

GNG 2101
Design Project User and Product Manual

Library Wayfinder Application

Submitted by:

GNG 2101 A04 - Group 17

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List of Acronyms and Glossary

Table 1. Acronyms

Acronym	Definition
TTS	Text to Speech

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1 Introduction

Learning how to navigate your way through an unfamiliar space can be a difficult thing to do. For example, a first-year student trying to find their way in a massive university library for the first time. This can be an even more daunting task when you consider the various accessibility needs, such as visual impairment, that must be accounted for. The goal of our Wayfinder application is to use Bluetooth navigation beacons in order to assist these people navigate their way through large indoor spaces, specifically the Morisset Library at the University of Ottawa. There have been previous iterations of this project that have been able to implement the navigation portion of the application, so our main focus was to zero in on the accessibility size of the app, making it so that anybody and everyone is able to access it.

This User and Product Manual (UPM) provides the information necessary for our users to effectively use our Wayfinding application, and documents our various prototypes. The following document is intended to give our users a larger understanding of the purpose and usage of our project. It is organized into several sections, starting with an overview of our project, followed by a Getting Started section, outlining various considerations before using the actual application. It then goes into details regarding the actual use of the application, followed by troubleshooting and support options, documentation of the product, and finally a conclusion, with recommendations for future work.

2 Overview

Many variations of wayfinding navigation in indoor spaces have been implemented in the past to help customers navigate to their desired location. However, most of these products fail to consider users who have disabilities and lack the aspect of accommodating to their needs. According to research conducted by Doctors in the Canadian Journal of Ophthalmology (2018), 5.7% of Canadians adults possess a visual impairment.¹ This meant that they weren't able to have access to the same level of service offered as those who don't have these disabilities. Products that were designed for accessibility were more often than not, more expensive than those same products that are geared towards abled-bodied individuals.

In the context of the University of Ottawa's main library, the Morisset Library, many students who visit the library can agree that the layout and general map of the floors are confusing, mostly if it was the first time they ever visited. Added on to that, students who have a disability might have an even harder time getting around.

This product has the goal of helping people get around the library, whether they have a disability in which they might need some assistance or a new student visiting the Morisset Library by saving time and reducing stress. The Library Wayfinder is an easy-to-use application made for everyone.

Implementing and improving the previous year's project of Library Wayfinder, we used MokoBlue's H2 Location Bluetooth Low Energy (BLE) beacon purchased to decrease the cost of production which will further decrease the price of this product. These beacons transmit an identifier to nearby devices to determine their location and using the wayfinding application, it will guide the user to their planned destination.

This application is to be used on mobile devices and includes many accessibility features that distinguish it from other products, including:

- Screen swiping
- Change of font size
- TTS (text-to-speech)
- English & French available
- Saved preferences

Other features include:

- FAQ page (frequently asked questions)
- Call Desk feature

All at a lower cost than other similar products in the market.

¹ [2018] ALJIED et al., *Prevalence and determinants of visual impairment in Canada: cross-sectional data from the Canadian Longitudinal Study on Aging*, from [https://www.canadianjournalofophthalmology.ca/article/S0008-4182\(17\)31135-3/fulltext#secsect0085](https://www.canadianjournalofophthalmology.ca/article/S0008-4182(17)31135-3/fulltext#secsect0085), on December 5, 2021.

3 Getting started

In its current state, our application currently only supports android devices, and it is not available on any app distribution platforms such as the Google play store. The only way to install the application is by downloading the project from our team's [Github](#), which can be done by pressing the green *Code* menu, then pressing *Download Zip*.

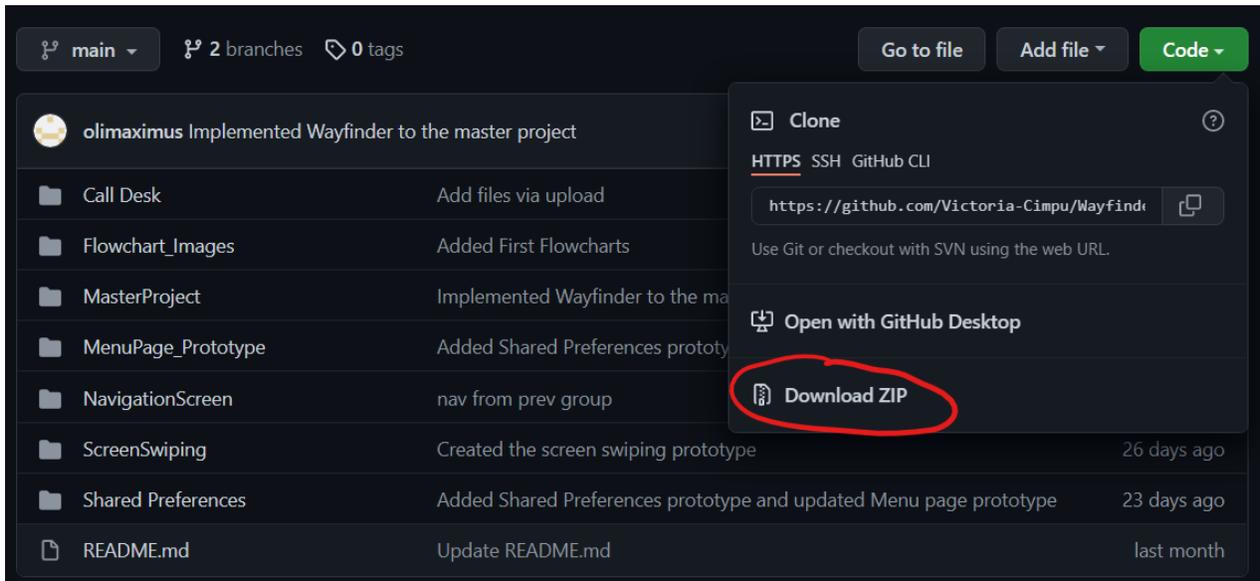


Figure 3.1 How to Download the Project from Github

After downloading the project, you must open the project folder through Android Studio, then connect an Android device to your computer and run the application on the device. As shown in Figure 3.2, the option to select the device can be seen on the left, and it can be installed and run by clicking the green play button

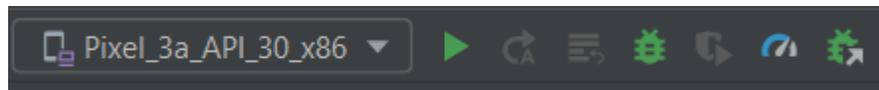


Figure 3.2 How to Run the Application on a Mobile Device through Android Studio

3.1 Set-up Considerations

The required equipment to set up the application includes an Android mobile device that possesses bluetooth capabilities, to connect to our beacons. Another requirement is a computer, which must be used to download the application from Github, and is also used to download the application on the mobile device through Android studio.

3.2 User Access Considerations

Our application has been built to be accessible and accommodate all potential users. To ensure this, our system includes several features, such as TTS, font size adjustment, and screen swiping, to increase the ease of use.

3.3 Accessing the System

To access the system, the user must first download the application, and run it on their android device using the Android Studio application. After it is installed on their device, it can be used like any other application for a mobile device. To be specific, navigate to the application section of your mobile device, and select the library wayfinding application from the options listed.

3.4 System Organization & Navigation

The system is organized into several different pages, which can be accessed through the home menu page which contains buttons that direct to these different pages. The various pages include the Wayfinding page, the Call Desk page, the FAQ page, and the Settings page. To increase accessibility, the pages can be navigated by swiping the screen to change the current page.

3.5 Exiting the System

To exit the system, all only required action is to close the application.

4 Using the System

The following subsections provide detailed, step-by-step instructions on how to use the various functions or features of the Wayfinding Application.

4.1 Menu Screen

When the user first opens the application, they will arrive at the Menu Screen. This page's goal is to redirect the user to the different features of the application, as well as to receive them when they press the back button from any of the other screens. This page contains five buttons: four activity buttons and a "Français/English" button. Tapping on the latter will change the language of the app to the desired language. Tapping any of the first four buttons will open the corresponding screen, which are covered in the next subsections.

It should be noted that the entire application has a screen swiping functionality, for better accessibility. The screens are placed from left to right in the same order as they appear on the buttons and in this section of the document. This means that the leftmost screen is the Menu Screen and the rightmost one is the Settings page. For future reference, a right-to-left swiping motion will be called a right swipe, as it opens the page on the right, and vice versa. For example, swiping right on the Menu Screen will open the Wayfinder page.

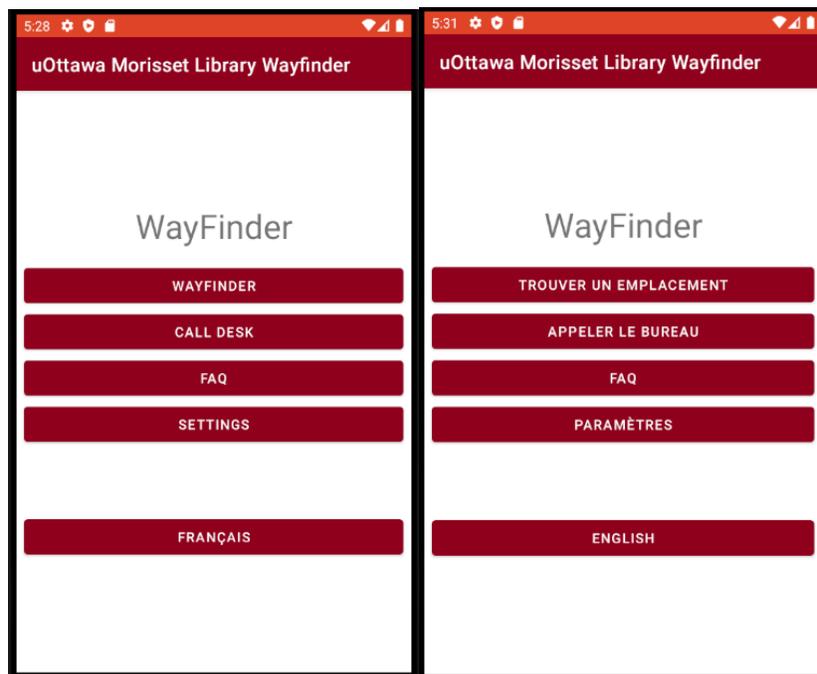


Figure 4.1: Wayfinder Menu Screen

4.2 Wayfinder Page

The Wayfinder page is the most complex of the app. When the user first opens it, they will be prompted to select a destination in the library. They will also receive a notice to activate bluetooth and allow the app to use it. Then the screen will display instructions to get to the destination and update itself when the user moves. At the bottom of the screen are three buttons, the top one will display the instructions from image to text, and vice versa when pressed again. The second one will repeat the TTS instructions for the user. Finally, the last button will end the wayfinding process and bring the user back to the Menu screen.

Swiping left on the Wayfinder page will open the Menu screen, while swiping right will open the Call Desk page.

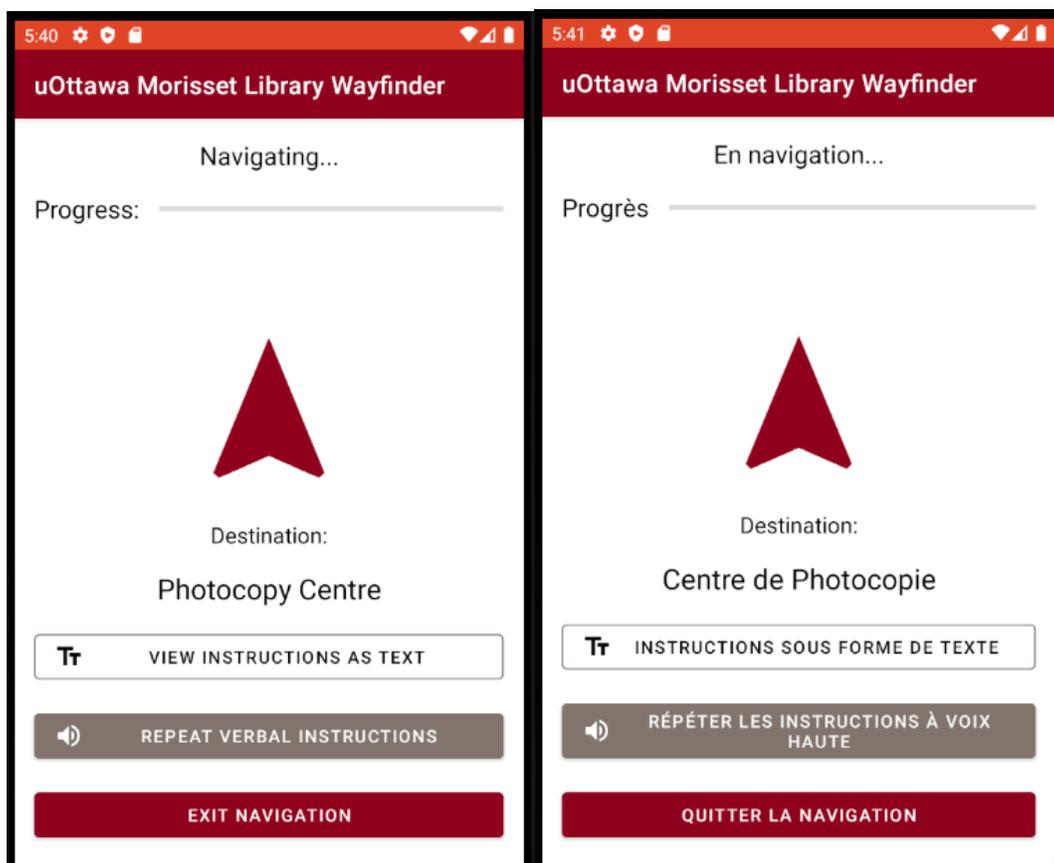


Figure 4.2: Wayfinder Page

4.3 Call Desk Page

The Call Desk page has a fairly simple layout that only contains some text and a button called “Request Assistance”. Pressing this button will open the smartphone’s calling application with the Morisset Library’s phone number pre-dialed. The user can then press the call button to proceed with the call and receive assistance, or the back button twice to go back to the Wayfinder Application.

Swiping left on the Call Desk page will open the Wayfinder page while swiping right will open the FAQ page.

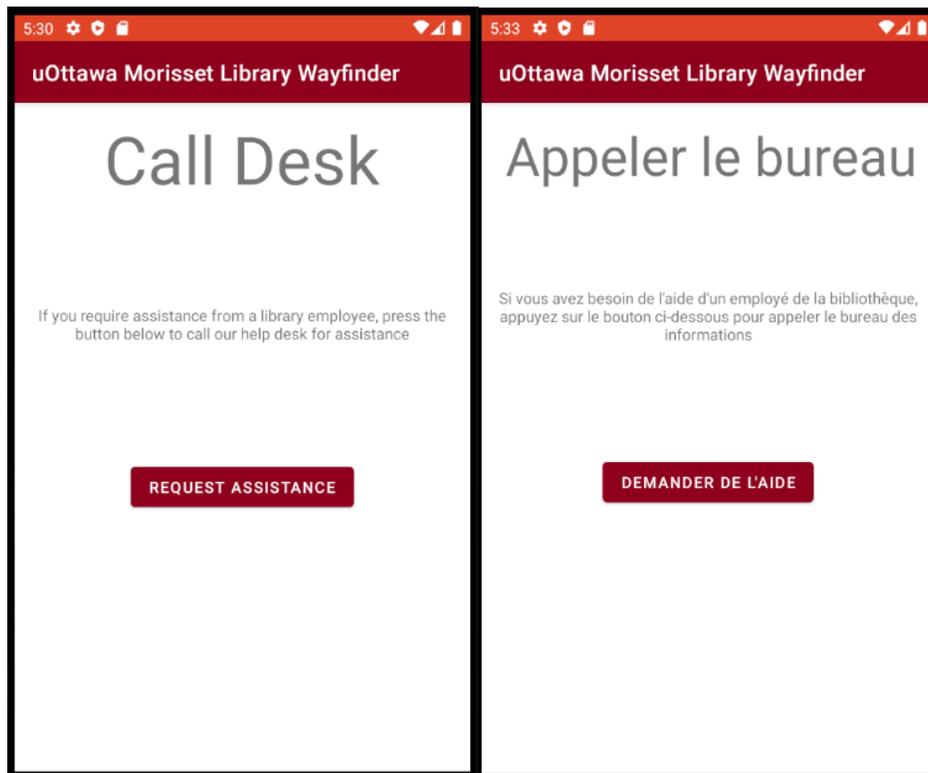


Figure 4.3: Call Desk page

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4.4 FAQ Page

The FAQ (Frequently Asked Questions) page is the simplest to use, as there is no action required from the user. The page contains all the frequently asked questions about the application, and the answers to them. The user only has to read them, or if TTS is activated, listen to them.

Swiping left on the FAQ page will open the Call Desk page, while swiping right will open the Settings page.

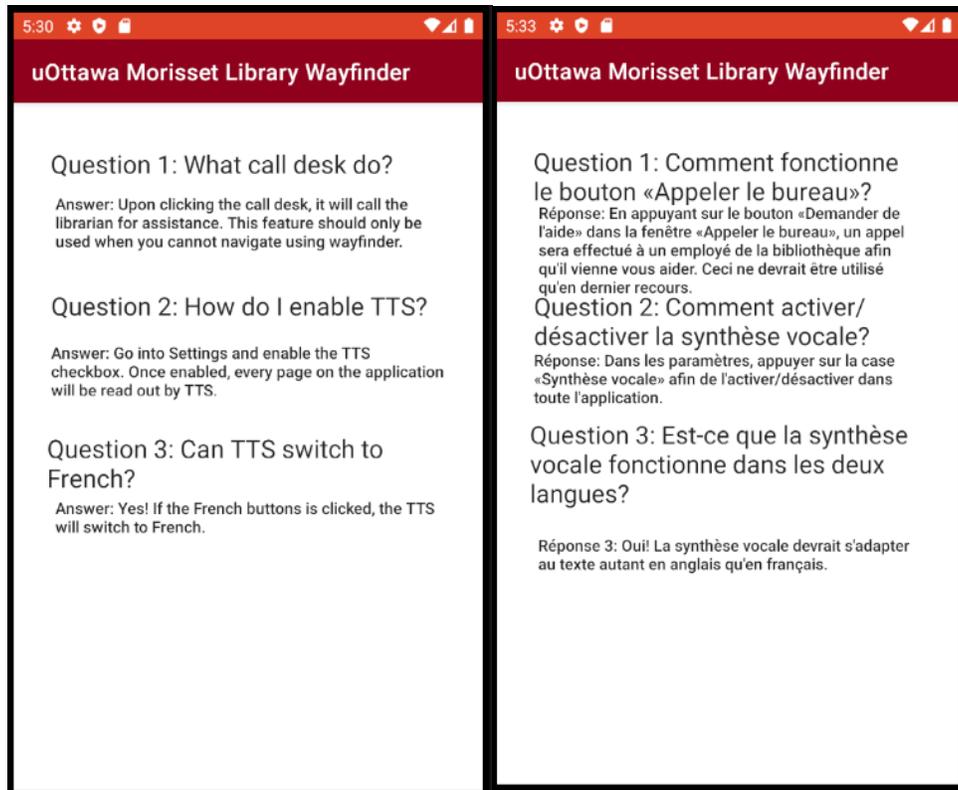


Figure 4.4: FAQ Page

4.5 Settings Page

The Settings page allows the user to change certain accessibility settings of the application. Firstly, there is a checkbox at the top of the screen called TTS. Tapping this checkbox toggles the text-to-speech functionality for the application. Secondly, the user will find the text size section just under the TTS checkbox. This section contains 3 options: Small, Medium and Large, each of them corresponding to a different text font size. Exactly one option can be selected at once. Finally, under the last section is the Save button. Tapping on it will apply the selected settings to the app. If the user doesn't press that button and changes screen, the changes will be forgotten.

Swiping left on the Settings page will open the FAQ page.

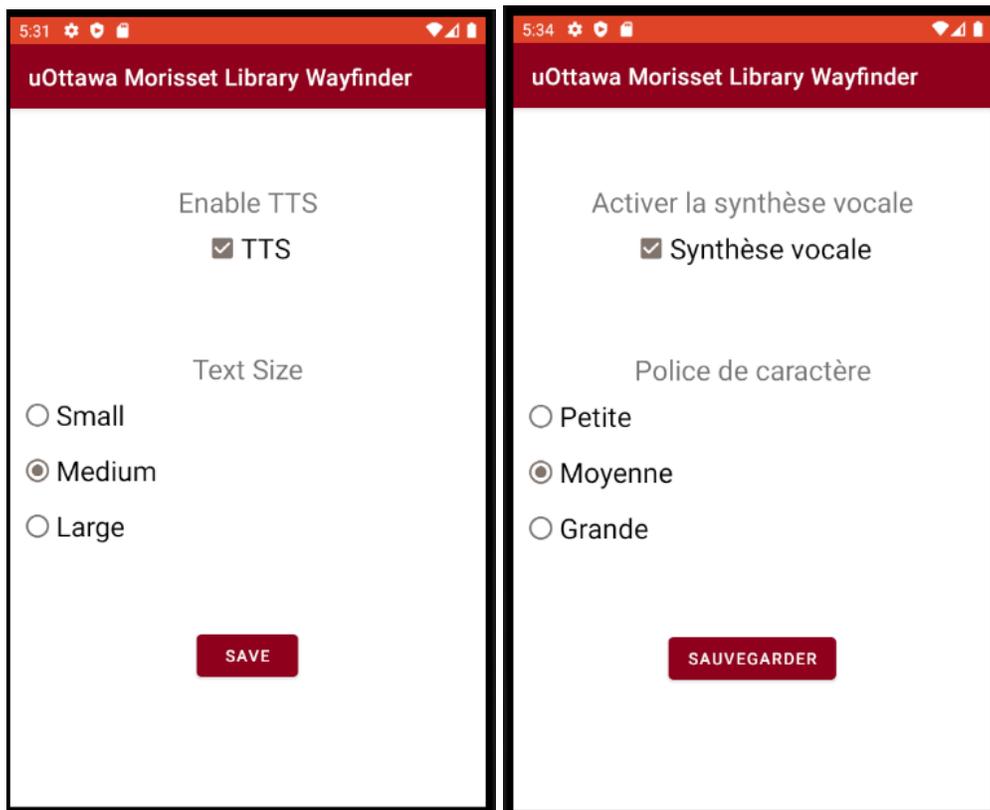


Figure 4.5: Settings Page

5 Troubleshooting & Support

The following section describes error correction procedures that can be taken in case of specific errors. Consistently following the listed procedures should lower the chance of any error occurring on both the users end and systems end.

5.1 Error Messages or Behaviors

5.1.1 ERROR: Beacon Undetected

A user will get the “Beacon Undetected” error if their device is unavailable to detect the beacons, which can happen for a variety of reasons. The first and most common reason is that the device does not have bluetooth enabled. In this case, enabling bluetooth should fix the connection issue between the device and the beacon. The second and lesser common reason is that they are connected and require some sort of maintenance. This could range from replacing the battery, to an internal hardware malfunction, and may require inspection of the beacon. For this reason, regular maintenance operations on the beacons are quite important. The last reason is that the user may not currently be in the range of a beacon, which will only occur if the user is trying to use the app if they are not in the library.

5.2 Special Considerations

If in any case, a section in the library is moved to a different location within the building, the beacons must be arranged again accordingly to provide an accurate navigation service.

5.3 Maintenance

As mentioned, regular maintenance on the beacons is essential for avoiding errors with the prototype. It is important to replace the battery when each beacon is nearing its battery life. Additionally, beacons should have an inspection every month for internal hardware failures. If these procedures are followed, the beacons will most likely not give any errors during usage.

5.4 Support

If additional support is required from the user's end, they can use the help desk feature to call the front desk of the Morriset library. The librarians and support should be able to assist the user with their unique inquiries. You can also reach them at: **(613) 562-5213**. For any additional inquiries, the following email address can be contacted for support from a technician: **bibliolibrary@uOttawa.ca**.

6 Product Documentation

6.1 Software

6.1.1 BOM (Bill of Materials)

The application software was developed using Android Studio. This software is free to download and thus result in no additional costs.

6.1.2 Equipment list

No additional equipment was needed for software development on this project, aside from an Android Mobile Device used for testing the application's wayfinding capabilities in the library. However, all other forms of testing (such as UI or non-wayfinding functionality) can be done using an Android Device emulator.

6.1.3 Instructions

The instructions for how to set-up the software system is covered in detail in the Getting Started section. The software system does not need to be rebuilt for new users, only set-up.

6.1.4 Considerations

The features implemented in the application were carefully selected to increase accessibility and meet the user requirements. Below are a few key decisions that were add regarding the application:

Creating an Android app. This was done due previous iterations of the wayfinding application being done in Android and because of the availability of the relatively easy to use Android Studio. Alternatives, such as making a website, were considered byt to limit our dependence on WiFi and to help seamlessly integrate the work previously done on the project, an Android app was selected. In the future, the app could be adapted to work on other operating systems such as Apple, however the scope of this project was limited to only Android.

Using SharedPreferences to save user's preferences for the setting page. This allows for the data to be saved locally to the user's device and allows for external databases such as Firebase to be avoided. This allows the app to store the data without raising privacy concerns.

Setting page. The setting page currently contains the TTS (Text to Speech) activation / deactivation and the Font Size selection. These were the settings that were picked for accessible customization by the user, however more may be added in the future based on future requirements of the app or user suggestions.

Screenswiping. This allows the user to easily navigate through the different feature pages without the need to visually locate buttons on the mobile device screen.

Bilingual app. Having the application have both English and French was considered an important inclusion. This was done by creating a “mirror” version of the app that had the exact same functionality as the English version but with French text. The French version was then connected to the English via a “Francais” button and vice versa with an “English button”. In the future, a more compact solution where only the text would need to change depending on language could be developed, however this solution works well considering the time constraints.

6.2 Beacons

6.2.1 BOM (Bill of Materials)

The beacons were purchased rather than produced. Thus, there is a lump sum total cost per beacon (plus shipping, expensive due to international shipping costs).

Item number	Part Name	Description	Quantity	Unit Cost	Shipping	Extended Cost
1	H2 Navigation Beacon	Wayfinding Bluetooth beacon	4	\$ 9.97	\$ 49.84	\$ 89.72
Total						\$ 89.72

Due to budgeting constraints only 4 beacons were purchased. However, to cover the entire first floor of the Morresit library, more would be needed. The cost of these beacons is relatively low compared to previous year’s projects and since shipping, while high, is a fixed cost, a bulk order of beacons would lower the overall cost per beacon.

6.2.2 Equipment list

Since the beacons were purchased as a completed product there was no additional equipment required.

6.2.3 Instructions

Since the beacons were purchased as a completed product, they only need to be ordered from the manufacturer. More information about the beacons can be found at: [H2 Indoor Navigation Beacon Waterproof Eddystone iBeacon \(mocosmart.com\)](http://mocosmart.com).

6.2.4 Considerations

The beacons were selected for their relatively low price compared to the alternatives, long battery life and large range.

6.3 Testing & Validation

The app was tested extensively in an emulator. All the different app features were checked for correct functionality. The app was tested on different versions of Android Devices using an “Android Virtual Device” which emulated mobile devices on a computer. This allowed for the verification of correct formatting and UI on different screen sizes and configurations.

For the beacons, minimal individual testing was done since they were purchased as a completed product. However, they were brought to the library and tested for installment location and usage in conjunction with the mobile app.

7 Conclusions and Recommendations for Future Work

Throughout the course of this semester our group has learned a lot about the engineering design process, particularly how a product is developed. We learned how to meet and empathize with a client, getting to know their needs that we then translated into a problem statement. We learned how to create metrics, ran benchmarks, and created target specifications, all of which we used to create a prototype, that we then built upon and improved with future prototypes before reaching our final product.

Throughout this process we all gained a lot of experience in teamwork and communication, learning of the benefits of sharing our progress with each other in order to resolve any conflicts as they appeared. For potential future work on this project, you may look to make an application that works not only on android devices but also IOS devices.

8 Bibliography

[2018] ALJIED et al., *Prevalence and determinants of visual impairment in Canada: cross-sectional data from the Canadian Longitudinal Study on Aging*, from [https://www.canadianjournalofophthalmology.ca/article/S0008-4182\(17\)31135-3/fulltext#secsect0085](https://www.canadianjournalofophthalmology.ca/article/S0008-4182(17)31135-3/fulltext#secsect0085), on December 5, 2021.