

GNG 2101 B

Project Deliverable J

Library Wayfinding

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Group B24

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December 3rd, 2020

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Abstract

The library at the University of Ottawa is a large facility, and people sometimes find it difficult to find their way inside. This is especially the case for people with visibility issues or the ones entering the library for the first time. This project helps solve this problem by creating an accessible wayfinding program that connects all the important areas of the library.

All of our work during the past three months is explained in this report. Before starting anything, we had to come up with a project plan to organize ourselves in order to complete all of our project tasks on time. Then, the first step of our work was the client meeting; where we empathized with our customers and turned their statements into customer needs. Those were turned into design criteria. Metrics were later established to lay out the measurable and non measurable attributes of our final product. With the help of benchmarking we were able to come up with target specifications; which set marginal criteria that our prototype must meet. This process is what allowed each member of the group to come up with conceptual designs. After this, the best concept or idea was chosen as the template of our first prototype.

Before moving forward, we had to study the risks and constraints that might slow us down. Every project is faced with these, but do our best to prevent failure and to make sure we respect our constraints while working on our project. We also thought about how well our product would sell if we were to commercialize it.

This prototype was then tested and improved repeatedly for most of the remaining time. After each test, we generated feedback that helped us upgrade our work. Our final product is able to meet all of the customer needs, and might even be better than we first anticipated.

The end consists of a conclusion and recommendations for future work. If anyone decides to take our project on and improve it, they could read this part and reach the full potential of this product's development.

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List of Acronyms

Acronym	Definition
BLE	Bluetooth Low Energy
Proto	Prototype
M/I	Marginal and Ideal

1 Introduction

The point of this project is to create a wayfinding app or website that will be used to aid newcomers in the visitation of the uOttawa library (Morisset branch). We are using low energy bluetooth beacons (BLE) that will be placed around the library and possibly on different floors to help transmit the location of the user to help display their location on their mobile device while using the software that will then proceed to aid them with selected directions given through audio cues. The use of audio cues is primarily to aid people with visual impairment to figure out their way around the library and find what they are looking for such as a book, study room, or service center.

A problem exists when newcomers arrive at the library and get confused on how to find their way around the library and what they are looking for. Our plan is to create a website or app that is accessible through a mobile device, which allows users to be guided to their location of interest instead of using visual signage. This program will proceed to display a path on how to exactly arrive at the desired location without having to ask for help and talk to someone, especially when public health guidelines such as social distancing are in place because of the Covid-19 pandemic. After speaking with the client, we have found that the main priority of the task is the use of BLEs and the activation of audio cues in either English or French so it is more accessible to a broader audience trying to access the uOttawa library. It is also important to include a picture (2D/3D) style path system within the website or app so that if a user does not need to receive audio cues on how to get around, they can simply receive a list of directions. The second priority is to make sure the website or app is able to be constantly updated so that if the library is ever rearranged, it is easy to update the information. This will be particularly useful when the full library is accessible to the student body once Covid-19 public health guidelines subside.

2 Need Identification and Product Specification Process

This section will be going through the problem statement process, benchmarking, metrics as well as the needs and target specifications identification.

2.1 Problem Statement

The uOttawa library (Morisset branch) lacks accessibility for people with visual impairments and/or disabilities. To fix this, we are programming a wayfinding system which utilizes low energy bluetooth beacons to signal visual and audio cues to users while accessing the library, which will aid in bridging the gap for these individuals and make the uOttawa library more accessible to all.

2.2 Need Identification

List	Priority*	Customer Needs	Specifications
1	5	Accessibility of software	Easy to operate and comprehend so anybody can operate
2	5	Audio cues	Both English and French
3	3	App	Available in both the Google store and Apple store
4	2	Website	If unable to create app a website is another pathway for creation and use
5	5	Beacons	Low cost beacons to increase number available for use
6	4	Adaptability	Creating a software that can adapt to different layouts of library and is easy to update
7	3	User friendly	Ensuring that the software is easy to understand and easy to navigate
8	2	Cost effective	The main price of the project is the cost of each individual beacon that must be placed in the library
9	4	Bilingual	Creating a software that is accessible in both english and french to help accommodate more people to the library
10	2	Visual cues	Visual cues for the user who prefer simple images to guide them, instead of mandating audio cues

**Priority Number: 5 - Very Important, 1 - Less Important*

Table 1: Need Identification

2.3 Benchmarking

Comparing both Key2Access¹ and BluuBeam² to the needs of our clients to determine which is overall a better candidate to compare our software.

Needs #	Specifications	*Importance Factor Number	Benchmark#1: Key2Access	Benchmark#2: ***BluuBeam
1	Accessibility	5	4	2
7	Interactive	3	4	4
6	Adaptability	4	3	2
2	Audi cues	5	4	3
1,7,10	Visual cues	3	3	4
3,4	Multiplatform (across OS)	4	5	4
3,7	User friendly (in app)	3	2	3
5	Beacons	5	3	4
8	Cost Effective	5	2	3
1,9	Bilingual	4	0	0
	**Final Score:	41	30	29

**Importance Factor Number: 5 - Very Important, 1 - Less Important*

***All Scores are based out of 5 and then multiplied by the importance factor number*

****App no longer in service/functioning*

Table 2: Benchmarking Process

2.4 Metrics

List	Needs	Imp.	Design Specifications	Relation (=,>,<)	Value	Units	Verification
------	-------	------	-----------------------	------------------	-------	-------	--------------

							Method
1	5,8	5	Beacons	<	30	\$	Estimate
2	2	4	Audio cues	<	110	dB	Testing
3	3,4	5	Ability access app or website	=	Yes	N/A	Testing
4	3	5	BLE connection	<	70	m	Testing
5	6	3	Adaptability	=	Yes	N/A	Testing
6	1,7,10	4	Visual cues	=	Yes	N/A	Analysis , Final Testing
7	9	4	Bilingual website	=	Yes	N/A	Testing
8	10	3	Interactive	=	Yes	N/A	Testing
9	1	4	Accessibility	=	Yes	N/A	Testing
10	7	4	User friendly	=	Yes	N/A	Testing
11	8	5	Budget	<	100	\$	Estimate , Final check

Table 3: Metrics

2.5 Target Specifications

List	Design Specifications	Relation (=,>,<)	Value	Unit s	Marginal Value	Ideal values	Key2access	BluuBeam
1	Beacons (per beacon)	<	30	\$	<50	<30	N/A	N/A
2	Audio cues	<	100	dB	<90	70	N/A	N/A
3	Ability access app or website	=	yes	N/A	Website only	iOS & Android App	iOS & Android App	iOS & Android App
4	BLE connection	<	70	m	<10	<30	N/A	N/A
5	Adaptability	=	yes	N/A	Cannot receive updates	Can receive updates	Can receive updates	Can receive updates
6	Visual cues	=	yes	N/A	Pictures	Pictures	Limited	Pictures

					(2D)	(3D)	visual cues	(2D)
7	Bilingual website (EN/FR)	=	yes	N/A	EN	EN/FR	EN	EN
8	Interactive	=	yes	N/A	Limited interactions	Multiple in-app actions	Limited interactions	Multiple in-app actions
9	Accessibility	=	yes	N/A	Only visual cues	Visual and audio cues	Visual and audio cues	Visual and audio cues
10	User friendly	=	yes	N/A	Operate with some difficulty	Easy to operate	Operate with some difficulty	Easy to operate
11	Budget	<	100	\$	>100	<50	>100	>100

Table 4: Target Specifications

Reasons:

1. The price of each beacon should be reasonable so that we can install enough for the key areas of the library to be detected.
2. The audio cues are useful for the visually impaired, but should also not be deafeningly loud or too quiet for users who are hard of hearing.
3. We would like the app to be available on all platforms. If it isn't, at least everyone can still access our program on a web version.
4. Ensuring that the connection between the beacons and the program is consistently stable, can be established at a reasonable distance, and does not encounter any problems that would affect the use of the software
5. Creating a software that can be easily updated when needed whenever the technology advances or when the library rearranges its display.
6. Instead of constant audio cues, users can select the option of a picture displaying the form of visual cues on a guide to their destination, either in 2D or 3D.
7. The University of Ottawa is bilingual, and hosts both English and French students. If the program can't be bilingual as well, we would settle for the more popular language, which is English (other companies also provide English only).

8. Creating a system that is interactive and immersive, with multiple in-app actions which affects the user experience.
9. The system ideally needs to be accessible to a broad range of users with disabilities and impairments such as individuals with visual or auditory impairments.
10. The system must be user friendly to enhance the user experience and ensure accessibility.
11. Ensuring that the project can be cost effective and not be too expensive to start and maintain, we want something that is sustainable for years to come.

3 Conceptual Designs

After empathizing with the client, the next step in the engineering design process is the conceptual design and project plan stage. This deliverable is intended for the team to gather ideas and to create an outline of the initial conceptual designs of the wayfinding application. This started by each one of the team members creating their own separate concepts and then proceeding to compare each design to the required target specification created from the needs given from the client. Ultimately, the concepts that score the highest mark is chosen as primary concepts and from there a new final design is created from gathering the best element from the primary concepts. After the selection of the best concept, a visual mockup of the wayfinding website was created using Adobe Photoshop. A compiled list of Pros and Cons were established to understand the limitations of our chosen concept, which led into a feasibility study conducted on the technological, economic, legal, operational, and scheduling constraints on our concept. With these constraints in mind, we will be able to move onto the next steps in the engineering design process.

3.1 Functional Decomposition

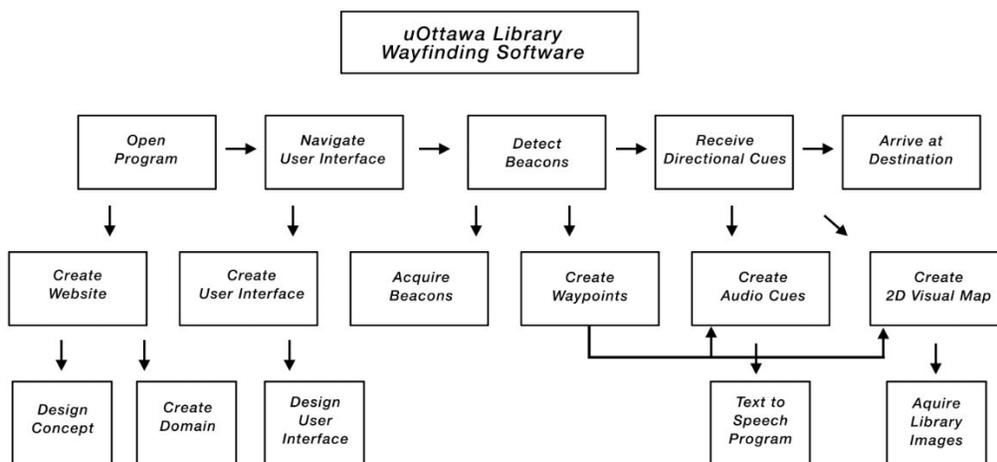


Figure 1: Functional decomposition of uOttawa wayfinding software

3.2 Concept Creation

MATT

Design 1

Explanation:

Once the website is opened, a large button will be displayed on wayfinding that upon pressing, provides the user with directional audio cues of the locations of all the bluetooth beacons within range of the device in order of nearest beacon to the furthest. If the user wants, they can click the individual locations listed in range and receive audio directions on how to find them.

Design 2

Explanation:

The user opens the website and is asked if they require visual or audio directions. If they require visual directions, a 2D picture map will guide the user through the library and prompt them with checkpoints to other waypoints as they walk through the library. If the user requires audio directions, the same visual features will appear however the checkpoints will have auditory cues when approaching them.

Design 3

Explanation:

The user opens the website and is shown an overhead map layout of the uOttawa library. When the user clicks on a waypoint, they are moved into a 3D first person view and guided to the waypoint using audio and visual cues as they move towards the waypoint. A large button makes it easy to switch between the 3D and 2D overhead map to switch waypoints.

LIAM

Design 1

Explanation:

Once the user opens up the app a 3D display of the selected location, in this case the Uottawa library. Once selected, a list will be displayed and the user will be able to select the desired location and it will display the area of that selection on the 3D map. After the user is near the Uottawa their location will be sent to the bluetooth beacons and it will display their location in the library on the app as a dot. The display will be live and will move accordingly to the user.

Design 2

Explanation:

Once the user logs into the website, it will display a list of different locations in the Uottawa library. Once selected the user will receive audio cues on how to arrive at the location. The website will

also give notifications on where help services are located and places such as washrooms.

Design 3

Explanation:

Once the user opens the website, a list of given locations in the Uottawa library under different titles will be displayed (Study rooms, Computers, etc.). After the user has selected a desired location a line path will be displayed for the user. Audio cues will also be given throughout the journey to accommodate people with disabilities. While the user is walking through the library locations of service centers and washrooms will be displayed as waypoints.

MIKAEL

Design 1

Explanation:

As the user opens the website, a full map of the library will appear. The user must then select a waypoint or destination based on the display. They can simply walk towards it while constantly seeing their own location.

Design 2

Explanation:

A search bar will be displayed on the screen as the user opens the website or website. The user will indicate which section/area he/she wants to go to, and the app will provide directions.

Design 3

Explanation:

No display. When the user is walking and approaches a certain section, a notification will pop up in the form of either text or audio cues to tell him/her where he/she is. If they click on the notification a clear image of their whereabouts with detailed descriptions will be shown on the website.

4 Project Plan, Execution, Tracking & Bill of Materials

4.1 Team Procedures

1. Day, time, and place for regular team meetings:
 - Regular team meetings will be held on Wednesday at 12:30pm-1:30pm on Discord chat
2. Preferred method of communication (e.g. e-mail, cell phone, Facebook, Blackboard Discussion Board, face-to-face, in a certain class) in order to discuss the project and to inform each other of team meetings, announcement, updates, reminders, problems:

- The team will communicate via a group chat on Facebook to discuss information regarding the project, announcements, updates, reminders and problems. Phone contact will also be in use in case of emergency or in need of immediate answer. Group meetings will be attended via live chat on Discord for better communication and able to further discuss the project.
3. Decision-making policy (by consensus? by majority vote?):
- Decisions will be made by putting the ideas through pros and cons, discussing them in depth and finally putting them up to a vote.
4. Method for setting and following meeting agendas (Who will set each agenda? When? How will team members be notified/reminded? Who will be responsible for the team following the agenda during a team meeting? What will be done to keep the team on track during a meeting?):
- Jean will be responsible for making sure that the team stays on track and up to schedule by reviewing our gantt chart and also ensuring that the updates with the project are up to date. Jean will also be in charge of ensuring that during the group discussions we stay productive and we accomplish our tasks for that desired meeting.
 - Meeting topics will be either proposed to the group beforehand or during the meeting.
5. Method of record keeping (Who will be responsible for recording & disseminating minutes? How & when will the minutes be disseminated? Where will all agendas & minutes be kept?):
- Liam will be responsible for noting down the contents and discussions of each meeting. They will be typed up and then posted onto Google Drive for future reference.

4.2 Team Expectations

Work Quality

1. Project standards (What is a realistic level of quality for team presentations, collaborative writing, individual research, preparation of drafts, peer reviews, etc.):
- Our group will be looking to aim for a high 85+. We will be achieving this grade by putting in intensive research in the selected areas of need, such as programming. Using proper engineering design techniques and necessary work ethic to achieve the end goal.
2. Strategies to fulfill these standards:

- Proper division of tasks
- Ensure that each team member has a deep understanding of the project and given task
- Proofread reports/presentations
- Rehearse presentations
- Promote active participation
- Attend labs/lectures
- Constant team meetings for updates on project completion

Team Participation

1. Strategies to ensure cooperation and equal distribution of tasks:
 - Assign tasks based on personal preference and strength
 - Provide constructive feedback
 - Have clear expectations
 - Maintain good communication
2. Strategies for encouraging/including ideas from all team members (team maintenance):
 - To respect the person who is talking
 - Provide constructive feedback
 - Promote credibility and fairness
 - Listen to each member's ideas
3. Strategies for keeping on task (task maintenance):
 - Maintain a positive attitude
 - Set deadlines
 - Assign a moderator so that all meetings and labs are productive
 - Track progress and be accountable
4. Preferences for leadership (informal, formal, individual, shared):
 - Leadership will be assigned based on task and completion of the project. For instance, Matt will moderate each team meeting, reports and presentations will have informal leadership with everyone contributing to their assigned parts. In addition, if there is a part on the project where a team member has a better understanding of the given subject leadership will be given to them.

Personal Accountability

1. Expected individual attendance, punctuality, and participation at all team meetings:
 - Attendance is mandatory but exceptions (medical) can be made
 - Each member should be on time or arrive within 10 minutes of each meeting
 - Check in with each group member during each meeting to ensure all work is being done

2. Expected level of responsibility for fulfilling team assignments, timelines, and deadlines:
 - Each task should be completed one day prior to the set deadline to allow other group members to proofread the work
 - Team members must note other members in the event that they need help or cannot complete a task on time
 - Liam will be responsible for uploading/submitting any project files.
 - Matt and Jean will serve as backups in the event of an emergency.

3. Expected level of communication with other team members:
 - Attend all meetings
 - Check the Facebook group chat often and reply promptly
 - Resort to cell phones if needed

4. Expected level of commitment to team decisions and tasks:
 - Everyone should take the time to make an informed decision! It's important to everyone's involvement and the development of the project. Some decisions or tasks might see more involvement from certain members than others, and that's ok! That being said, everyone should be prepared to share equally in decisions making and the completion of tasks.

Consequences for Failing to Follow Procedures and Fulfill Expectations

1. Describe, as a group, how you would handle infractions of any of the obligations of this team contract:
 - Any infraction of the team contract will be made by group consensus and made on a case by case basis. Team members will also be expected to give justification as to why the infraction occurred.

2. Describe what your team will do if the infractions continue:
 - Talk with the individual as a group and a group consensus shall be made

- If infractions become repetitive and extreme, the remaining group members shall consult TA's and the professor to discuss different steps that could be made to end the continuation of the infractions.

4.3 Preliminary bill of materials

Part Number	Part	Description	Quantity	Unit Cost	Extended Cost
1	Bluetooth Beacon	(size), bluetooth connection with software.	2-5	\$30	
2	Domain	Name of the website. It can come with ".com", ".ca", ".org" etc.	1	\$2	10\$/year

Table 5: Bill of Materials

4.4 Project plan

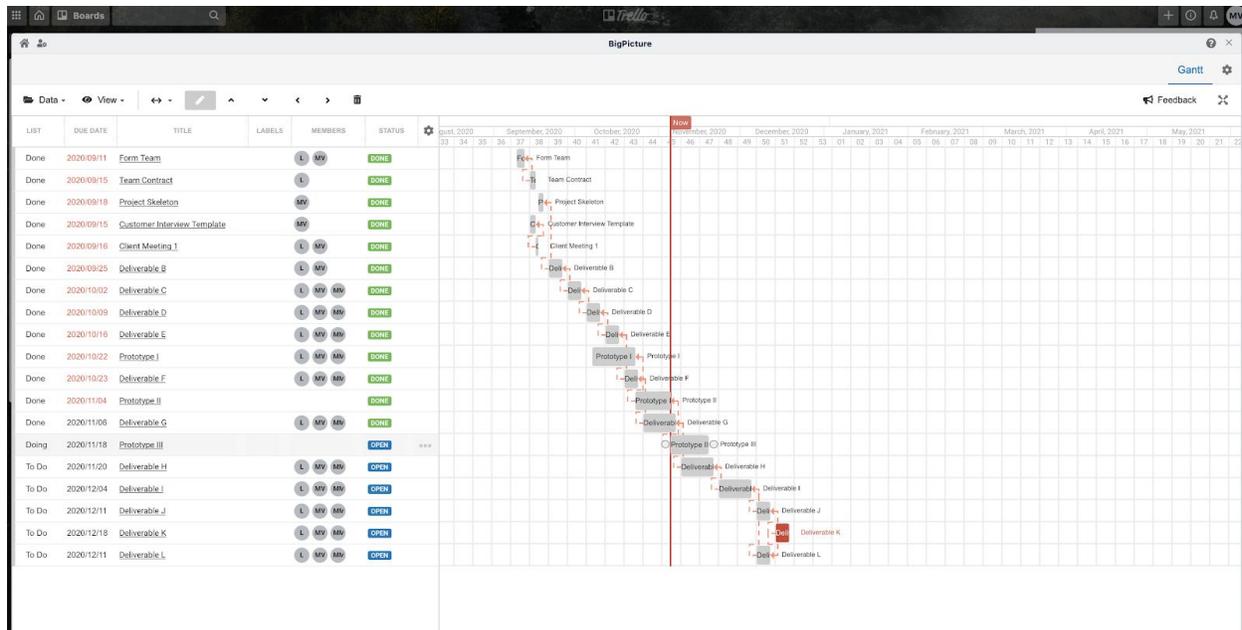


Figure 2: Project Plan

5 Analysis:

Based on the given client needs, we have selected the favoured design from each member totalling to 3 different concepts. We will proceed to add the concepts to a decision matrix as seen below. This matrix works by outlining the design criteria determined by the clients needs. Each individual concept in the matrix will be then given a score out of 5 corresponding on how well they could perfond the given need. Afterwards, the score of each concept is totalled and the design with the highest score will be the one that is selected for future use.

5.1 Concept Analysis

Based on the 3 concepts given from each team member, one design from each member was chosen to be added to the design matrix below to be compared and possibly chosen as the final concept the team would follow.

Individual Concept Options			
	Design 1	Design 2	Design 3
Selection Criteria 1-5 (1 being the lowest score)	Design #3 by Liam	Design #1 by Matt	Design #3 by Mikael
Cost	2	3	2
Accessibility	4	4	5
Audio cues	4	5	4
Adaptability	5	4	3
User friendly	4	3	3
App	0	0	0
Website	5	5	4
Visual cues	5	2	4
Total Score	29	26	25

Table 6: Decision Matrix for individual designs

5.2 Concept Selection

In order to select a concept that is considered in the design process, we chose our favoured concept from each member and evaluated them in a decision matrix found in table 1. We then proceeded

to discuss the feasibility of each concept. Feasibility in this case was defined as being: A concept that is able to be prototyped and then produced for a set client in an appropriate timeline given from the teams set of expertise, knowledge and resources.

5.2.1 Reasons for selection

We are going to evaluate the top three concepts, discuss them further and finally reach an agreement as to which concept we will be pursuing and be using as a base for a final concept as a team. The main reasons for selection are the ones used in the decision matrix compiled of the clients needs. In addition, we will evaluate our skills and experience in creating such designs to be able to submit a functional and up to standards project.

5.3 Final Concept Selection

As a team we chose design #3 by Liam. We thought it was a great concept as it covered most of the clients needs. It is a simple website that uses a simple display page for easy access and gives the user a selection of different locations in the uOttawa library. Once a location is selected the option of audio cues and visual cues of a map are given. The audio cues are very simple and will notify the user where they are headed and let them know where they can locate washrooms and service centers. The visual cues are represented as a map of the library and it shows the live location of the user using the bluetooth beacons situated around the library. The concept covers an overall understanding of the clients' needs.

5.4 Final Concept (Modified)

As a final concept, the additional features of design #1 from Matt will be implemented to the selected concept #3 from Liam. The reason for such modification is because the display feature of Matt concept is much simpler with a big button for interaction and ease of use. This feature is to increase the user friendly part of the website to accommodate a broader audience to access the library and to ensure that they don't get confused on how to use the given system.

5.4.1 Visual representation

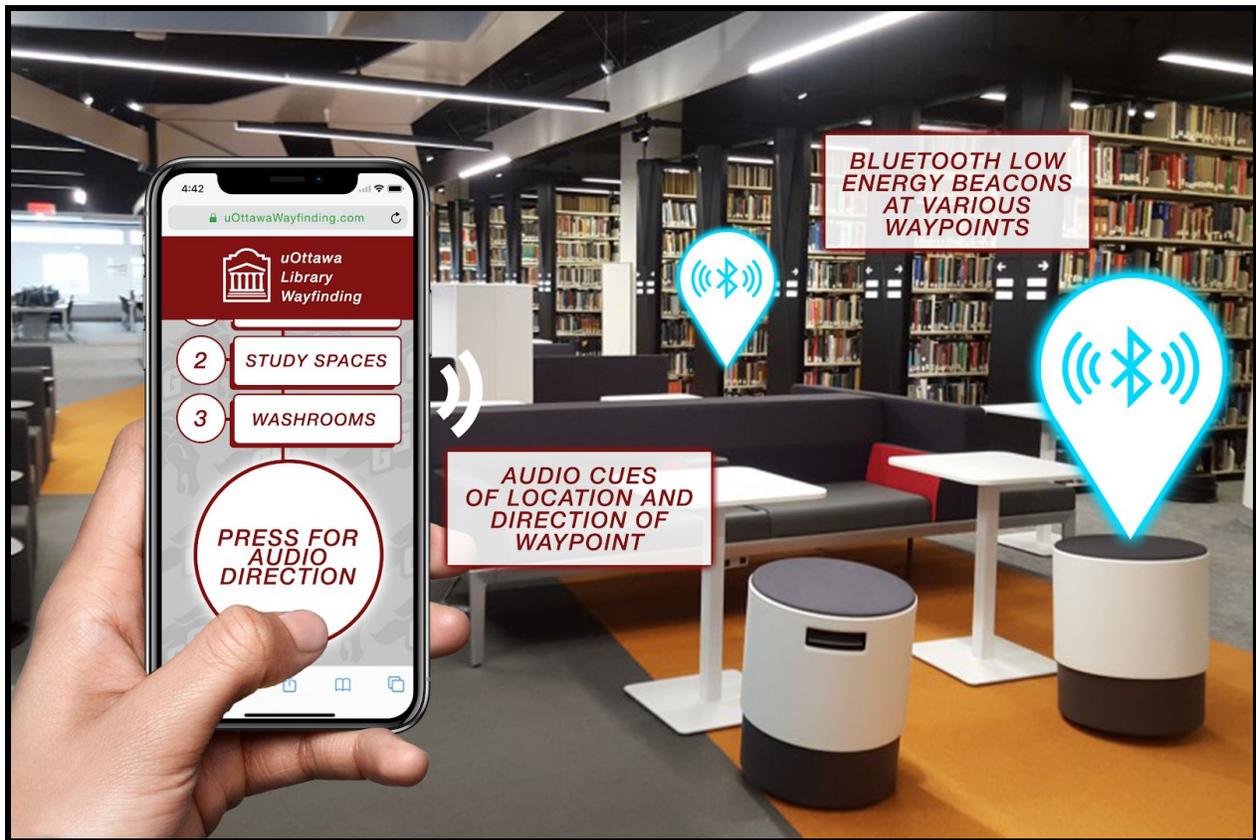


Figure 3: Physical representation of final concept

5.4.2 Functionality of Final concept

Reasons for selection

We chose the modified design as a final concept, because it satisfies all clients needs by having the required visual and audio cues, access to bluetooth beacons and is easy to access. The visual cues are received as a simple list system using the live location received from the connection of the user's mobile device and the bluetooth beacons are situated around the library. The audio cues work in a similar function and receive the location of the user and output audio cues of where the next turn or special waypoint is. The simplicity of the display system of the website is another reason for selection. We don't want to create something that is too complicated to navigate. We want to accommodate all ages, even people that don't quite understand how to use bluetooth technology.

Pros and Cons

Pros:

- Gives user flexibility between visual and audio cues

- User friendly interface
- Easy to update
- Accessible on any mobile device capable of internet connection
- No downloads necessary

Cons:

- Not optimized for specific operating system
- With limited financial resources we can't place enough beacons for a majority of the library to be mapped.

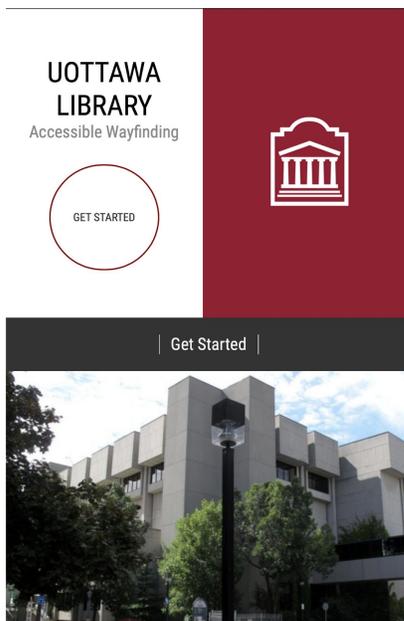
6 Prototyping, Testing and Customer Validation.

In this section, we will be discussing and going through the steps taken to develop our prototypes and tests conducted at each phase of the project. First we will discuss in detail the first prototype of the project and will analyse and evaluate the results found from testing. Finally we will discuss the clients feedback and discuss how we changed and developed the prototype to bring us to our second prototype in order to ensure a functioning design.

6.1 First Prototype

The first functional prototype is being made using HTML5, CSS, and JavaScript on VS Code and currently consists of a welcome page, list of waypoints, and visual directions for those waypoints in the library. This prototype's function is simply to test the platform of the program and get an overall sense of layout completed before audio cues and bluetooth signalling can be added. The website has flexible display capabilities to adjust to any screen it is on, from mobile devices to tablets and computers.

a)



b)



Figure 4: a) Screenshot of the welcome page for the website, which consists of the “uOttawa Library Accessible Wayfinding” title with a “Get Started” button that brings the user to an information page below (currently has an image of the library as a placeholder). b) Screenshot of the list of waypoint locations, which is located after the welcome page and allows the user to click on a waypoint that directs them to visual directions of that waypoint (currently has an image of the waypoint as a placeholder).

6.1.1 Prototype Testing

List	Design Specifications	Relation (=,>,<)	Value	Units	Marginal Value	Ideal values
1	Beacons (per beacon)	<	30	\$	<50	<30
2	Audio cues	<	100	dB	<90	70
3	Ability access app or website	=	yes	N/A	Website only	iOS & Android App
4	BLE connection	<	70	m	<10	<30
5	Adaptability	=	yes	N/A	Cannot receive updates	Can receive updates
6	Visual cues	=	yes	N/A	Pictures (2D)	Pictures (3D)
7	Bilingual website (EN/FR)	=	yes	N/A	EN	EN/FR
8	Interactive	=	yes	N/A	Limited interactions	Multiple in-app actions
9	Accessibility	=	yes	N/A	Only visual cues	Visual and audio cues
10	User friendly	=	yes	N/A	Operate with some difficulty	Easy to operate
11	Budget	<	100	\$	>100	<50

Table 7: Target Specifications

After comparing our first prototype to the target specifications from deliverable B, we can see that the first prototype is performing relatively well. The reason for this is that we have created a website that is user friendly, accessible and also very adaptable. The prototype has very few options in the menu, so the user won't get confused on where to find information or which section of the website to use in

order to find their desired location. The prototype is also able to be updated or edited with very little difficulty. This entails that the software is able to detect multiple locations in the library that are within the view of the beacons. The software can then be updated accordingly. In addition, the prototype has visual cues that provide aid for the user to reach their destination, using images and text. The text can be in both french and english to accomodate a broader audience in the Ottawa region.

Tabular format demonstration expected and actual testing results of prototype

List	Design Specifications	Value	Units	Marginal Value	Ideal values	Expected	Actual
1	Beacons (per beacon)	30	\$	<50	<30	Yes	No
2	Audio cues	100	dB	<90	70	Yes	No
3	Ability access app or website	yes	N/A	Website only	iOS & Android App	Website	Website
4	BLE connection	70	m	<10	<30	Yes	No
5	Adaptability	yes	N/A	Cannot receive updates	Can receive updates	Easy to update	Achieved
6	Visual cues	yes	N/A	Pictures (2D)	Pictures (3D)	Yes	Yes
7	Bilingual website (EN/FR)	yes	N/A	EN	EN/FR	Yes	Yes
8	Interactive	yes	N/A	Limited interactions	Multiple in-app actions	Yes	Yes
9	Accessibility	yes	N/A	Only visual cues	Visual and audio cues	Yes	Yes
10	User friendly	yes	N/A	Operate with some difficulty	Easy to operate	Easy to operate	Achieved
11	Budget	100	\$	>100	<50	0\$	0\$

Table 8: Target Specifications with prototype testing results

6.2 Client Feedback

During our third client meeting, we demonstrated the current version of our prototype that we created. This prototype is much different than the first one that we showed our clients in the last meeting.

Our current prototype has been built off a website builder called WordPress instead of coding it by hand with the use of HTML5, CSS, and JavaScript. This allows us to create a more polished and user friendly interface with streamlined functionality across the website. In addition, we removed the use of low energy bluetooth beacons from our design and instead opted for a simpler method, which generates directions to every waypoint, from every waypoint.

When these changes were brought up with the client, they agreed on our decisions of the sudden changes and agreed that the idea of eliminating the use of bluetooth beacon was well calculated. The clients thought that the user interface of our current website was well up to standards and commented on its simplicity. The clients also stated that they enjoyed how easy it is to navigate the website and its level of user-friendliness. The clients were informed that the addition of audio cues will be implemented in the later prototypes, as we are still trying to further understand its functionality and how the user will be given the option to either turn them on or off. The clients informed us that we must consider the option of creating an ad free website and account for the possibility of needing to export or transfer the website code to a uOttawa sub-website instead of being part of WordPress.

Changes and improvements needed for future prototypes primarily include the use of functioning audio cues. This is a key feature that the clients require, because of its ability to grant accessibility to users with visual impairments. Other improvements that were discussed were the addition of more visual cues such as images in the directions for a more polished product.

7 Final Solution

Our final prototype is the high fidelity product. We have added extra features that we briefly mentioned to our clients in our third meeting. Instead of using bluetooth beacons to have directions, we thought it would be easier both for us and our users if the directions between important waypoints were already implemented in the website, and did not require connection to bluetooth signals. In this case, the user can simply choose their path by selecting their desired destination followed by the waypoint they are closest to. All the instructions will be backed up with a plugin that reads the directions out loud for the user. This is ideal for people that have any sort of visual impairments, or simply a user who prefers to be told where to go out loud.

7.1 Prototype II

The images below represent our medium fidelity prototype, as seen through the screen of a mobile device (which is what most of our clients would be using). As we can see, it is very simple and straightforward, which satisfies one of our most important customer needs: accessibility.

On the first image from the left is the homepage of the website, where there is a “start” button, which is the only option that can be selected. This is to make sure that the number of clicks remains as low as possible. The least amount of steps one has to go through, the better. The second image shows the instructions on how the website functions if the user scrolls down. After clicking on “start”, the user will be sent to a page which lists all the important waypoints in the library (shown by the third image). After clicking on the desired location, there will be instructions on how to get there (fourth image).

Essentially, there would be multiple directions that link each waypoint to one another. For example, we have the directions to the elevator from the front door in the fourth photo below. No matter what page the user might be using, there will be a “menu” icon at the top left of the screen. This one will allow the user to switch from different pages in a simple manner. Based on our skillset and the needs of our customers, we feel that this prototype is an important step forward to a final product that will aid users in accessing the uOttawa library.

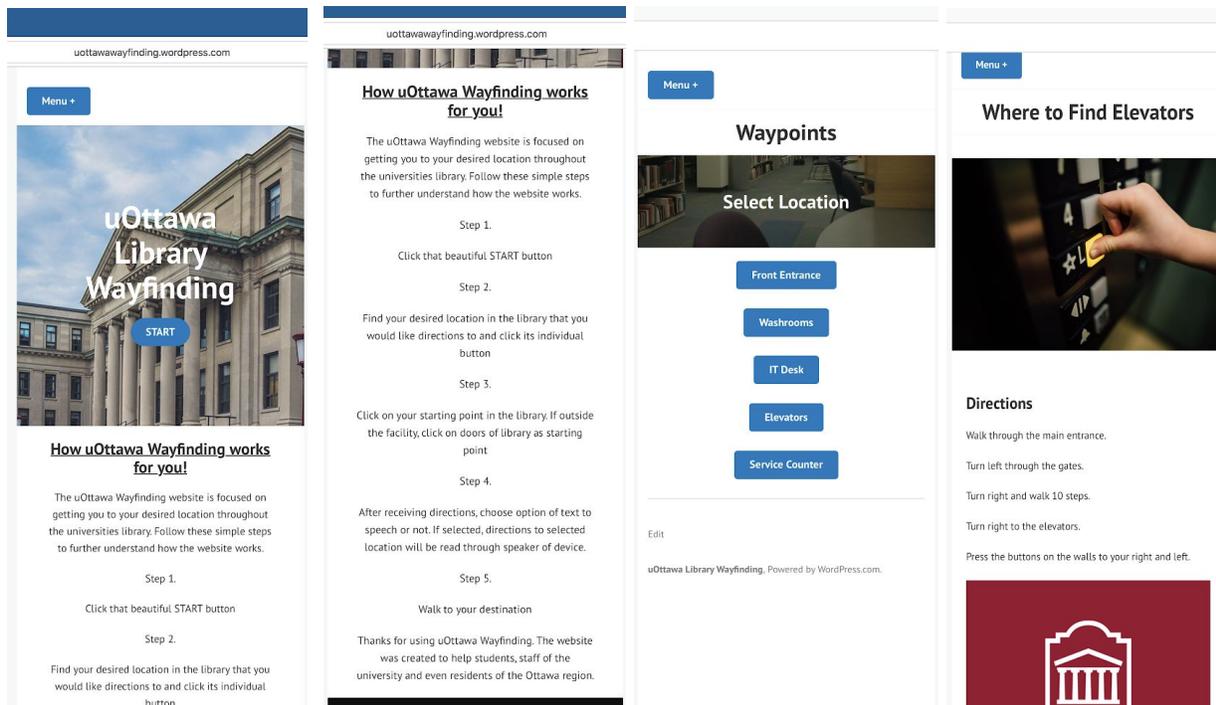


Figure 5: Images of final prototype and its layout

7.2 Prototype Testing and Analysis

During our prototype testing, we are trying to figure out how easy it is to navigate the website, the level of visual cues, accessibility, adaptability, level of interaction, language, user friendliness and the function of audio cues. To test these specifications, we will be asking users such as family and friends to use our latest prototype.

Tests of different specifications:

Visual cues:

Visual cue testing will be given from the website and will be measured through satisfaction of the user on a rating of 5. Users will use a physical prototype.

User 1: 5/5

User 2: 4/5

User 3: 5/5

All users claimed to be satisfied with the visual cues given from the website for directions to the different locations in the library. They stated that they thought the pictures have enough information for the user to understand what steps to take and what to look for on the way to their desired destination.

Accessibility:

Accessibility of the website will be tested by determining how many clicks it takes the user to find the destination they are looking for. After this, the user will rate on a scale of 1-5 how accessible the directions were.

User 1: 5/5

User 2: 5/5

User 3: 5/5

Every user that tested the accessibility was able to find their desired waypoint in 5 clicks or less, which they determined to be very easy compared to conventional websites. They enjoyed the simple and uncluttered spread of buttons which led them to their desired waypoint on the website.

Adaptability:

For adaptability testing we decided to add a new hypothetical location in the library as an example and see how long it would take to create a new waypoint on the website and add proper directions. This would give us important information on how the staff at the library would be able to add to the website in the future.

After sharing account information so that the tester would be given access to the website and able to edit. He was able to access the website editor with ease and after 15 minutes of adding a new waypoint and directions into the website. Once the website was updated by the user and the stopwatch ended with a total time of 20.5 minutes. We decided to take time to ensure that all steps worked and that nothing was missing in the directions. We concluded that the website has the necessary tools and easy access to be able to be updated with ease and with little knowledge of how everything works.

Interactive:

Interaction with the website will be measured through satisfaction of the user on a rating of 5. Users will use a physical prototype.

User 1: 5/5

User 2: 5/5

User 3: 5/5

Users stated that they enjoyed the interaction and the use of big buttons through the website. They claimed that it felt more interactive when given many different choices such as the different waypoints. They also enjoyed the use of the big blue buttons as the start button and waypoint selection.

Language:

Language was tested by a user who is bilingual (EN/FR), one who speaks only french, and one who speaks only english. We asked the users who speak one language to give us feedback on the grammar and instruction simplicity in their native language. Additionally, the bilingual user was able to tell us if the translations were consistent between the two website versions. All three users said that they understood the written text well and appreciated the ability to switch from english to french easily if they so desired to.

User friendly:

User friendliness with the website will be measured through satisfaction of the user on a rating of 5. Users will use a physical prototype.

User 1: 4/5

User 2: 4/5

User 3: 5/5

Users state that the user friendliness of the website is up to standards, however could use some improvements. Users claimed that they enjoyed the experience at the start of the website where it gives them steps on how everything works and the decision page of the waypoints. After selecting the desired location in the library they were brought to the selection of starting positions in the library. The users claimed that they got confused as to what to select next and that the instructions on the main page were not completely clear and easily forgettable.

Audio cues:

Audio cues in the website will be measured through satisfaction of the user on a rating of 5. Users will use a physical prototype.

User 1: 5/5

User 2: 5/5

User 3: 5/5

Users stated that the audio cues given by the text-to-speech plug-in went above and beyond their expectations. One user stated that they enjoyed the speed and pitch of the audio cue and praised that the directions were written in a clear manner that translated well to verbal speech.

Tested Specifications			
List	Specifications	Expected Results	Actual Results
1	Visual Cues	Visual cues are helpful with the aid of navigation through the library	Visual cues are up to standards and give clear steps to navigate the library. Users give 4.5/5
2	Accessibility	Easy to access	The website is very accessible and can be navigated through in less than 5 clicks.
3	Adaptability	Simple to update with little to no difficulty	Website is able to be updated very easily and in quick succession.
4		Interactive with user in the	Website is very interactive

	Interactive	user of in website buttons	with the use of blue buttons for selection. Users give 5/5
5	Language	Bilingual website, User has option to select either website in english or french	Website is well written and the ability to choose between english and french is thoroughly appreciated.
6	User friendly	Website is easy to understand and navigate	A few pages of the website are easy to understand and simple to navigate. There are however some pages that are more complex and that confuse the users. Users give 4.3/5
7	Audio cues	Audio cues once selected user function without ease and the speech is clear	Satisfaction of audio cues rose above the users' expectations. Users give 5/5.

Table 9: Tested Specifications and results

8 Conclusions and Recommendations for Future Work

To summarize, the execution of the proposed project plan was successful. The website is fully up and running with minimal bugs. The ability to select a desired location to be guided to by the website, either by steps or by selected audio cues all work and is designed to be very simple to ensure that no users get confused by how everything works. The map with added numerical waypoints is to ensure that if people don't fully understand the layout of the library they can view the whole first floor and decide where they want to go with a more visual representation.

This project has been a long learning process for every member of the team. We learned how to properly manage our time and successfully a project plan by keeping up to date with all deliverables and completing them ahead of time. The group has also learned to plan for contingencies in case the original plan was unsuccessful or fell apart for any reason.

For the future, the use of beacons should be implemented to be able to receive the live location of the user from the their mobile device, so that it can show them where they are exactly in the library and direct them with live audio cues or a a line path that they could view from their device.

9 Bibliography

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APPENDICES

APPENDIX I: User Manual

Main features:

- Step by step directions
- Audio cues

Product functions and maintenance:

For this specific product, no heavy maintenance is required. Both the manual directions and audio cues are functional and bug free. Alteration in library layout will result in change of specific directions in certain areas and replacement of audio cues, therefore will need to be revised (See troubleshooting on how to solve this problem).

For the manual directions, the user will be shown a list of final destinations, locations the user would like to arrive. Once a location has been selected a page of starting locations will be displayed. This is so the user can select where they are specifically in the library. If outside the library select, the entrance as the starting location. Once both final and starting locations have been selected a page will be displayed showing the individual steps that must be made to arrive at the given final location. These locations can easily be changed by simple manipulation of the pages or editing the text on the given directions. These edits can be done through Wordpress editor.

For the audio cues, the user has the option to play them or not. If they do decide to use them, they are located at the top of every page and they must select the play button. Once selected a video will read out all directions on the given page. The audio cues were made online by a text to speech software after inserting the selected directions.

Part, Functions and capabilities:

The project is composed of a free website maker called Wordpress and a free Amazon text to speech creator. Wordpress is used as the skeleton of the entire project. It is used to support the main pages and selection of final and starting locations, which then proceed to bring the user to different pages consisting of directions to different waypoints that the user selected. In addition, the Amazon text to speech creator is used to download MP3 files of the different directions and the added text on pages to help guide the users around the library into their desired location.

Installation of directions:

The directions are simply added using text in Wordpress and take very little time.

- Sign in to Wordpress
- Select website and press customize

If needed to add another page of directions

- Select new page in task bar select blank layout
- Add given title of starting location to final location
- Add picture of map of library layout
- Type text of direction below image in text box in point form
- Publish current page
- Copy link
- Add link to button that the user must click to bring them to given page

If needed to edit page of directions

- Select page and select edit at bottom of page
- Once selected click on text and edit directions
- Update page

Installation of audio cues:

The audio cues are an add-on that will make life easier for any of our users that are visually impaired. We used a text-to-speech software called amazon polly (2).

We simply copy the text we want to be said out loud into the software, save it as an MP3 file, and insert it into the correspondent page.

A play button will show up at the top of every page, which can be clicked in order for the desired text to be said out loud.

Bilingualism

The university of Ottawa is the biggest bilingual university in North America. It would only make sense that this website were also bilingual. That way, both french and english speaking students would be able to navigate through it easily.

To switch from English to french, simply click the “FR” button on the main screen of the english version.. To go back to english, click on the “ENG” button on the main screen of the french version.

Health and safety guidelines:

As a safety precaution, be aware of all your surroundings and any obstacles in your way while wayfinding on the website. Directions may not be updated and could result in navigation to a newly restricted area due to health and safety guidelines implemented by Public Health for the Covid-19 pandemic.

The wayfinding website does not confer official directions for fire safety exits. Any evacuation guidelines or paths should be acquired from the main uOttawa library website.

Troubleshooting:

As with all programs it may crash or files could be lost. In the case where the links between pages no longer go to the proper page you can select see all pages function in the task bar of Wordpress editor. From there you can find the title of the desired page that got lost and select. Once selected, you can copy its link and return to the desired page of beginning and insert the intended link to the page. If the addition of the audio files to the website do not function. The best step is to simply redownload the file and refresh the Wordpress page. Once both the file is downloaded and the page is refreshed try inserting the file once again.

APPENDIX II: Design Files

To be able to access the Wordpress website, an account will need to be created and access will need to be granted by Matthew Villeneuve-Laroche. This is because he is the main creator of the website and has full access to everything. However once access has been granted by his account to the other, the account that has been created is able to edit the website whenever they please.

Link to Website

<https://uottawawayfinding.wordpress.com/>

MakerRepo project link:

<https://makerepo.com/MattvLaroche/gng2101b24library-wayfinding>

