CptS 484: Software Requirements

WRS Evolution

Requirements Elicitation

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Revision History

Date	Version	Changes	Editor

[1]. Introduction

1.1. Purpose of the System

1.1.1. Our goal is to build a smartphone app that will assist visually impaired people with safely navigating their way indoors. For example, a blind visitor may want to go from one office to another and thus will need help finding a safe route to their destination. The app will ask for the destination, give instructions for their desired route, and take note of any obstacles that may stand in the user's way. It will also take into account the familiarity of the route and the time it takes to reach the end of it. In addition, our team will incorporate several requirements into the app. They include but are limited to:

- A ubiquitous system
- Usable for blind people/visually impaired
- Customizable
- Easily extendable
- Choose the fastest route

The primary audience for this app are people who are severely visually impaired. Therefore it is important to not only make the app work accurately, but also have great usability.

1.2. Scope of the System

1.2.1. The scope of the system includes achieving both Phase I goals and Phase II goals, completing all the necessary requirements in the requirements doc, and passing all of the test cases for the project. The team is currently working on completing Phase One, which contains:

Designing the requirements model,

- Specification for the app,
- A complete WRT document,
- A revised Phase I plan, a collection of our team meetings,
- A Powerpoint presentation of our project,
- A prototype implementation of the app

It is due by October 13th, 2019. Everyone in the team is assigned to a certain section of each project document. In addition, there are also weekly group meetings in order to ensure the project's quality and to maintain good communication between each team member.

1.3. Objectives and Success Criteria

1.3.1. Our main objectives include:

- Being able to navigate indoors
  - The app will need to be able to instruct the user to go from one room in the building to another
- Safe, quick, and comfortable navigation
  - The app will need to notify users of any possible obstacles in the way while also providing the quickest and most convenient path possible.
- Easy to use
  - Due to the intended target, the app will need to be user friendly to the visually impaired.
  - The app will offer a variety of features that will make the user's journey much easier. They include short, concise instructions, the ability to pause and change destination, being able to utilize the user's routine schedule, and place emergency calls if needed.

Our success criteria will include:

- Whether or not the user is able to reach the destination within a certain amount of time
- If the app is able to detect typical obstacles that might be in the way
- If the user is able to utilize the app's features without any bugs/errors.
- If the user is able to use the app without encountering any huge problems, such as the chosen route being not optimal and encountering any unwanted obstacles.

1.4. Definitions, Acronyms and Abbreviations

Unified Modeling Language (UML) - A diagram with the purpose of visually representing a system along with its main actors, roles, actions, artifacts or classes, in order to better understand, alter, maintain, or document information about the system.

Internet Operating System (iOS) - An operating system used for mobile devices manufactured by Apple Inc.

Xamarin - An IDE that allows for the development of cross-platform mobile applications using C#.

Android - An open-source operating system used for smartphones and tablet computers.

Gyro sensors - A device that senses the change in rotational angle per unit of time.

GPS - Stands for Global Positioning System. It is a radio navigation system that allows users to determine their exact location in the world.

Waterfall model - A breakdown of project activities into linear sequential phases, where each phase depends on the deliverables of the previous one and corresponds to a specialisation of tasks.

C# - An object-oriented programming language made by Microsoft.

Model View Controller (MVC) - A software design pattern commonly used for developing user interfaces which divides the related program logic into three interconnected elements. They include the *model* (data), the *view* (user interface), and the *controller* (processes that handle input).

General risk - An activity or event that may compromise the success of a software development project.

Acceptance testing - A level of software *testing* where a system is tested for acceptability. The purpose of this *test* is to evaluate the system's compliance with the business requirements and assess whether it is acceptable for delivery.

Voice Recognition - The ability of a machine or program to receive and interpret dictation or to understand and carry out spoken commands.

1.5. Overview

1.5.1. We are currently designing and creating a smartphone app called “Theia” that will help assist the visually impaired indoor navigation. As stated in the project requirements document, the features needed for this app consists of:

1.5.1.1. Indoor Navigation
1.5.1.2. Obstacle Detection
1.5.1.3. Consideration of Route Familiarity

Therefore, we will include building maps and utilize the GPS in order to ensure indoor navigation, use the phone’s sensors in order to detect any obstacles that may be in the way, and have a Room Profile for users who mainly want indoor navigation for their daily routes.

In addition, we also need to complete the needed requirements. They are categorized into two sections - functional and non-functional. Since non-functional may be more important to accomplish than functional ones, our team will be focusing on the former first before moving onto the latter.

There are currently two phases for this project: Phase I, which includes coming up with requirement models, specifications, and a prototype implementation and Phase II. Our team will be completing Phase I and Phase II by their due dates.

[2]. Issues

2.1. Domain, Stakeholders, Functions & Non-Functional Objectives

2.1.1. Domain

Preliminary Domain ID	Preliminary Domain Description
PD1	Individuals with severely impaired eyesight, ranging from legally blind to total blindness.
PD2	Caretakers of the disabeld.

2.1.2. Stakeholders

INFLUENCE	High	● Professor Bolong	● Blind community ● Team Members
	Low	● App Raters	● Washington State University Student ● American Council on Education ● Parents
		Low	High
		INTEREST	

2.1.3. Functions

Preliminary Functional Req. ID	Preliminary Domain Description
PFR1	Object detection in order to avoid any collisions when traveling.

2.1.4. Non-Functional Objective

Preliminary Non-Functional Req. ID	Preliminary Domain Description
PNF1	Safe, fast, and comfortable navigation for indoor places.
PNF2	User-friendly interface for the visually impaired.

2.2. Functional Requirements

Requirement ID	Functional Requirement	Description	Priority (1-3)
FR1	GPS tracking	Track the user position with gps while navigating through building. The user should receive updates thought their trip based on the progress they have made. GPS will be used to tell if the user has stayed on their path and give the direction system information on their position.	1
FR2	Object detection	Detect objects with the camera to alert user of upcoming path obstructions. This includes tables, open doors, other people, and various objects that would inhibit their ability to walk along the route. This will utilize the camera hardware and an algorithm to detect objects in the view.	2
FR3	Voice recognition	Ability for user to give commands through speech. The main users will not be able to use a graphical interface, so voice commands will need to be the main interaction method with the app.	2
FR4	Settings	Save user configuration, common locations, speed, buildings.	2
FR5	Navigation	Provide correct directions to navigate the user through the building to their destination. This will be delivered through speech, alerting the user to continue straight, to make any turns, or when they have gone the wrong way.	1
FR6	Map parsing	Ability to parse imported map data in a way that directions can be obtained from the output.	1
FR7	Emergency reporting	A fail-safe will be implemented to alert emergency contacts in the event of a failure.	3
FR8	Hardware Buttons	Remapping hardware buttons to allow for	3
FR9	Settings UI Page	Provide a UI for configuring settings	3
FR10	Vibration	Vibrate the device when the app alerts the user	3
FR11	Navigation UI		1

2.3. Non-Functional Requirements

Requirement ID	Non-Functional Requirement	Description	Priority (1-3)
NF1	Directions	Provide directions to the user through the use of various software and hardware. A system is needed to determine directions from current location to destination using data provided from imported map.	1
NF2	Blind User Interface	Interface (apart from settings) must be usable without the ability to see the screen. Utilizing voice commands and hardware buttons will be needed.	1
NF3	Efficient Directions	Will provide the shortest reasonable route to the destination. The system will determine the shortest route from location to destination.	3
NF4	Caretaker Options	Setup for the app that is targeted towards to caretaker. This can include gui.	2
NF5	Availability	The app will need to be running throughout the trip and any failures will need to be followed up by alerting proper entities.	2

2.4. Testing Requirements

Test Case ID	FR ID	Test Case	Test Steps	Test Data	Expected Results
TC1	FR1	Verify Gps	1. Detect Gps Signal 2. Sample Data 3. Confirm Data as current location	Location = Spark	Lat = 46 Long = -117

TC2	FR1	Detecting Movement	1. Detect Gps Signal
			2. Continually sample data
			3. Move with changing latitude
			4. Move with changing longitude
				Start Location = {Lat,Long}
				End Location = {Lat, Long}
					Start Location = Start Location
					End Location = End Location

TC3	FR2	Detecting object	1. Object obstructs users path 2. Bring object into camera view	Object = chair	Camera system detects and flags the object.
TC4	FR2	Alerting user of object	1. Object gets detected	Object detected = True	Camera sends alert to navigation system
TC5	FR3	Storing voice input	1.User speaks test phrase 2.App stores correct phrase	Test phrase = “This is a test”	Stored phrase = “This is a test”
TC6	FR3	Parsing voice input	1.User speaks test command 2. App follows the spoken command	Test command = “Call emergency phone number”	The app will call the emergency phone number upon hearing the command.
TC7	FR4	Saving settings configuration	1. User puts in their test configurations into the setting. 2.App saves it until user decides to change it.	Test settings: Set volume to super high, change emergency contacts, map, and room profiles	The app will save the given settings correctly.

TC8	FR4	Settings changes take effect in app	1.User changes their setting configuration. 2. App takes in the change and then saves it.	First put in one set of setting configurations and test if the app saved them correctly. Then input another set of setting configurations.	The app will correctly save and show the new settings configurations.
TC9	FR5	Directions come from map	1.User inputs starting location and destination 2.User starts navigation 3.App selects the best route and gives the correct instructions on screen and verbally	1.Put in test locations, follow navigation, and see if instructions pop up and if they are correct (user arrives to the test destination).	User follows directions and arrives at the correct destination.
TC10	FR5	Direction appears when required	1.User inputs starting location and destination 2.User starts navigation 3. App shows instructions during route	1.Put in test locations, follow navigation, and see if instructions pop up	User sees instructions pop up as they are traveling and they arrive at the correct destination.
TC11	FR6	Store input map	1.User inputs desired map 2.App correctly stores map	Input test map	Stored map = test map.
TC12	FR6	Map parsed into data structure	1.User input test map 2. App uses the map to give instructions for route	Test map input = Sloan Building	The app will utilize the map's layout to find the best route for the desired location in the building.
TC13	FR7	App crash detecting	1.Crash code sent to application 2.Application crash 3.Emergency contacts alerted	Exit code = crash (-1)	App logs crash and performs emergency call
TC14	FR7	Emergency contact alerted	1.App senses that the user has stopped moving for a long time during navigation or is	Stop moving during navigation for a	App will immediately call the emergency

			commanded to call the contact 2.App then immediately calls the emergency contact	long time	contact
TC15	FR8	Hardware button press detected	1. Hardware button gets pressed 2. Signal gets intercepted by navigation system	Up or Down volume button pressed	Navigation system detects correct button
TC16	FR8	Default action remapping	1. Hardware press detected 2. Default action intercepted 3. Remapped action performed	Navigation system detects button	Remapped action performed instead of default action
TC17	FR9	Settings Menu Opens	1. Click on the gear symbol 2. The app then takes you to the Settings Menu	Click on the gear symbol	The user will be taken to the Settings Menu
TC18	FR9	Options appear for user	1. Open settings menu	Click on the gear symbol	Options display on screen
TC19	FR10	Vibration activates	1.Navigation sends signal to vibration hardware 2.Hardware receives signal and operates	Vibration signal sent	Phone vibrates
TC20	FR10	Vibration activated on event	1.User goes the wrong way during navigation 2.The app will send off a vibration to signal the user's error	Test instruction: go the opposite way for one of the instructions during the navigation	The phone will vibrate once it senses that the user's position is going the wrong way.
TC21	FR11	Navigation UI opens	1. Menu screen switches to Navigation 2. Voiced directions start once directions are loaded on screen	Navigation request and directions set	Navigation UI should load without fail and have all features ready to go for the user
TC22	FR11	Button functionality	1.User clicks pause 2.User clicks resume	Ongoing navigation	App pauses navigation then starts when buttons are pressed

[3]. WRS

3.1. W

3.1.1. Problem

Our problem is to create an app that will help those who are visually impaired, navigate through an area to get to their destination by using an app on their smartphone.

3.1.2. Goals

Design app page UI as a computer drawn image to provide reference for graphic interface code development by September 13th 2019

Mock design implemented in C# using Xamarin as an Android application by September 27th

Map designs of Sloan Hall created as hallways and room physical map by October 4th

3.1.3. Improved Understanding of Domain, Stakeholders, Functional & Non-Functional

3.1.3.1. Domain: Disabilities

- Visually Impaired

3.1.3.2. Domain: Activities

3.1.3.3. Stakeholders

- Visually Impaired
- Secondary: Caretakers

3.1.3.4. Functional Objectives

3.1.3.4.1. Navigating Indoors

3.1.3.5. Non-Functional Objectives

3.1.3.5.1. Safe Navigation

3.1.3.5.2. Fast Navigation

3.1.3.5.3. Comfortable Navigation

3.1.3.5.4. User Friendly Interface

3.2. RS

3.2.1. Functional RS

3.2.1.1. Accepting from the user the location to go

3.2.1.2. Figuring out routes to reach the destination

3.2.1.3. Telling the user to stop at the right place to turn

3.2.1.4. Detecting obstacles and telling the user what to do in order to avoid collision

3.2.1.5. Placing emergency calls and messages, possibly after a fall or when the system has lost its current location

3.2.1.6. Figuring out the next action(s) based on the user's habits/schedule

3.2.2. Non-Functional RS

3.2.2.1. The system shall help the user safely navigate indoors

3.2.2.2. The system shall lead the user through the fastest route

3.2.2.3. The system shall be usable for blind people

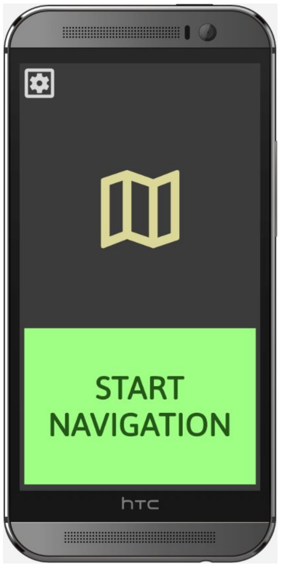
3.2.2.4. The system shall be ubiquitous

3.2.2.5. The system shall be customizable for every user

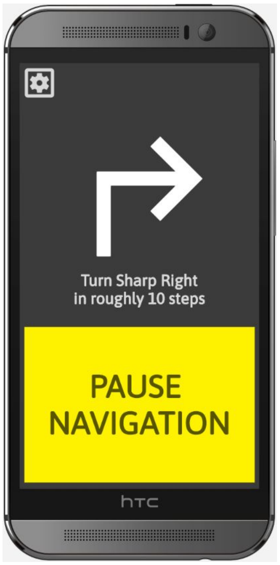
3.2.2.6. The system shall be easily extensible

[4]. Preminimary Prototype

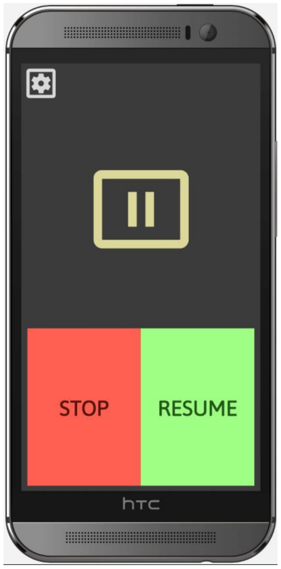
Main Menu



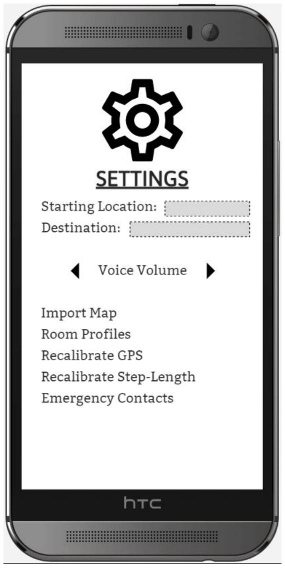
Navigation Mode


Turn Sharp Right
in roughly 10 steps

Pause Menu

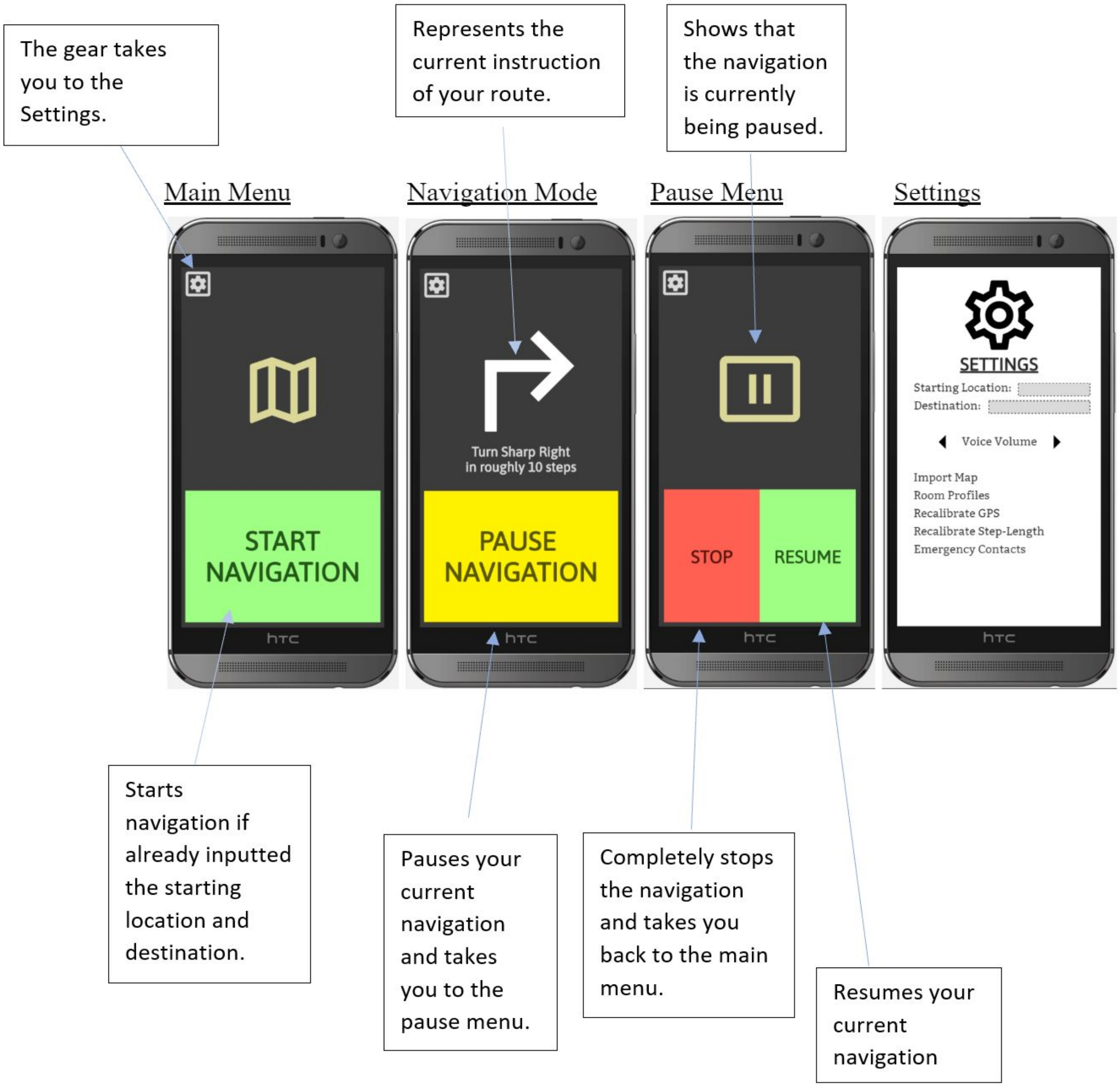


Settings


SETTINGS

Starting Location:

Destination:



The gear takes you to the Settings.

Represents the current instruction of your route.

Shows that the navigation is currently being paused.

Starts navigation if already inputted the starting location and destination.

Pauses your current navigation and takes you to the pause menu.

Completely stops the navigation and takes you back to the main menu.

Resumes your current navigation

[5]. Prototype Interface Mock-ups

5.1. Interface:

- UI:
    - Buttons
        - Start (Graphical / Hardware remapping)
        - Setting
    - Display
        - Direction Arrow
        - Small map
        - Steps taken / remaining
        - Warning about user being blind
    - Voice
        - Directions
        - Motivational messages (You’re doing great! You went the wrong way! Congrats, you’ve reached your destination!!)
        - When to stop

- Start-Up (include Windows start-up music)
    - Destination (Building & Room Number)
    - Import Map
    - Length per Step
    - Name
    - Emergency Contacts
- Execution
    - Voice Inputs
        - Say “Start” on screen menu → Prompt for destination
            - Say Destination → Starts Navigation
        - Say “Stop” during navigation → Voice output possible commands.
            - Say “End” → Returns to menu
            - Say “New Destination” → Input New Destination
    - Turn off directions when finished with trip
        - Return to main screen
    -
- Settings
    - Voice (Sound, Language)
    - Naming Profiles (Input Room #, Room Name)

5.2. Features:

5.2.1.1. Main Page

5.2.1.2. Start Navigation Button

5.2.1.3. Settings Button

5.2.1.4. Navigation page

5.2.1.5. Direction arrow

5.2.1.6. Direction text

5.2.1.7. Pause button

5.2.1.8. Settings button

5.2.1.9. Pause Menu

5.2.1.10. Pause visual

5.2.1.11. Settings button

5.2.1.12. Stop and Resume buttons

5.2.1.13. Settings page

5.2.1.14. Data entry fields

[6]. User Manual

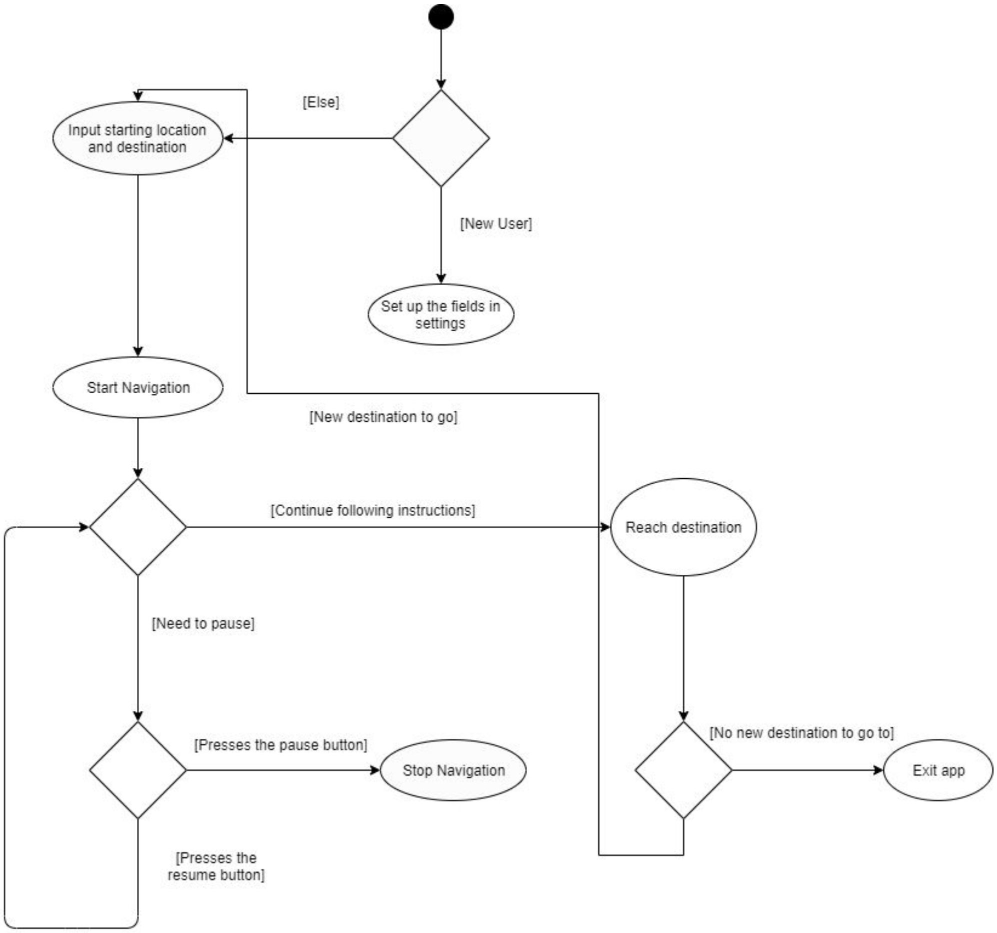
6.1. Purpose of the Prototype

The purpose of the prototype is to be able to understand how the application is supposed to look like and what functionalities will be available.

6.2. Warnings

Because the app is for the visually impaired, it is important that we ensure that they are able to travel the route safely and accurately. Thus, we will be utilizing two different vibration/sounds as safeguards: One to tell the user that they have reached the right stop in their navigation and another to signal that they are too far-off from their route.

6.3. Diagram of the interface


[Else]
Input starting location and destination
[New User]
Set up the fields in settings
Start Navigation
[New destination to go]
[Continue following instructions]
Reach destination
[Need to pause]
[Presses the pause button]
Stop Navigation
[No new destination to go to]
Exit app
[Presses the resume button]

6.4. Instructions

1. In order to get started, first go to settings.
2. Input the maps you want to use, room profiles, and emergency contacts.
3. Input the Starting Location and Destination.
4. Adjust Voice volume and recalibrate when needed.
5. Follow voice commands/commands on screen.
6. Press Start Navigation to start your journey
7. Press Pause Navigation to pause your journey
8. Press stop in order to fully stop your journey or resume to go back to it

[7]. Traceability

[8]. Traceability Matrix

Req. ID	Requirement Description	Test Case ID	Status
FR1	Track user with GPS	TC1, TC2	TC1: Untested TC2: Untested
FR2	Object detected User alerted	TC3, TC4	TC3: Untested TC4: Untested
FR3	User speaks command Command is executed	TC5, TC6	TC5: Untested TC6: Untested
FR4	Settings configured Configuration saved	TC7, TC8	TC7: Untested TC8: Untested
FR5	Directions created Relay to users	TC9, TC10	TC9: Untested TC10: Untested
FR6	Map inserting Stored in data Direction creation	TC11, TC12	TC11: Untested TC12: Untested
FR7	Emergency Detecting Proper reporting	TC13, TC14	TC13: Untested TC14: Untested
FR8	Remapping hardware Button press detection	TC15, TC16	TC15: Untested TC16: Untested
FR9	Settings UI Page	TC17, TC18	TC17: Untested TC18: Untested
FR10	Vibrations	TC19, TC20	TC19: Untested TC20: Untested
FR11	Navigation UI	TC21, TC22	TC21: Untested TC22: Untested
NF1	Correct directions		
NF2	Interface accessible without sight		
NF3	Determine best route		

NF4	Setup options for caretaker		
NF5	No connections dropped during route		

[9]. References

9.1. ...

[10]. Appendix I: Process Details

10.1. Phase 1 Roles

10.1.1. Originally had sections of the document split up but ended up collaborating together on the entire document, including writing and editing.

10.1.2. Chris:

10.1.3. Cong:

10.1.4. Taryn:

10.1.5. Anne:

10.1.6. Sean:

10.2. Meetings

10.2.1. Weekly meetings on Discord if group members are not able to meet in-person.

10.2.2. Weekly Tuesday meetings on campus as a group to collaborate and work on the project. This includes our own meeting notes that are put up on Google Drive for our reference.

10.2.3. Regularly communicate through Discord on a daily basis.

10.3. Activities

10.3.1. Collaborative work and brainstorming ideas (i.e. for prototype)

[11]. Index

A

Acceptance testing - A level of software *testing* where a system is tested for acceptability. The purpose of this *test* is to evaluate the system's compliance with the business requirements and assess whether it is acceptable for delivery.

Android - An open-source operating system used for smartphones and tablet computers.

B

C

C# - An object-oriented programming language made by Microsoft.

D

Discord - Freeware VoIP application and digital distribution platform. This was originally used for the video game community. The platform allows text, image, video, and audio communication between users in chat servers.

E

F

Functional Requirements - Defines a function of a system or its component, where the function is described as a specification of behaviour between inputs and outputs.

G

General risk - An activity or event that may compromise the success of a software development project.

Goals - Refers to achieving a desired outcome at a specific end date

GPS - Stands for Global Positioning System. It is a radio navigation system that allows users to determine their exact location in the world.

Gyro sensors - A device that senses the change in rotational angle per unit of time.

H

Hardware - The collection of physical parts of a computer system.

I

Interface - Shared boundary across where two or more separate components of a computer system exchange information.

Internet Operating System - An operating system used for mobile devices manufactured by Apple Inc.

J

K

L

M

Model View Controller (MVC) - A software design pattern commonly used for developing user interfaces which divides the related program logic into three interconnected elements. They include the *model* (data), the *view* (user interface), and the *controller* (processes that handle input).

N

Non-Functional Requirements - A requirement that specifies criteria that can be used to judge the operation of a system rather than specific behaviors

O

Object Detection - A software feature that assists the computer to detect potential objects for different reasons.

P

Problem - A situation that needs to be solved

Prototype - An early sample, model, or an early release of a product built in order to test or lay out a concept or process for the later product. This prototype does not define the finished product (i.e. Interface wise, functionality, ect).

Q

R

Requirements - A feature that is absolutely necessary in a software development project. There are different levels of requirements that may be more important in a project over another.

S

Stakeholders - People or a group of people affected by a software development project

T

Theia - Greek Titan Goddess of sight (Thea) and shining ether of the bright, blue sky.

Traceability - Ability to relate the various types of software artefacts created during the development of software systems.

U

Unified Modeling Language (UML) - Diagrams that visually representing a system along with its main actors, roles, actions, artifacts or classes, in order to better understand, alter, maintain, or document information about the system.

User Friendly - A machine or a system that is easy to use and understand.

User Interface - is the point of human-computer interaction and communication in a device. This includes displays on screens, appearance on a monitor, keyboard, mouse, ect.

User Manual - Lays out the steps and actions required to use the app.

V

Visually Impaired - Known as vision impairment or vision loss. It is the decreased ability to see to a degree such that it causes problems that cannot be fixed through usual means such as glasses and contacts.

Voice Recognition - The ability of a machine or program to receive and interpret dictation or to understand and carry out spoken commands.

W

Waterfall Model - A breakdown of project activities into linear sequential phases, where each phase depends on the deliverables of the previous one and corresponds to a specialisation of tasks.

WRS - Resource File including the problem, functional requirements, and non-functional requirements.

X

Xamarin - An extension of C# that allows for the development of cross-platform mobile applications

Y

Z