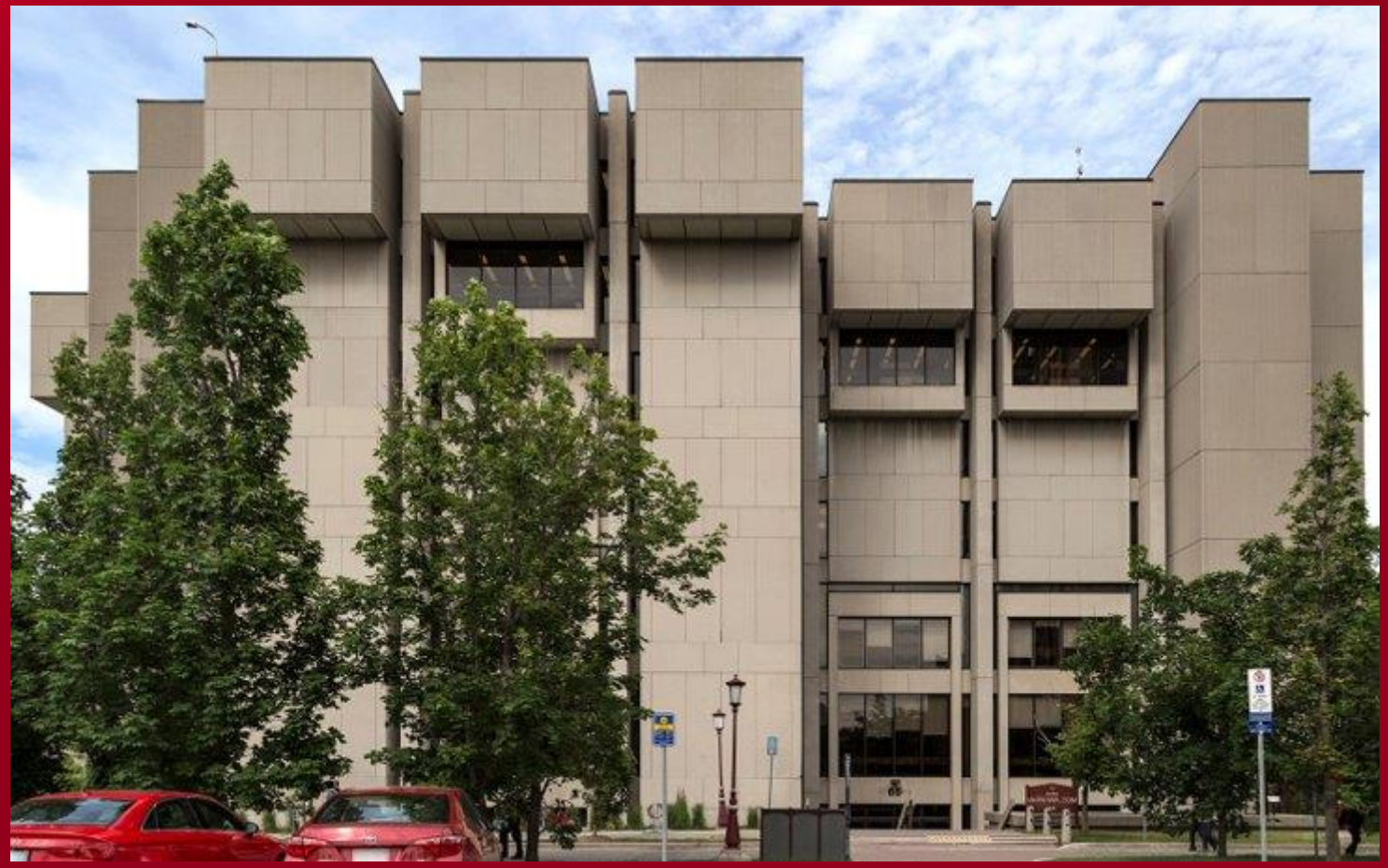
PATHFINDR

RAISING THE BAR ON VISUALLY IMPARED NAVIGATION

THE PROBLEM

Visually impaired people struggle every day to navigate the world around them, in a safe and efficient manner.

THE CLIENT



uOttawa

PROBLEM STATEMENT

Design a system that can be accessed by visually impaired and other library users through an app that allows users to navigate to important locations on the first floor of the Morisset Library.

CUSTOMER NEED

- Assists visually impaired users
- Accessible through the users' phone
- Navigate to key locations within the library
- Reliable
- Accessible for everyone
- Easily modifiable
- Notifies users via auditory and visual notifications
- Low cost
- Enables staff to broadcast new announcements and change existing ones

BENCHMARKING

- Checkpoint system
- More expensive
- More robust/complex system
- Used in the London Underground

- GPS location
- Less effective and slower system
- More affordable
- Used in Ottawa Public Libraries & city hall

TARGET SPECIFICATIONS

Metric	Marginal Range	Ideal Range	Units
Time from App start to navigation start	$x \leq 30$	$x \leq 15$	Time (s)
Customer satisfaction	$x \geq 3/5$	$x \geq 5/5$	Subjective
Effective range of beacon	$x \geq 6$	$x \geq 10$	Distance (m)
Battery life of beacon	$x \geq 1$	$x \geq 5$	Years
Time to reprogram beacon location	$x \leq 420$	$x \leq 300$	Time (s)
Cost per beacon	$x \leq 70$	$x \leq 30$	CAD$
Beacon weight	$x \leq 750$	$x \leq 500$	Weight (g)
Beacons size	$x \leq 25$	$x \leq 10$	Size (cm)
Effectiveness of notifications	$x \geq 4/5$	$x = 5/5$	Subjective
Time to broadcast announcements	$x \leq 6000$	$x \leq 5000$	Time (ms)

DECISION MATRIX - APP

App Metrics:

1) Time from app start to navigation start

2) Customer Satisfaction

5) Time to reprogram beacons

9) Effectiveness of notification

10) Time to broadcast announcement

Concept	Score
Create android app from scratch	4.54
Cross-platform app from prebuilt frameworks	3.64
Create app using MIT App Builder	3.86
Auditory notifications	3.85
Haptic notifications	3.62
Selected Concept	**Create android app from scratch**

DECISION MATRIX - BEACON

Beacon Metrics:
2) Customer Satisfaction
3) Effective range
4) Battery life
5) Time to reprogram
6) Cost
7) Weight
8) Maximum Dimensions

Concept	Score
Bluetooth Signals	3.98
3D Printed Beacon Housing	3.84
Position Vectors via Triangulation	3.81
IR Signals	3.56
Ultrasonic Acoustic Signals	3.09
Wi-Fi Signals	2.27
Selected Concept	**Bluetooth Signals**

CONCEPT SELECTION

App:

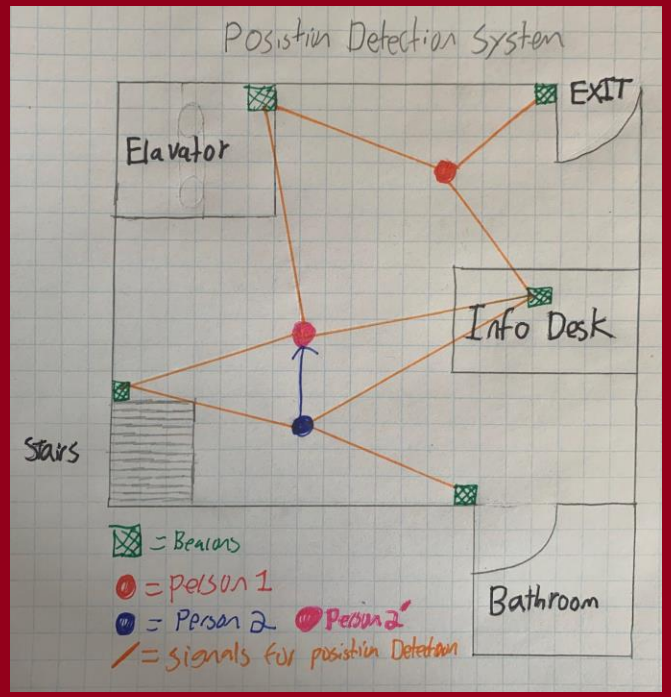
- Android app
- Haptic and/or Auditory Notifications
- A unique app or authentication process for employees to use for administrative tasks

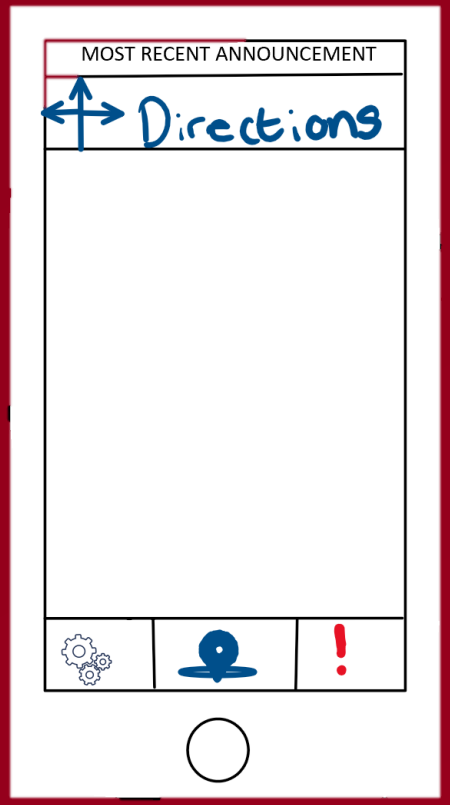
Beacon:

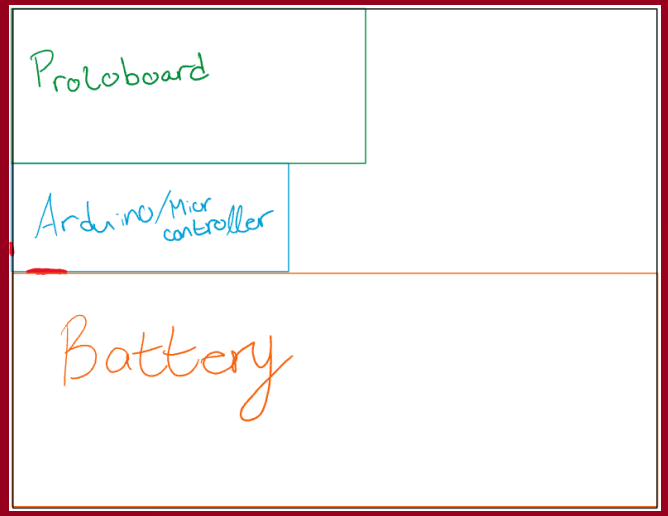
- Bluetooth Signals
  - Triangulation and displacement vectors
- 3D Printed PLA
- Mounted with screws

DEVELOPMENT PROCESS

Hand Sketched Mock-ups

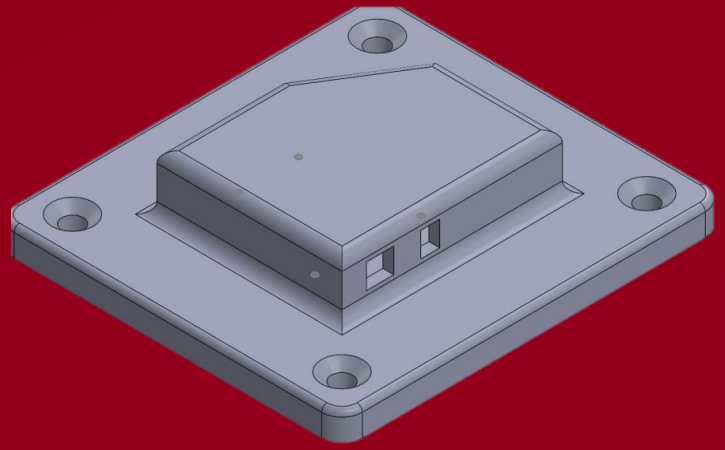


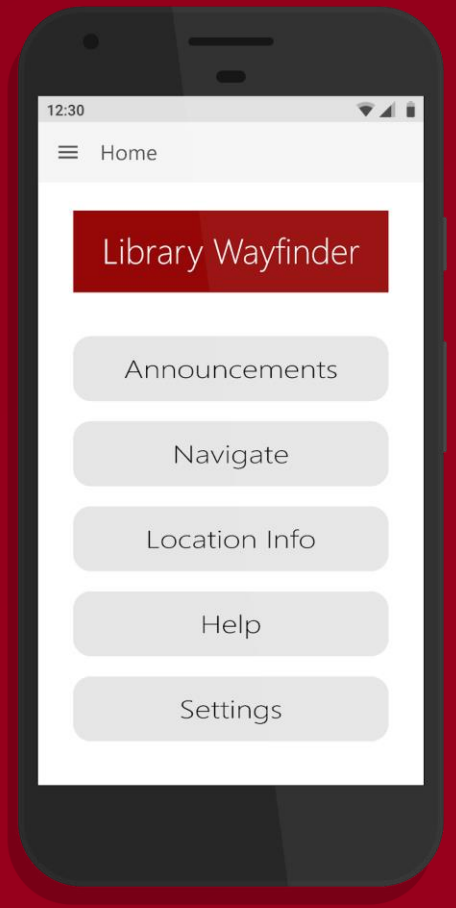


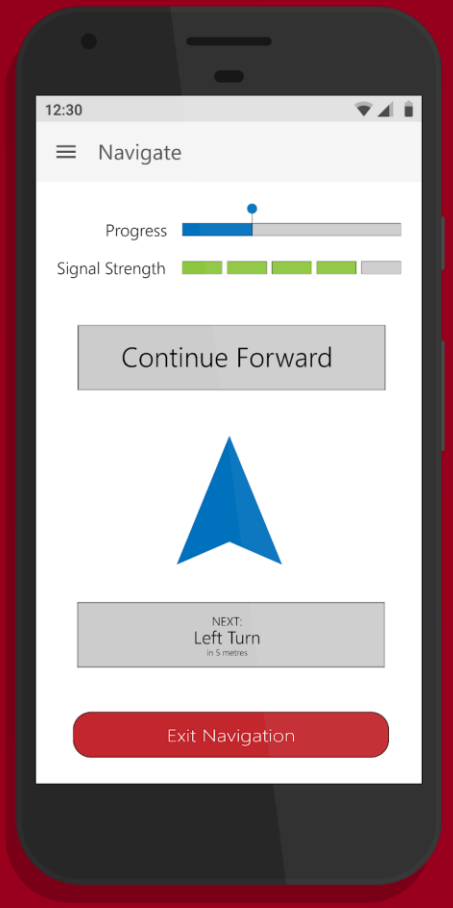


DEVELOPMENT PROCESS

Prototype 1

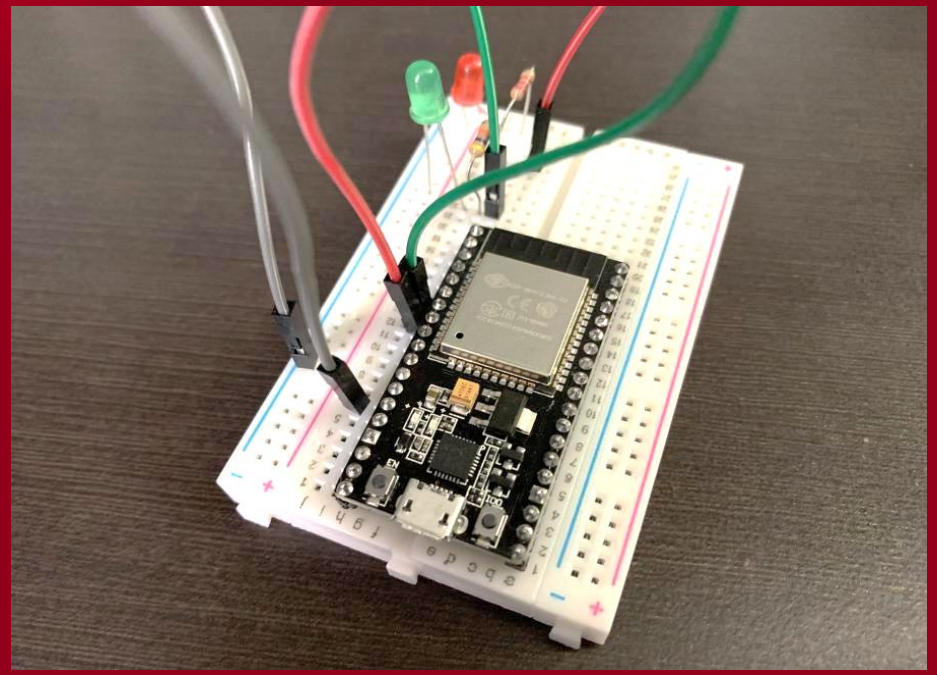


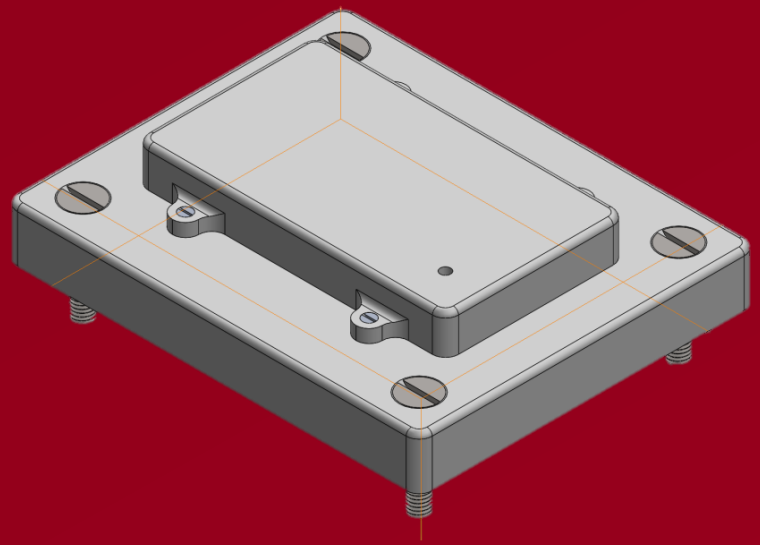


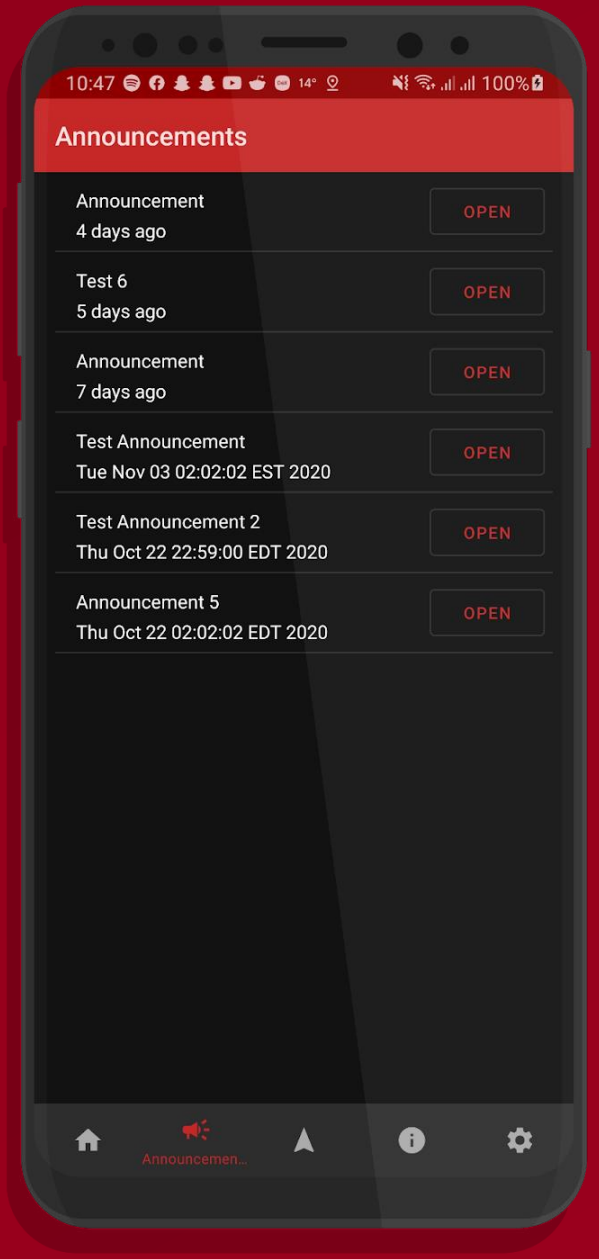


DEVELOPMENT PROCESS

Prototype 2

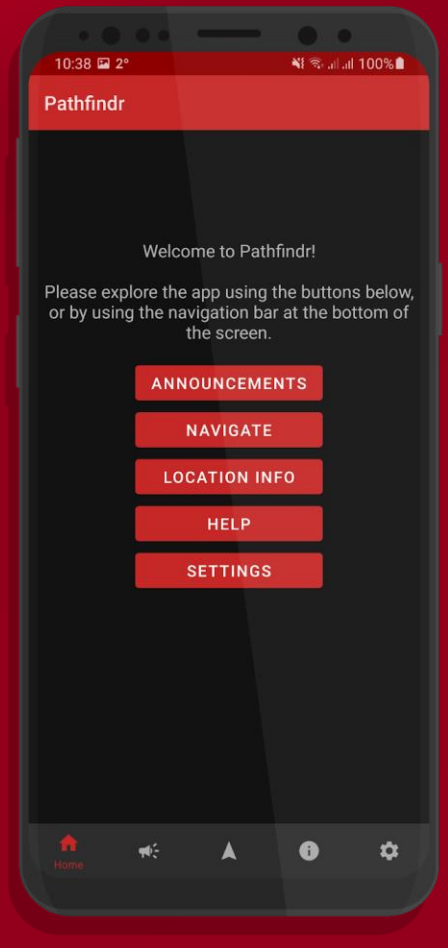


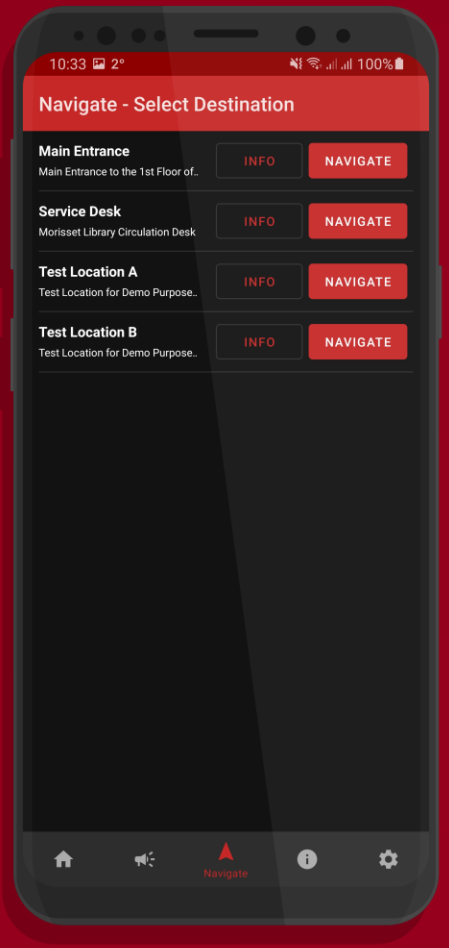


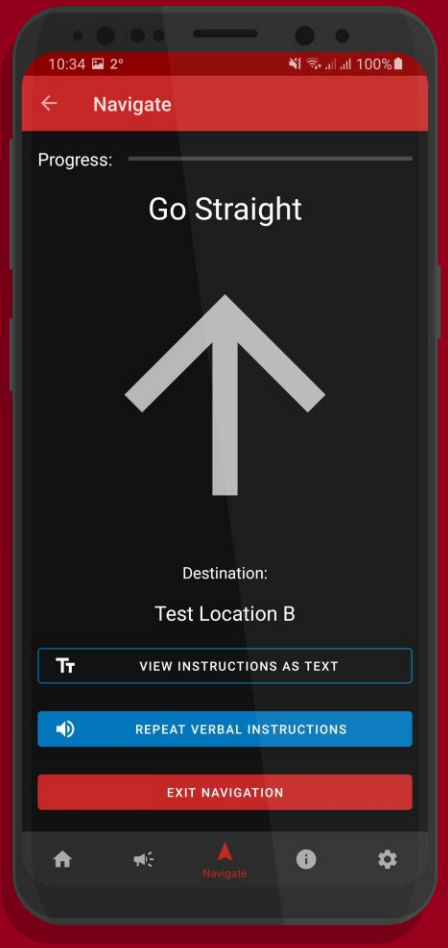


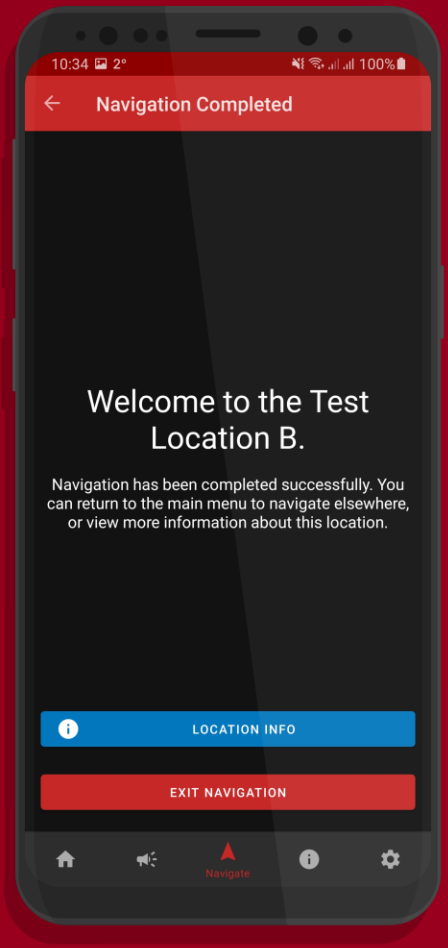
DEVELOPMENT PROCESS

Prototype 3

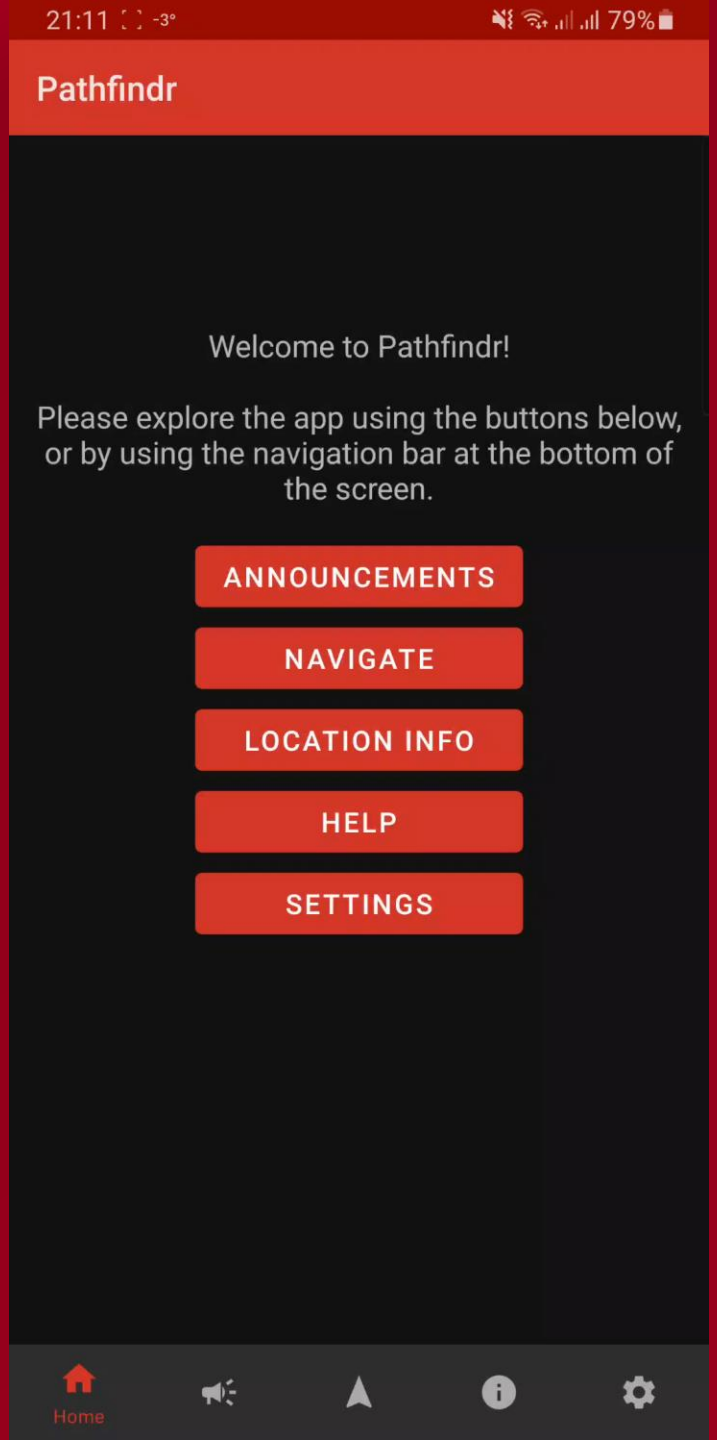









SORTIE
EXIT


21:11 -3°
79%
Pathfindr
Welcome to Pathfindr!
Please explore the app using the buttons below, or by using the navigation bar at the bottom of the screen.
ANNOUNCEMENTS
NAVIGATE
LOCATION INFO
HELP
SETTINGS
Home

PROJECT PLAN

DISCORD

BUSINESS MODEL CANVAS

<table>
<tr><th>Key Partners</th><th>Key Activities</th><th>Value Proposition</th><th>Customer Relationships</th><th>Customer Segments</th></tr>
<tr><td rowspan="2">- Clients
- Users
- Investors
- Suppliers</td><td>- Location Optimization
- Continuous commitment to accessibility</td><td rowspan="2">- Accessible Wireless Navigation
- Reduce customer uncertainty
- Direct customer traffic flow</td><td>- Customer Service
- Social Media Presence
- Promotional Offers</td><td rowspan="2">- Public spaces/services (malls, airports)
- Private Corporations looking to increase accessibility</td></tr>
<tr><td>Key Resources
- Bluetooth Beacons
- Mobile App</td><td>Channels
- Online
- Word of Mouth
- Direct Marketing</td></tr>
<tr><th colspan="3">Cost Structure</th><th colspan="2">Revenue Streams</th></tr>
<tr><td colspan="3">- Employee Salaries
- Production Costs</td><td colspan="2">- Hardware Fee
- Software License (Annual Subscription)</td></tr>
</table>

3 YEAR INCOME STATEMENT

Sales	
2700 Units	$108000
90 Subscriptions	$54000
Total Sales	**$162000**

Costs of Goods	
Total Cost	**$32400**

Operating Expenses	
Patent	$16000
Shipping	$6000
Marketing	$12000
Salaries	$20160
Equipment	$9000
Depreciation	$2700
Rent	$56000
Website	$120
Total Operating Expense	**$121980**

Operating Income	
Total Income	**$7620**

BILL OF MATERIALS

Notable Features:

- Shipping is free
- BOM is for 4 beacons
- 3D printed case is only free if PLA is used

Material	Extended Cost
3D printed case	$ -
AA Battery Holder	$ 4.00
AA Batteries	$ 5.00
ESP32/ESP32S	$ 37.98
Protoboards	$ 8.00
6-32 Screws	$ 1.92
#6 Heat Inserts	$ 2.72
#4 Screws	$ 7.36
#4 Hex Nuts	$ 4.32
Green LEDs	$ 0.12
Red LEDs	$ 0.12
Wire	$ 0.44
Resistors	$ 0.64
Shipping	$ -
Subtotal	$ 72.62
Taxes	$ 9.44
Grand Total	$ 82.06

LEGAL, ETHICAL AND SAFETY OBLIGATIONS

- Adhere to all laws and regulations of our country as well as our university
- Will Adhere to terms and services of the software we are using
- Currently no agreements or legislations that could prevent completion of this project

LESSONS LEARNED

RELIABLE

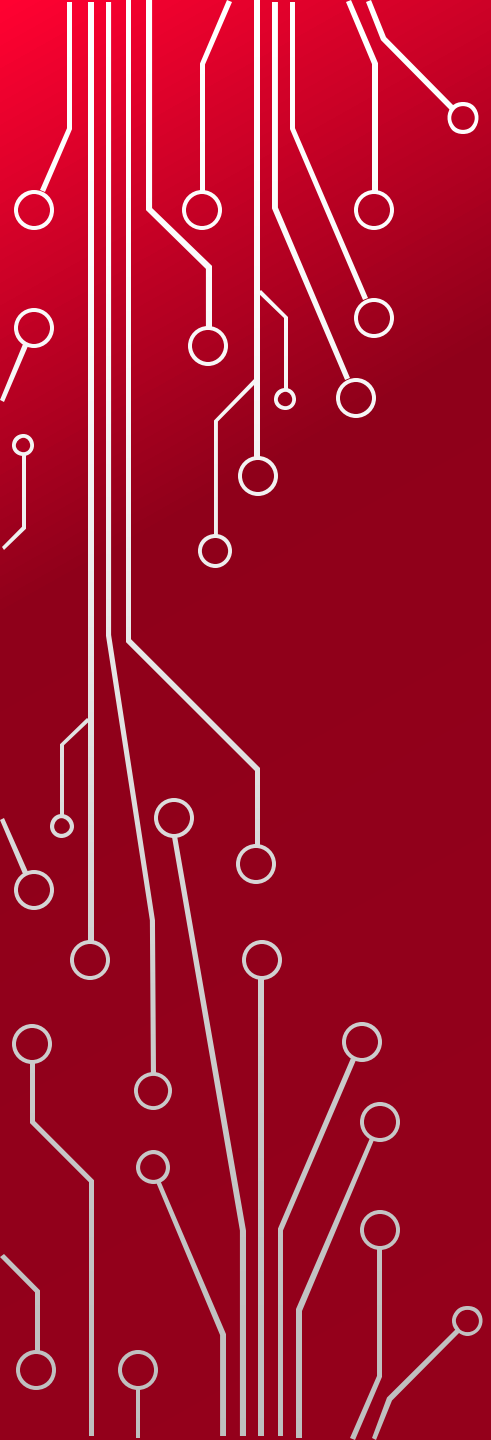
AFFORDABLE

INNOVATIVE

SIMPLE

EFFECTIVE

THE BAR



PATHFINDR

Q & A

BENCHMARKING

- Wayfindr is used in the London Underground

- Key2Access (K2A) is used in the Ottawa Public Library and City Hall

Metric	Wayfindr	K2A (OPL)	Units
Time from App start to navigation start	--	10	Time (s)
Customer satisfaction	4/5	2/5	Subjective
Effective range of beacon	100	5	Distance
Battery life of beacon	3	--	Years
Time to reprogram beacon location	--	--	Time (s)
Cost per beacon	$132.64	--	CAD$
Beacon weight	86	--	Weight (g)
Beacons size	6.9	15	Size (cm)
Effectiveness of notifications	5/5	1/5	Subjective
Time to broadcast announcements	--	--	Time (s)

THREE-YEAR INCOME STATEMENT

Assumptions

- 10 beacons/floor with average of 3 floors/building
- 600 libraries in Canada and targeting 5% of this market is 30
- Therefore over 3 years that is 2700 beacons and 90 clients

Sales

2700 Units at $40 a unit

90 Subscriptions at $300/year

Total sales $162000

Cost of Goods Sold

2700 units at $12 a unit

Total Cost $32400

Gross Profit on Sales $129600

Operating Expenses:

Patent $16000

Shipping $6000

Marketing Expenses $12000

Salaries $20160

Equipment $9000

Depreciation $2700

Rent $56000

Website $120

Total Operating. Expenses **$121980**

Operating Income **$7620**

Material	Location	Quantity	Unit Cost	Extended Cost
3D printed case	Makerlab	4	$ -	$ -
AA Battery Holder	Makerlab	4	$ 1.00	$ 4.00
AA Batteries	Makerlab	16	$ 0.32	$ 5.00
ESP32/ESP32S	2x Makerlab, 2x Amazon	4	$ 9.50	$ 37.98
Protoboards	Makerlab	4	$ 2.00	$ 8.00
6-32 Screws	Home Depot	16	$ 0.12	$ 1.92
#6 Heat Inserts	McMaster-Carr	16	$ 0.17	$ 2.72
#4 Screws	Home Depot	16	$ 0.46	$ 7.36
#4 Hex Nuts	Home Depot	16	$ 0.27	$ 4.32
Green LEDs	Makerlab	4	$ 0.03	$ 0.12
Red LEDs	Makerlab	4	$ 0.03	$ 0.12
Wire	Makerlab	4	$ 0.11	$ 0.44
Resistors	Makerlab	8	$ 0.08	$ 0.64
Shipping			$ -	$ -
Subtotal				$ 72.62
Taxes				$ 9.44
Grand Total				$ 82.06

DECISION MATRIX - APP

App						
M	**W**	**1**	**2**	**6**	**8**	**9**
1	27%	5	4	4	2	5
2	37%	5	4	4	5	3
5	10%	3	3	3	2	3
9	22%	4	3	4	5	3
10	4%	4	3	3	4	5
	Score	**4.54**	**3.64**	**3.86**	**3.85**	**3.62**

Metrics:

1) Time from app start to navigation start

2) Customer Satisfaction

5) Time to reprogram beacons

9) Effectiveness of notification

10) Time to broadcast announcement

Concepts:

1) Create android app from scratch

2) Cross-platform app from prebuilt frameworks

6) Create app using MIT App Builder

8) Auditory notifications

9) Haptic notifications

DECISION MATRIX - BEACON

Metrics:
2) Customer Satisfaction
3) Effective range
4) Battery life
5) Time to reprogram
6) Cost
7) Weight
8) Maximum Dimensions

Concepts:
3) Wi-fi signals
4) Ultrasonic acoustic signals
5) IR signals
7) Bluetooth signals
14) Position vectors via triangulation
15) 3D Printed beacon housing

		Beacons					
M	**W**	**3**	**4**	**5**	**7**	**14**	**15**
2	26%	2	1	2	4	5	5
3	16%	5	2	2	4	5	4
4	18%	1	4	4	4	3	3
5	3%	1	5	5	5	2	4
6	21%	2	4	5	3	3	4
7	8%	2	5	5	5	3	2
8	8%	2	5	5	5	3	3
Score		**2.27**	**3.09**	**3.56**	**3.98**	**3.81**	**3.84**

LESSON LEARNED

- Prototype development takes a long time
- Making a profitable product is very challenging
- Communication is crucial to a productive team