu
- Edit emergency contact - edit users emergency contacts, only available when on the options page
- Change map - changes current map to given map name, only available when on the options page (map must exist within the application)
- Resume navigation - if emergency mode is active and user is ok, then resumes navigation
- Contact help - enters emergency contact list for help.
- Call - calls the name given. Name must be in emergency contact list.

5.5 Options Menu

When the options menu is opened via speech or click:

- Direction Frequency - changes the frequency of directions
- Emergency contacts - can edit, remove, or add emergency contacts
- Volume - can increase or decrease volume within app
- Saved maps - can delete or switch maps

6. References

[1] https://web.archive.org/web/20150512062236/http://www.who.int/mediacentre/factsheets/fs282/en/
[2] https://work.chron.com/elderly-caretaker-job-description-15693.html
[3] https://web.archive.org/web/20150116081559/http://www.acm.org/tsc/apis.html
[4] https://en.wikipedia.org/wiki/Android_(operating_system)