



Figure 1: Safety Beacon Logo

REQUIREMENTS DOCUMENT

SAFETY BEACON - CMPT 275

Group 7

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Website

github.com/nathantannar4/Safety-Beacon

Table of Contents

| | |
|---|-----------|
| 2. Revision History | 4 |
| 3. Introduction..... | 5 |
| 4. Intended Audience | 5 |
| 4.1 Alzheimer’s Patient | 5 |
| 4.2 Family Member or Healthcare Professional (Caretaker)..... | 5 |
| 5. Features and Functional Requirements..... | 6 |
| 5.1 Sign Up/Log In Process | 6 |
| 5.1.1 Initial Setup | 6 |
| 5.2 User Profiles | 7 |
| 5.2.1 Caretaker Menu | 7 |
| 5.2.2 Patient Menu..... | 7 |
| 5.3 Caretaker Menu Features..... | 8 |
| 5.3.1 Safe Zones | 8 |
| 5.3.1.1 - Safe Zone View | 8 |
| 5.3.1.2 - Safe Zone Entry/ Exit Detection and Alerts | 8 |
| 5.3.1.3 - Adding Safe Zones | 8 |
| 5.3.1.4 - Remove/ Edit Safe Zones | 8 |
| 5.3.1.5 - View Alert History | 8 |
| 5.3.2 Core Location Tracking (Bookmarks and Location)..... | 9 |
| 5.3.2.1 - Location View | 9 |
| 5.3.2.2 - Refresh Patient’s Current Location | 9 |
| 5.3.2.3 - Add/Delete/Edit Bookmark | 9 |
| 5.3.2.4 - Adding a Bookmark..... | 9 |
| 5.3.2.5 - Remove/ Edit Bookmarks..... | 9 |
| 5.3.3 Analytics (Reports and History) | 10 |
| 5.3.3.1 - Location History | 10 |
| 5.3.3.2 - Report View..... | 10 |
| 5.4 Patient Menu Features..... | 11 |
| 5.4.1 Bookmarks View..... | 11 |
| 5.4.2 Augmented Reality Mode | 11 |
| 5.4.2.1 - Augmented Reality Home Finder Mode | 11 |
| 5.4.2.2 - Augmented Reality Navigation Mode | 11 |
| 5.4.3 Take Me Home..... | 11 |
| 5.4.4 Current Location..... | 12 |
| 5.5 Settings | 12 |
| 5.6 Error Reporting..... | 12 |
| 6 Non-Functional Requirements..... | 13 |
| 7 Example Tutorials..... | 14 |
| 7.1 Scenario 1: Account Registration | 14 |
| 7.2 Scenario 2: Patient’s Navigation | 16 |
| 7.3 Scenario 4: Caretaker’s Report View and History | 18 |
| 7.4 Scenario 5: Patient’s Safe Zone Setup | 19 |
| 8 Glossary | 20 |
| 8.1 General | 20 |
| 8.2 Technical | 20 |

| | |
|-----------------------------|----|
| 8.3 Screen Names | 21 |
| 8.4 View/Button Names | 21 |
| 9. References | 22 |

2. Revision History

| Version | Status | Publish/Revision Date | Authors |
|---------|---------|-----------------------|--|
| 1.0 | Created | October 16, 2017 | Nathan Tannar Jason Tsang Philip Leblanc Josh Shercliffe Youjung Kim |

3. Introduction

Alzheimer's is a disease that affects not only the patient but everyone close to them. One day you may find yourself worried that a family member will forget where they live or get lost when they wander off. It is statistically shown that 6 out of 10 patients that wander off will get lost! [1]

While you may not always be by their side, with Safety Beacon you can rest easy knowing you have a direct link to their current and previous whereabouts. [2] There are benefits for the patient too. By using augmented reality (AR), Safety Beacon makes walking navigation more intuitive by overlaying instructions directly on your surroundings through the display. No more confusion trying to translate your cardinal direction onto a two-dimensional map. Additionally, with a dual user interface, setup and management of the application can be handed to the caretaker, allowing for a frustration free experience for the patient. Safety Beacon gives travel independence to Alzheimer's patients whilst aiding in worst case scenarios, helping alleviate the worry of them getting lost.

4. Intended Audience

4.1 Alzheimer's Patient

One of the main audiences for this application (app) are individuals suffering from Alzheimer's, hereby referred to as the patient. The patient would need to have an iPhone device carried on person wherever they go. For patients with severe Alzheimer's, or are not in the habit of carrying their phone, this app would not be effective in the likelihood that they leave without their phone. A possible solution beyond the scope of this course would be to introduce hardware that works in conjunction with the app, such as using an Apple Watch, which could be worn regularly. Hence, this app will be designed for individuals diagnosed with Alzheimer's accustomed to always carrying their phone with them. In addition to helping patients navigate through an augmented reality feature, their location will be connected with another individual (their *caretaker*) at all times.

4.2 Family Member or Healthcare Professional (Caretaker)

The other main audience is the individual who is tracking the location of patient, hereby referred to as the caretaker. The caretaker is likely to be a family member of the patient or a healthcare professional. Using geofencing, the caretaker will be notified whenever the patient leaves a designated area. In addition to being up to date with their location, they will also perform the application setup for the patient, such as adding or editing location bookmarks.

5. Features and Functional Requirements

5.1 Sign Up/Log In Process

A user is shown two log in/ sign up options: using Facebook or email. If the user selects the Facebook option, they will be presented with Facebook's login Application Protocol Interface (API). If the user selects the email option, they will be presented with the Email Input Screen. The Email Input Screen will ask for the user's email as well as a password for the account. In both instances, if the Facebook or email entered is not associated with an account, they will be prompted to confirm sign up of an account using the login information they just entered.

5.1.1 Initial Setup

After logging in for the first time, the user will select the type of account (patient or caretaker).

- If it is a patient account, a unique 8-character ID will appear. This page will remain until a caretaker enters this ID
- If it is a caretaker account, an input box requesting for the patient's unique ID will appear. This page will remain until the caretaker enters a patient's ID

Once the caretaker enters the patient's ID, both accounts become active and they will be sent to their respective Main Menus.

5.2 User Profiles

The User Profile is different based on the type of user. If a caretaker is logged in they will be presented with the Caretaker Menu. If the patient is logged in they will be presented with the Patient Menu.

5.2.1 Caretaker Menu

On the main page, the Caretaker Menu consists of a tab bar in which they can choose from several different views:

- Safe Zone
- Bookmarks
- Reports
History
- Settings

5.2.2 Patient Menu

The Patient Menu consists of a Map View on the main page. On this Map View, there will be the following buttons on top of the Map. The buttons are large to make them noticeable but not too large to obstruct the Map View:

- Bookmarks
- Augmented Reality Mode
- Take Me Home
- Current Location
- Settings

5.3 Caretaker Menu Features

Consists of features accessible from the Caretaker Menu.

5.3.1 Safe Zones

Safe Zones are only available through the Caretaker Menu, and is used to notify the caretaker when a patient has left or entered preset safe zone.

5.3.1.1 - Safe Zone View

A view displaying all current safe zones setup for a patient, through a list and map view. The list view will show all safe zones arranged in alphabetical order, with the map view displaying these safe zones on a map.

5.3.1.2 - Safe Zone Entry/ Exit Detection and Alerts

Upon a patient entering or leaving a safe zone, the caretaker will be sent an alert. In order to prevent false positives created by GPS inaccuracy, due to poor reception, the patient must be detected a minimum of 50 meters outside the safe zone. The alert will appear on the caretaker's iPhone via a push notification for the app.

5.3.1.3 - Adding Safe Zones

Safe Zones are added to the map and list through the "New Safe Zone" button. The caretaker will be prompted to enter an address and a radius (in meters), which will define the center point and area of the safe zone. The caretaker may also find the location they wish to enter through the interactive map. Pressing and hold for 2 seconds on a point on the map will automatically fill the address portion of the prompt. A radius can then be entered afterwards. In addition, each individual safe zone will have a reference name.

5.3.1.4 - Remove/ Edit Safe Zones

The caretaker will be able to select previously set safe zones through a list, or point on the map view. They will then be prompted to choose whether they wish to edit or delete the selected safe zone. Selecting delete will remove the safe zone entirely, while selecting edit will prompt the same view as "Add Safe Zone Button", but with the details filled to be edited.

5.3.1.5 - View Alert History

The caretaker will be able to view all previous alerts from a patient, through the View Alert History button on the Safe Zone View. This alert history page will allow the caretaker to see a daily, weekly, and monthly list of alerts in order of highest occurrence.

5.3.2 Core Location Tracking (Bookmarks and Location)

The application will check and update the patient's location on the server in 5 minute intervals. If the patient has moved more than 25 meters from their last location or their location has not changed within 60 minutes, their location will be updated on the server. This is to ensure the server has the latest location of the patient within the last hour.

5.3.2.1 - Location View

The location view will display a marker on the map indicating the patient's current location. Additionally, separate markers will display bookmarked locations set for the patient on the map. A button can be tapped to refresh the current location of the patient.

5.3.2.2 - Refresh Patient's Current Location

The caretaker will have an option to refresh the current location of the patient. This will force the patient's device to update its location onto the server. This will then update the patient's location on the caretaker's map. The map will be centered around the patient's current location indicated with a blue dot marker.

5.3.2.3 - Add/Delete/Edit Bookmark

The Bookmarked Locations View will show a list of bookmarked locations for the patient to access. A button can be tapped to present the option of adding a new bookmark. Existing bookmarks can be swiped to present edit and delete options.

5.3.2.4 - Adding a Bookmark

A prompt will ask to input the name and the address of the bookmark. If the user attempts to add a bookmarked location with a non-existing address, they shall be unable to add the bookmark. The caretaker may also find the location they wish to enter through the interactive map. Pressing and hold for 2 seconds on a point on the map will automatically fill the address portion of the prompt.

5.3.2.5 - Remove/ Edit Bookmarks

The caretaker shall have an option to edit the address or name of an existing bookmark. Selecting the edit option, the caretaker will be displayed the same view as "Adding a Bookmark", but with the content already populated. There will be an option at the bottom to delete the bookmark entirely.

5.3.3 Analytics (Reports and History)

Using the location history collected from the patient, trends can be found to help the caretaker understand the movements of the patient. For instance, the caretaker will be able to see frequently visited locations, and deduce if the patient is repeatedly going to the same location because they forgot they already went. Furthermore, the caretaker can check if the patient has not left home for several days, which could be a sign that there is a problem that they should attend to.

5.3.3.1 - Location History

Location History View will display the location history of the patient starting with the most recent, overlaid on a map. Locations will be marked with a red tag and have a timestamp to show when the patient was first there. The caretaker will be able to apply a time filter at the bottom of the screen to filter out unwanted tags, or to see the whereabouts of the patient over a certain time period. The default time period is set to the past 24 hours.

5.3.3.2 - Report View

The Report View displays trends in a list in regard to the patient's location history:

- The total amount of time spent per day at stored bookmarked locations like home, with location to the left and time spent to the right. These bookmarked locations will be displayed from most time spent to the least
- Time spent at locations that are not bookmarked, but have been logged at for more than 3 times
- A pie-chart of the total time spent per stored bookmark location when a stored bookmark is selected from the list
- Swiping on a location on the list will bring it up in the Location History View, with the time filter set to 12 hours before and after the location log

5.4 Patient Menu Features

Consists of features accessible from the Patient Menu.

5.4.1 Bookmarks View

The Bookmarks View will display all bookmarked locations on the map. These locations are set by the Caretaker Menu. In patient's user interface, these locations will show the bookmark name, as well as the full address beneath in a list format. Each bookmark in the list can be clicked, and the Augmented Reality Navigation will begin after a prompt confirming the destination from the patient's current location. There will be a button to cancel the navigation if wished afterwards.

5.4.2 Augmented Reality Mode

The Augmented Reality View shall consist of two separate modes. The mode will be dependent on whether the patient is currently walking while navigating or not. When navigating, they are presented with the Augmented Reality Navigation Mode, else they are presented with the Augmented Reality Home Finder Mode if toggled manually from the default two-dimensional map screen.

5.4.2.1 - Augmented Reality Home Finder Mode

A mode for the Augmented Reality View that only places a single AR sprite over the patient's home if they are within 100 meters, or in the air hovering in the direction of the patient's home if they are more than 100 meters away. It will also display the basic cardinal directions (north, west, south, east), changing with the direction the patient is pointing the device.

5.4.2.2 - Augmented Reality Navigation Mode

A mode for the Augmented Reality that places an AR sprite at the coordinate point of the next walking navigation instruction. The AR sprite will have text describing the next navigation instruction (i.e. turn left). The current navigation instruction will also be placed in a label in the view. When the final destination is approaching, the AR sprite will have text describing it as the final destination.

5.4.3 Take Me Home

Within the patient's main user interface screen, there will be a Take Me Home Button which will instantly start AR navigation instructions to the bookmark named "Home". There will be a button to cancel the navigation if wished afterwards.

5.4.4 Current Location

Within the patient's main user interface screen, there will be a current location button. When pressed, it will update their current position and center it on the map with a blue dot. This will also update the location of the patient stored on the server.

5.5 Settings

The Settings of both the Caretaker and Patient Menu will allow for the user to logout, and contain a "Feedback" button to contact the developers. Any additional features, or settings for current features, will also be displayed here to be changed. The version number of the application will also be shown here.

5.6 Error Reporting

If for whatever reason the application encounters an error causing a crash, an error report will be generated and sent to the developers using Google's error reporting framework Fabric. The error report will consist of the fatal error message that the iOS system logs in addition to the line of code in a particular file that caused the crash. The caretaker will also have the option to send an email to the developers through the "Feedback" button under the settings.

6 Non-Functional Requirements

| Property | Measure |
|---------------------|--|
| Hardware | The app will only be compatible with iPhones 6s and 6s Plus or newer |
| Software | The app will only be compatible with iPhones running iOS 11 or above |
| Usage Requirements | <ul style="list-style-type: none"> ▪ The app will require a connection to Wi-Fi or a cellular data connection to operate ▪ The app requires the patient to have their iPhone with them at all times for accurate measurement ▪ The app requires 2 users, a caretaker and patient |
| Usage Permissions | <p>The app will require the user to grant access to:</p> <ul style="list-style-type: none"> ▪ Current location of the device while using the app, and in the background ▪ Camera <p>The app will require the user to allow:</p> <ul style="list-style-type: none"> ▪ Receiving push notifications to the device ▪ Background app refresh |
| Performance | The app should not suffer any performance issues when rendering AR sprites, or saving the location to the server, by utilizing multi-threaded dispatch queues provided in iOS |
| GPS System | The GPS system should provide accurate location information. Any temporary irregularities should be filtered |
| Battery Performance | While running in the background, the user's iPhone should be able to sustain at least of 8 hours of battery life |
| Ethics | Patient's location and location history are sensitive information and should therefore not be accessible to anyone other than the caretaker |
| User Interface | <ul style="list-style-type: none"> ▪ The app should have large text, icons and vibrant colors to make things easily legible and accessible ▪ The app should be simplistic and intuitive enough to allow for a minimal learning curve |
| Hosting Server | <p>The server will be hosted on Google Cloud Platform and will</p> <ul style="list-style-type: none"> ▪ Only allow connections over HTTPS ▪ Route connections to the API through NGINX ▪ Encrypted the user's password using a SHA512 algorithm |
| Security | <ul style="list-style-type: none"> ▪ Hosting Server is managed by Google Cloud Platform ▪ A caretaker is only given access to a patient after they have entered the unique code of the patient ▪ Only the caretaker has access to the patient's location |

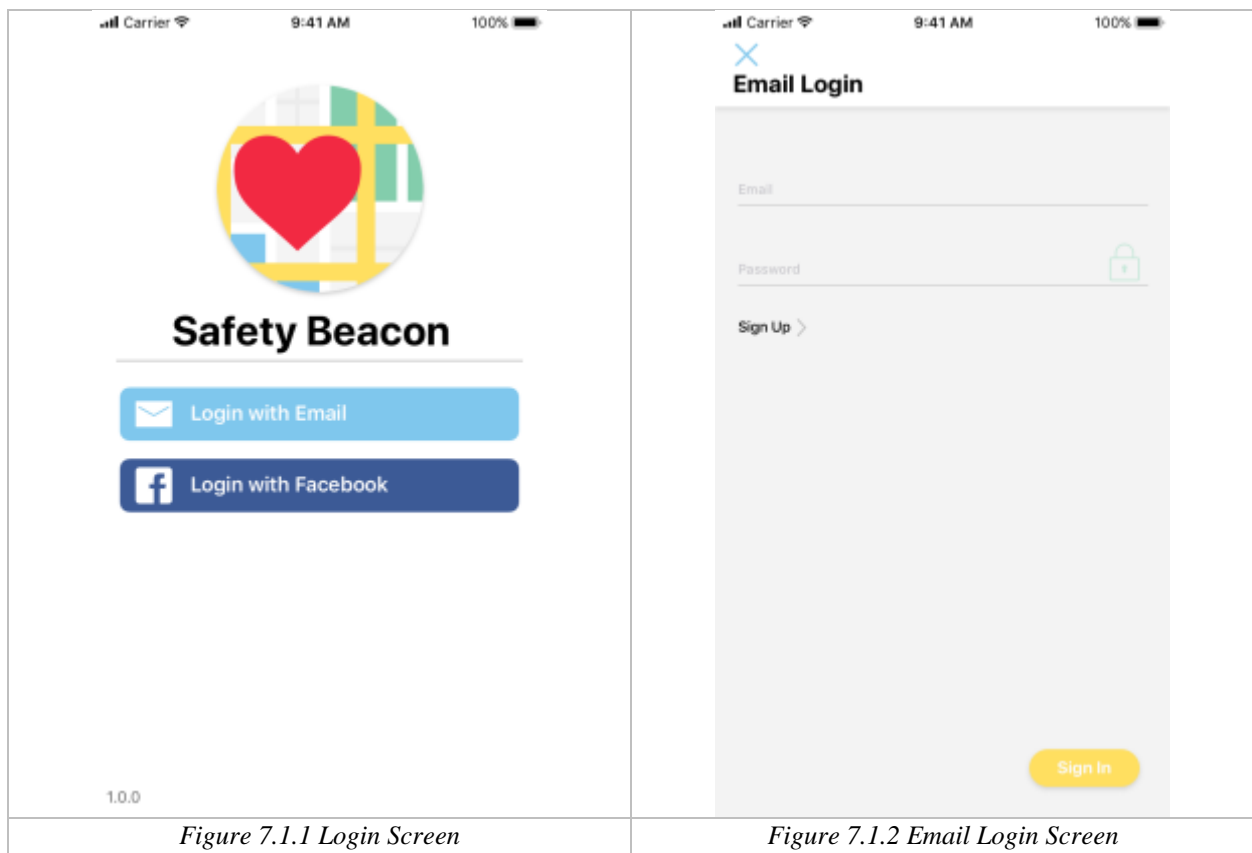
7 Example Tutorials

7.1 Scenario 1: Account Registration

A caretaker and patient want to sign up for accounts and link themselves together.

On launching the app, the caretaker or patient logs in/ signs up with Facebook or with their email and password. They will be detected as accounts that do not exist and asked if they would like to create these new accounts

1. Once both phones are logged in, both will be displaying a selection screen which determines the type of account, either Caretaker or Patient
2. On the patient's iPhone, select Patient and you will be shown their unique ID
3. On the caretaker's iPhone, select Caretaker and enter the patient's unique ID
4. That's it! The accounts are now linked, and the patient and caretaker menus will be shown respectively



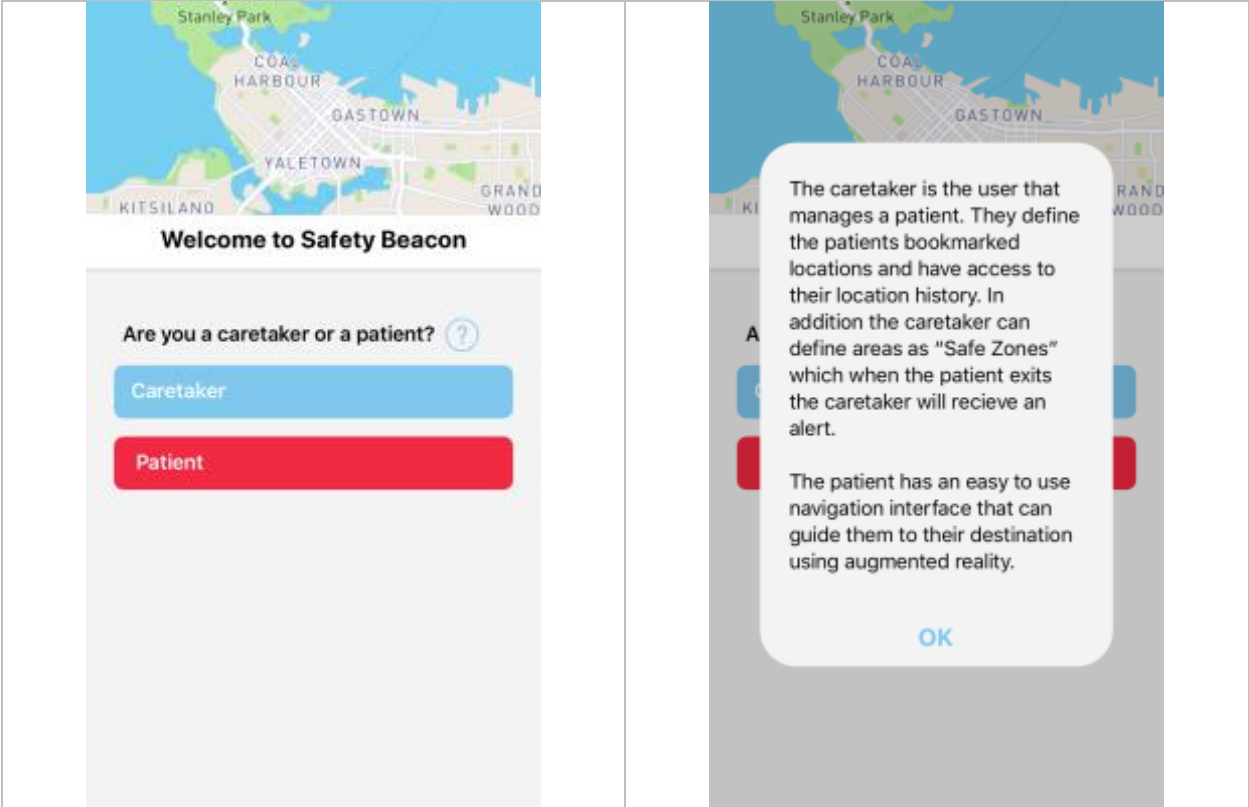


Figure 7.1.3 Caretaker or Patient Selection

Figure 7.1.3 Help Prompt

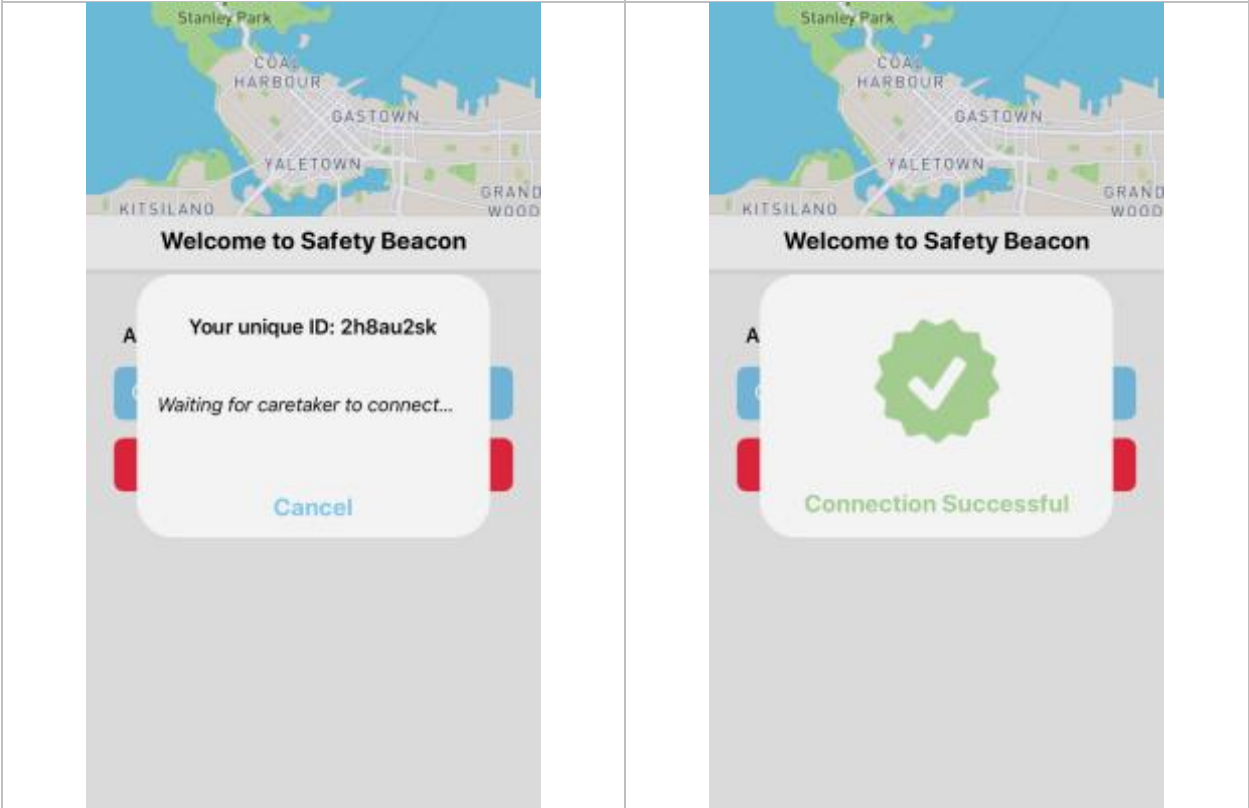


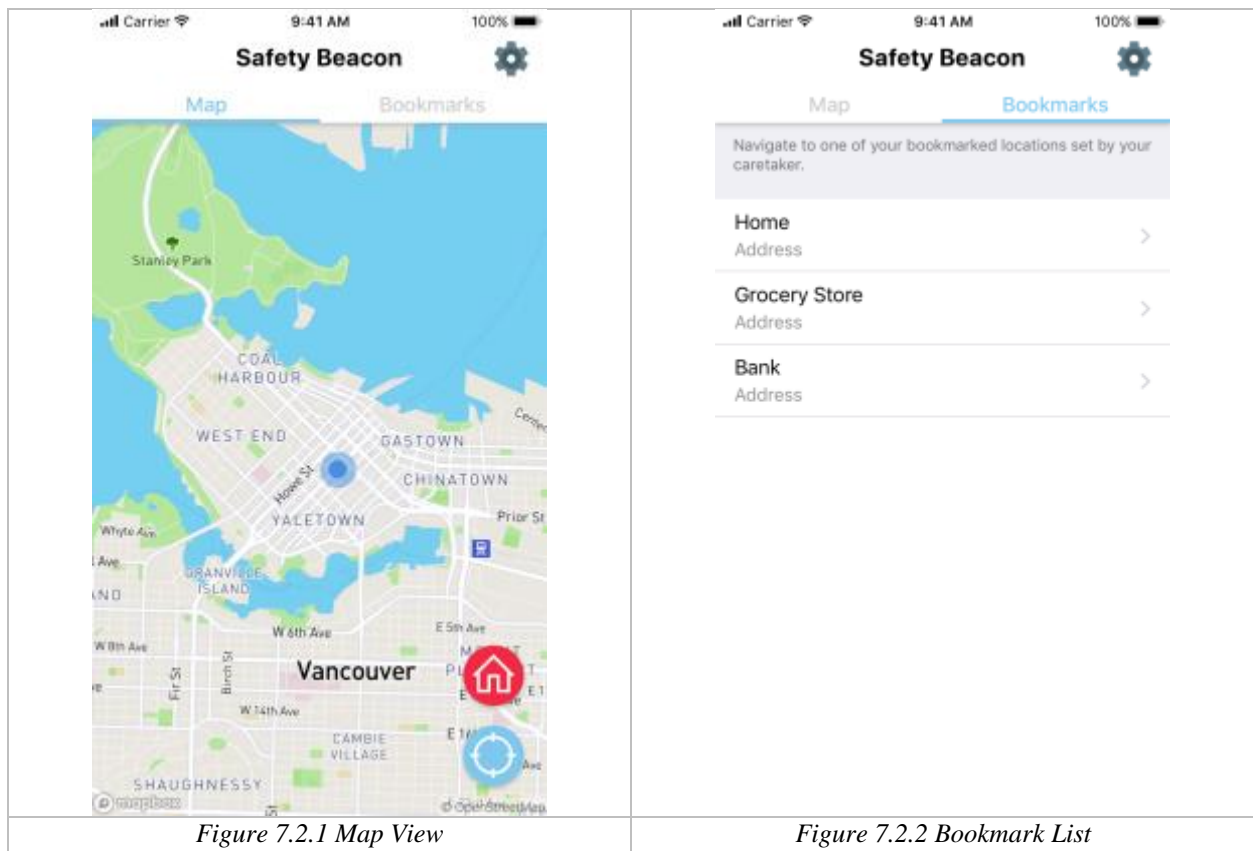
Figure 7.1.4 Patient Generated ID


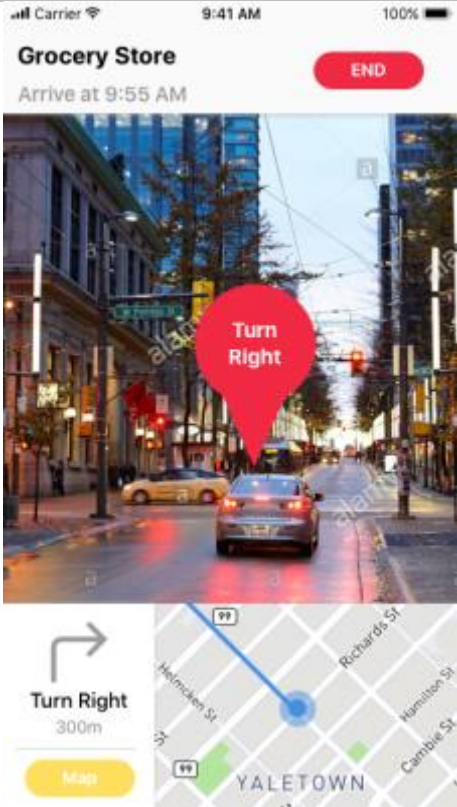
Figure 7.1.5 Successful Connect

7.2 Scenario 2: Patient's Navigation

Both a patient and a caretaker's accounts are linked and the caretaker has bookmarked a location for the patient. The patient now wants to navigate to the bookmarked location. For this scenario, that location is the grocery store.

1. On the Patient Menu, the patient selects the Bookmarks Button
2. They select the grocery store from the list
3. The patient is presented with the Navigation View which will ask to confirm their selection
4. Once confirmed they are brought into the Augmented Reality Navigation View and walking navigation instructions begin

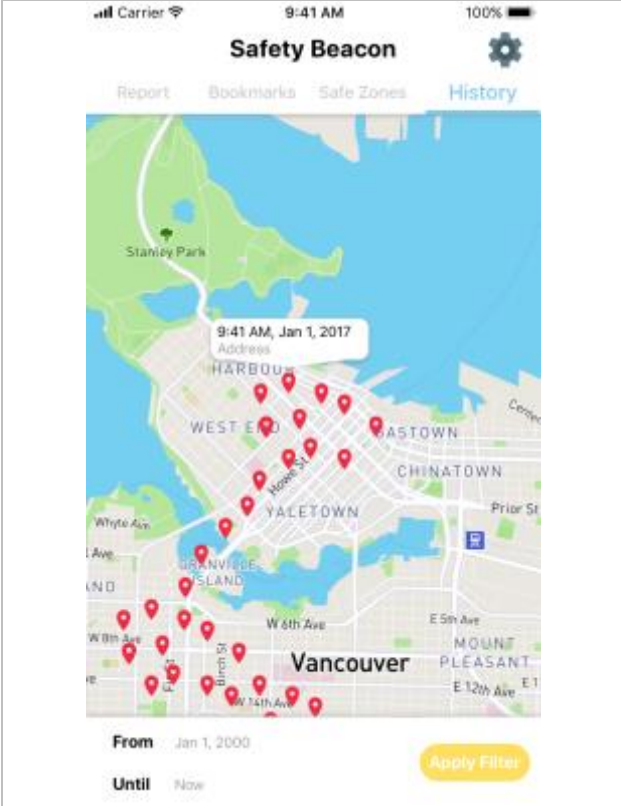
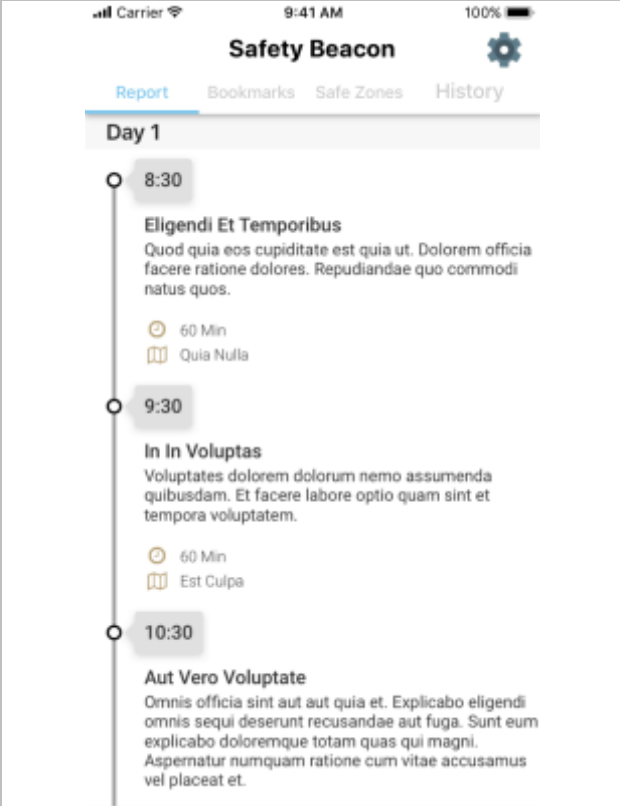


| | |
|--|---|
|  <p>Carrier 9:41 AM 100%</p> <p>Grocery Store 500m, 14 min</p> <p>Cancel</p> <p>Start Navigation</p> |  <p>Carrier 9:41 AM 100%</p> <p>Grocery Store Arrive at 9:55 AM</p> <p>END</p> <p>Turn Right</p> <p>Turn Right 300m</p> <p>Map</p> |
| <p>Figure 7.2.3 Confirmation Prompt</p> | <p>Figure 7.2.4 Login Screen</p> |

7.3 Scenario 4: Caretaker's Report View and History

The caretaker wants to view the patient's location history

1. On the Caretaker Menu, select the History Tab
 - a. Apply the desired filter
2. They decide they want more information about their history so they check the Report tab which shows an analytical summary of their history

| | |
|---|---|
|  <p><i>Figure 7.3.4 History</i></p> |  <p><i>Figure 7.3.4 Report (Not Final)</i></p> |
|---|---|

7.4 Scenario 5: Patient's Safe Zone Setup

The caretaker wishes to setup a safe zone at the patient's home address, to notify them when the patient enters and leaves their house.

1. On the Caretaker Menu, select Safe Zone Menu
2. The caretaker then taps the “Add New Safe Zone Button”
3. Upon loading the “Add New Safe Zone” popup screen, enter in the desired address and radius for the safe zone

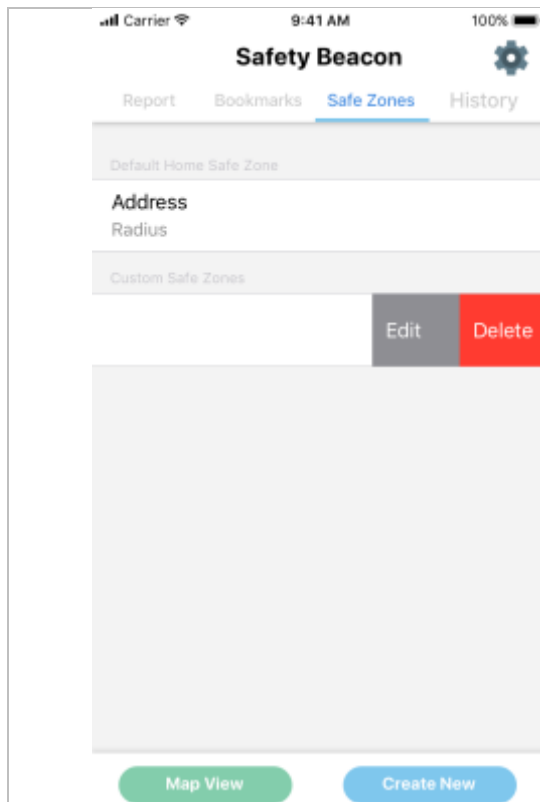


Figure 7.5.1 Safe Zone Menu with Item Swiped

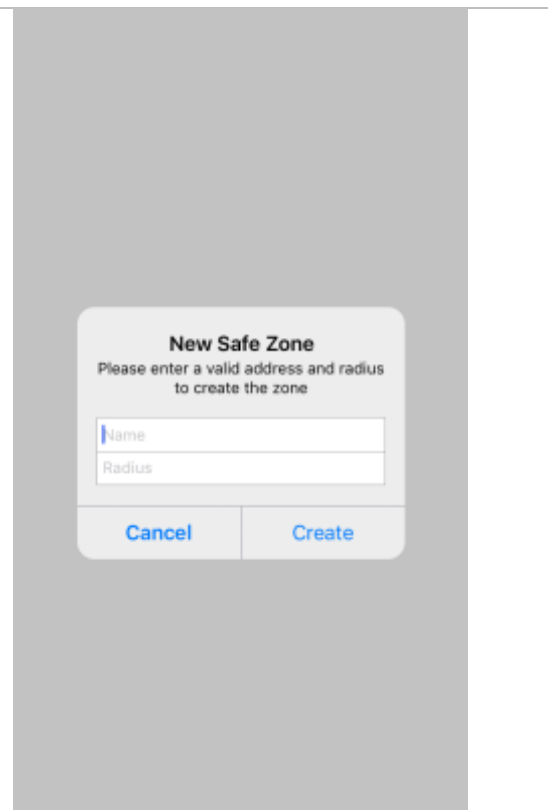


Figure 7.5.2 Adding New Safe Zone

8 Glossary

8.1 General

| Term | Definition |
|---------------------|--|
| Admin Access | The ability to view a user's current and previous locations, edit bookmarked locations, edit safe zones and view a daily report |
| Patient | The user with Alzheimer's |
| Caretaker | The user with admin access over the Alzheimer's patient |
| User | Both the caretaker or the patient using the application |
| Safe Zone | A location on the map defined as a coordinate with a radius defined by the Caretaker. Alerts are given to the Caretaker when the Patient enters or leaves these zones. |
| Augmented Reality | A technology that superimposes a computer-generated image on a user's view of the real world, thus providing a composite view. |
| Bookmarked Location | A location saved to the database that consists of a name and address. |
| Tableview | A view displaying indexed list of items |
| Maximum Frequency | The rate at which a Patient's location check occurs |
| Server | A Ubuntu 14.04 virtual machine instance running on Google Cloud Platform with NGINX, Parse Server and MongoDB running on it. |

8.2 Technical

| Term | Definition |
|--------------|---|
| AR Sprite | A computer-generated image on a user's view of the real world |
| Unique ID | An 8-character string of uppercase/lowercase letters and numbers given to each user |
| Geofencing | Use of GPS to create a virtual geographic boundary, enabling software to trigger a response when a mobile device enters or leaves a particular area |
| Error Report | A report generated by Crashlytics that describes why the app crashed and which line of code caused the crash |

8.3 Screen Names

| Term | Definition |
|---------------------------|---|
| Login Screen | A view consisting of the applications logo, name and version info |
| Email Input Screen | A view consisting of two text inputs, one for their email and another for their password, and a button that can either log the user in or sign them up. |
| Safe Zone View | A combined list and map view of the currently set safe zones. The top 75% of the view will be dedicated to the map view displaying safe zones, and the bottom 25% will be dedicated to an alphabetical list of safe zones. |
| Bookmarked Locations View | A list view of the bookmarks locations that the patient will have easy access to navigate to. Only a Caretaker can edit the list. |
| Location History View | A view consisting of a map with markers on all of the patients previous locations. A filter can be applied to narrow the search to specific days/times |
| Map View | A view consisting of the patient's current location |
| Report View | A view consisting of the patient's daily report up to the current time |
| Settings View | A view consisting of the user's account information and the account that they are linked to (either a patient or caretaker), application licenses, and credits |
| Augmented Reality View | A view consisting of a slightly transparent Map View overlaid on the current video being captured by the phone's camera. There are various AR sprites placed in the video depending on current walking navigation instructions. |
| Navigation View | A view consisting of turn-by-turn walking navigation instructions while also displaying the user's current location |

8.4 View/Button Names

| Term | Definition |
|-------------------------------|--|
| Bookmarks Button | A button that presents the Bookmarked Locations View |
| Go Home Button | A button that initiates walking navigation instructions to take the patient home |
| Settings Button | A button that presents the Settings View |
| Augmented Reality Mode Button | A button that switches the Map View to the Augmented Reality View |
| Map View Button | A button that switches the Augmented Reality View to the Map View |

9. References

- [1] A. Association, "Alzheimer's Association," 2017. [Online]. Available: <http://www.alz.org/care/alzheimers-dementia-wandering.asp>.
- [2] A. Association, "Alzheimer's Association," 2009. [Online]. Available: http://www.alz.org/alzheimers_disease_10_signs_of_alzheimers.asp.