Wayfinding Systems Proposal

Written by Harnaz Sidhu, Charlotte Miller, Riley Sasaki, Carter Vande Moore, Henry Kopplin & Aston Tan

Phase 1: Systems Planning and Selection

Introduction of project:
We've been assigned to update the current system that's in place for wayfinding across Mass Audubon. Currently, Mass Audubon offers paper maps and PDFs of the maps on their website for hikers to use when navigating the trails. This system of wayfinding is not fully effective as a way of navigating. We created three unique business plans as alternatives to the current system. Through a direct comparison and researching existing software, we were able to identify the business plan that would be most effective and efficient in achieving our goals of simple and uncomplicated wayfinding.

Business Plan A: Cell Phone App

Advantages:

- Cheaper
- Easy to download an app
- Existing software costs around $1000
- Option to buy software and leading examples on how we would be able to create our own.

Disadvantages:

- Not everyone has access to a phone
- Technology malfunctions: phone dies, cell service.
- Big upfront cost

Business Plan B: Handheld GPS Rental

Advantages:

- Everyone has the same ability to rent a handheld GPS
- Opportunity to earn back profit if we decide to charge for rentals.
- No need to worry about cell signal loss or battery.
- GPS systems are built for heavy weather.

Disadvantages:

- Responsibility when renting to members of Mass Audubon
- If one device is around $80-$100, and if we wanted to have enough stock even during busy times, it would cost around $15,000 upfront.
- You only have a set number, not a lot of flexibility.

Business Plan C: Cell Phone App + Upgraded Tree Signage

Advantages:

- Easier and more reliable navigation.
- Trail signage is used as a backup for technological malfunctions.
- The signage and app symbols can match so that they are interchangable.

Disadvantages:

- More planning
- Not everyone has access to a phone
- Current signage system would have to be taken down.

Existing Apps and Software:

There are a few apps that already exist that provide GPS maps for some of the Mass Audubon trails. These apps don't provide maps for all of the Mass Audubon trails so a new app would need to be developed. Software, on average, costs around $1000. This cost would cover an app that would provide maps for all the Mass Audubon parks. This is a much cheaper option in comparison to a physical GPS. One device costs between $80 and $100. If a park purchased 50 GPS devices, that would cost between $4000 and $5000. With 60 different parks, physical GPS devices would cost $24,000 to $30,000 while an app would be around $16,000, which will be further explained in Phase 2.

Business Plan Summary:

The Business Plan that we, as a team, have decided to pursue is Business Plan C. This system will give visitors the most flexibility in the type of navigation they want to use, will reduce costs significantly, and is reliable when there are technological malfunctions. We will create an iPhone app using pre-existing software that enables map downloads and creates easier navigation. While GPS handheld systems would be more reliable, as GPS rely on satellites rather than cell towers, the cost of GPS handheld systems as a business plan is too large to be a viable option. While phones have the disadvantage of losing cell service, being able to have a downloaded map of Mass Audubon on your own device allows for reliable navigation regardless of the service in the area. Additionally, we would create QR codes at the Mass Audubon kiosks to provide detailed information about the trails and wildlife. With technological issues in mind, for when all else fails, we think it is important to have a sufficient back-up plan. The updated tree signage would give visitors another option of navigation without having to rely on technology. The updated signage would be a form of color coding the trees on the trails to identify which trail you are on. Each trail would have a single unique color and we would keep the existing arrow navigation system that is currently in place. As a whole, this business plan will help visitors enjoy the nature and wildlife of Mass Audubon without having to worry about navigation problems.

Phase 2: Systems Analysis

Cost Benefit

To start the cost-benefit analysis, we looked at the non-recurring costs of making a wayfinding app. We came to the conclusion that these costs would include the upfront costs of making the app, which includes software costs and the costs to hire and pay for app developers. For software costs, we decided it would cost ~$1000 for software, and then we decided app developers would be paid $30/hr and work for about 500 hours on the app, costing $15000. Next, we analyzed recurring costs, which consisted of the costs necessary to update the app. We decided software costs for this would be about $250 per year, and that personnel costs would be 75% of the original cost, and then be discounted at 25% per year, leveling off to 25%. We chose these numbers because we assumed that the app would need more updates in its earlier years than it would in later years. Finally, we looked at the benefits of a wayfinding app. We concluded that the only benefit would be the money saved from printing maps, which we assumed to cost about 15 cents a piece to make. Without the app, we assumed that 90% of visitors took a map. After the app comes out, we assumed that 40% of people would use the app in the first year, and every year after 5% more people would use the app due to it becoming more advanced.

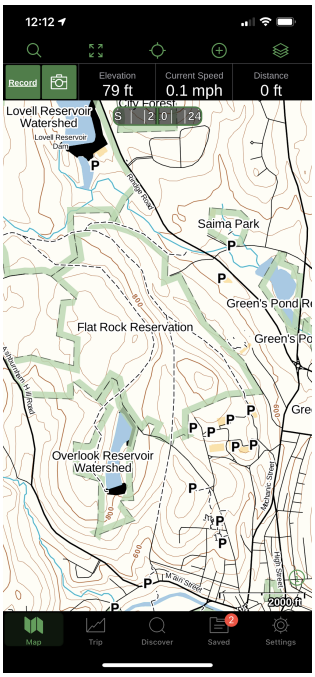
Figure 1 - Cost Benefit Analysis

			Fiscal Year				
Costs			**2020**	**2021**	**2022**	**2023**	**2024**
Non Recurring	**Rate**	**Hours**					
Hardware			$0.00				
Software			$1,000.00				
Networking			$0.00				
Infrastructure			$0.00				
Personnel	$30.00	500	$15,000.00				
Recurring							
Hardware				$0.00	$0.00	$0.00	$0.00
Software				$250.00	$250.00	$250.00	$250.00
Networking				$0.00	$0.00	$0.00	$0.00
Service Fees				$0.00	$0.00	$0.00	$0.00
Infrastructure				$0.00	$0.00	$0.00	$0.00
Personnel (Discounted @ 25% Per Year)				$11,250.00	$7,500.00	$3,750.00	$3,750.00
Discount Rate	0.25			75.00%	50.00%	25.00%	25.00%
Total Costs			**$16,000.00**	**$11,500.00**	**$7,750.00**	**$4,000.00**	**$4,000.00**
Benefits							
Cost Reduction (from maps)			$27,000.00	$30,375.00	$33,750.00	$37,125.00	$40,500.00
Total Benefits			**$27,000.00**	**$30,375.00**	**$33,750.00**	**$37,125.00**	**$40,500.00**
Net Costs/Benefits			**$11,000.00**	**$18,875.00**	**$26,000.00**	**$33,125.00**	**$36,500.00**

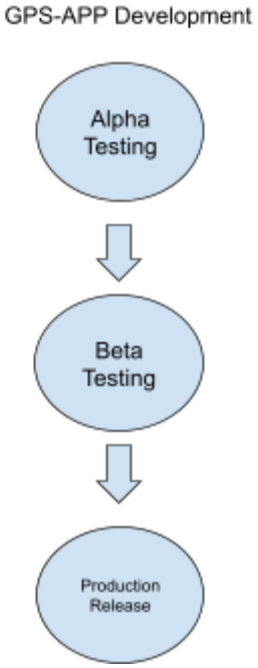
Figure 1.1 - Map Costing

			Fiscal Year				
Map Costing	**Pre-App**		**2020**	**2021**	**2022**	**2023**	**2024**
Paper Map Sales							
Visitor/Mo	500,000						
Percent of Visitors Who Take Maps	90.00%						
Number of Visitors Who Take Maps	450,000						
Printing Costs	$0.15						
Total Costs for Maps	$67,500.00						
People Using App			40.00%	45.00%	50.00%	55.00%	60.00%
App Savings			**$27,000.00**	**$30,375.00**	**$33,750.00**	**$37,125.00**	**$40,500.00**

Prototype - Alpha Testing

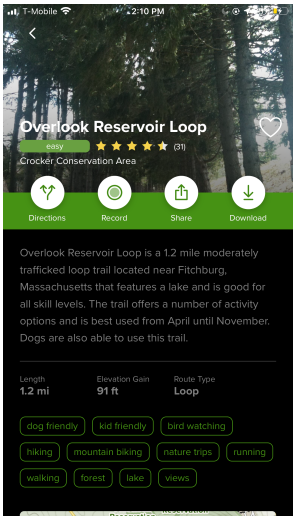


For Alpha testing, we primarily focused on adapting the most important information from the document analysis into our design. The main feature we emphasized as top-of-mind was map clarity. Since the users of this app will spend most of the time using the map function, we found it most important. Some of the features we adapted included were trail markers, parking insignias, and coloring of water areas. Although this design lacks extra features, the developers were able to test the essential fidelity of the app.



Prototype - Beta Test

For Beta testing, we delivered a nearly finished version of the app that had many more features when compared to its Alpha counterpart. To start, the maps were easier for the users to find trails and view overall, and also have trails on the map outlined with users being able to click on them to view trail information. When clicking on a trail, a user now sees the trail's elevation throughout the path along with pictures and a summary of the trail itself. Moreover, the user can see their location on the map so that they are able to use the app to see if they are on the path or not.



Multi-Weighted Criteria Analysis

We used a multi-weighted criteria analysis to consider competing investments. In this case, we compared the cost of a hardware GPS solution to the APP-Based GPS.

The hardware GPS solution would be to give visitors a hardware device when entering the visitor center, so that they can follow the trail's preloaded map on the device. The device would then be returned to the visitor center on exit of the park.

The APP-based GPS allows for the visitor to utilize their smartphone's GPS capability to navigate themselves through the park. The APP based solution also offers multiple expansions for future developments.

In terms of requirement weights, we gave User Interface the highest weight as we believe that ease of use is important to park visitors. We also gave security capabilities a high weight because we emphasise customer privacy. BI Capabilities were the lowest of the three requirements, as extra intelligence will be helpful but not necessary. In terms of constraint weights, we weighted software, hardware, evenly and operating and ease of training evenly.

We gave the hardware solution a low UI score because the foriegn device might be hard for park visitors to use. However, its high security score eliminated privacy concerns. The lack of business intelligence on the hardware solution made it unattractive. We determined that the software costs were the highest category in the analysis because the software comes with the purchase of the device. However, the ease of training was the lowest.

The GPS APP had mostly even scores for the software, hardware, operating, and ease of training constraints. It excelled in the UI requirements as a user-friendly device has the highest potential for being adopted by park visitors.

Overall, the GPS APP is the best investment for us because it not only exceeds the requirements of our business but also abides by the constraints set by management.

Figure 2 - Multi Weighted Criteria Analysis

	Weight	Hardware Solution		GPS-APP	
		Rating	Score	Rating	Score
Requirements					
User Interface	22.00%	1	0.22	5	1.1
Security Capabilities	18.00%	5	0.9	3	0.54
BI Capabilities	10.00%	0	0	4	0.4
Subscore	50.00%		1.12		2.04
Constraints					
Software Costs	15.00%	5	0.75	3	0.45
Hardware Costs	15.00%	2	0.3	4	0.6
Operating Costs	10.00%	3	0.3	3	0.3
Ease of Training	10.00%	1	0.1	4	0.4
Subscore	50.00%		1.45		1.75
Total Score	**100.00%**		**2.57**		**3.79**

Collecting Requirements

In systems analysis, collection requirements are an important part of the software development lifecycle/ Requirements collection gathers information from stakeholders in the company to understand how a system should function. In our case, we utilized questionnaires, observations, and document analysis to determine what was necessary for our app.

In terms of questionnaires, we had park visitors fill out a series of questions to establish their current wayfind preferences and demographics. A screenshot of the survey can be found below:

In addition, we also utilized observations to see how data is currently flowing. We investigated existing trial signage and determined how to improve upon the initial design

We opted to improve the design of the existing trailheads by adding QR codes with information about the trail. Trailhead information access points will allow park visitors not to only be more immersed in the wildlife they should expect to see on the trail, but also safer.

Lastly, we conducted a document analysis leveraging existing trail maps as inputs. We looked to keep the parts of the design we felt useful-- such as topography, trail names, and coloring, but also worked to improve the design by cleaning up the legend into a compiled menu versus on screen. We felt this made the map more clearer to the reader and thus more efficient in the long run.

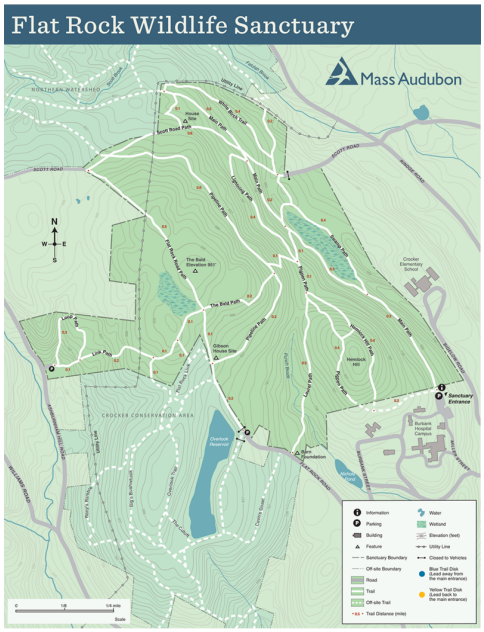
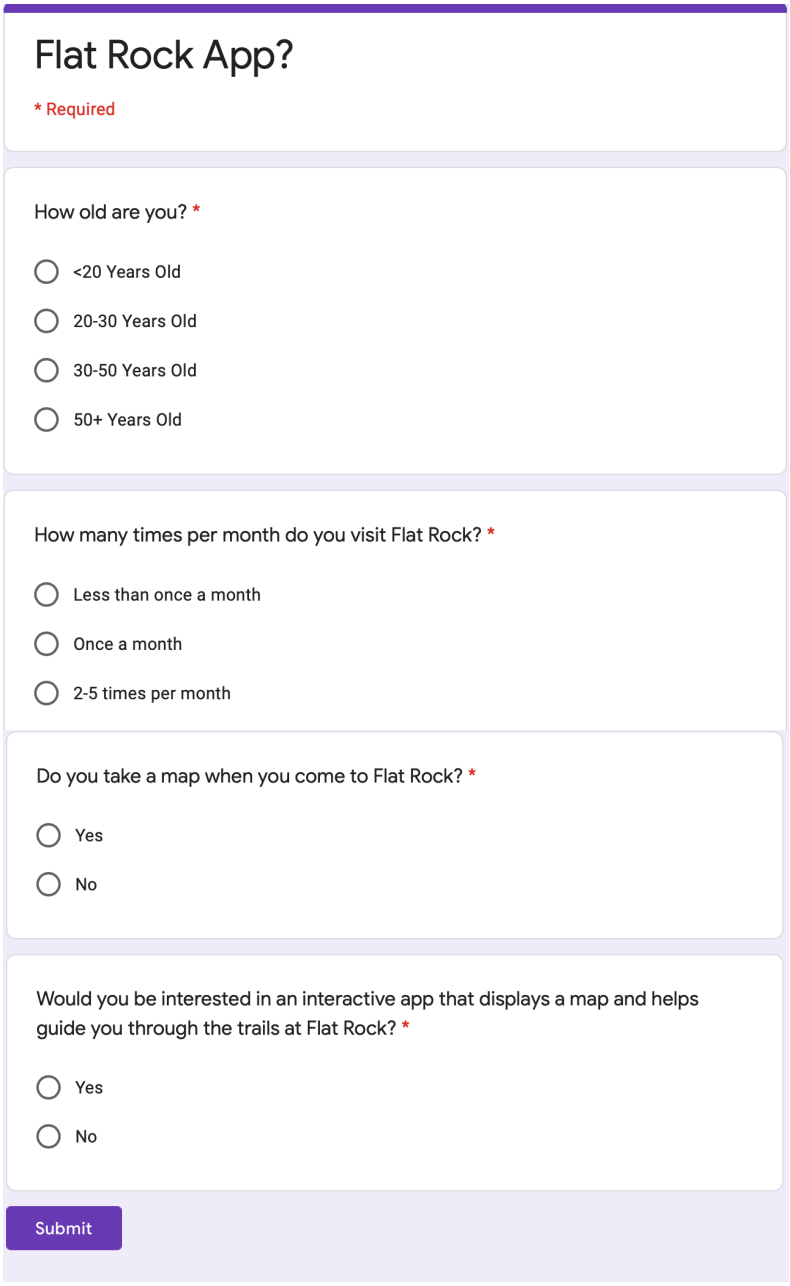


Figure 3 - Collection Requirements Questionnaire



Flat Rock App?

* Required

How old are you? *

- <20 Years Old
- 20-30 Years Old
- 30-50 Years Old
- 50+ Years Old

How many times per month do you visit Flat Rock? *

- Less than once a month
- Once a month
- 2-5 times per month

Do you take a map when you come to Flat Rock? *

- Yes
- No

Would you be interested in an interactive app that displays a map and helps guide you through the trails at Flat Rock? *

- Yes
- No

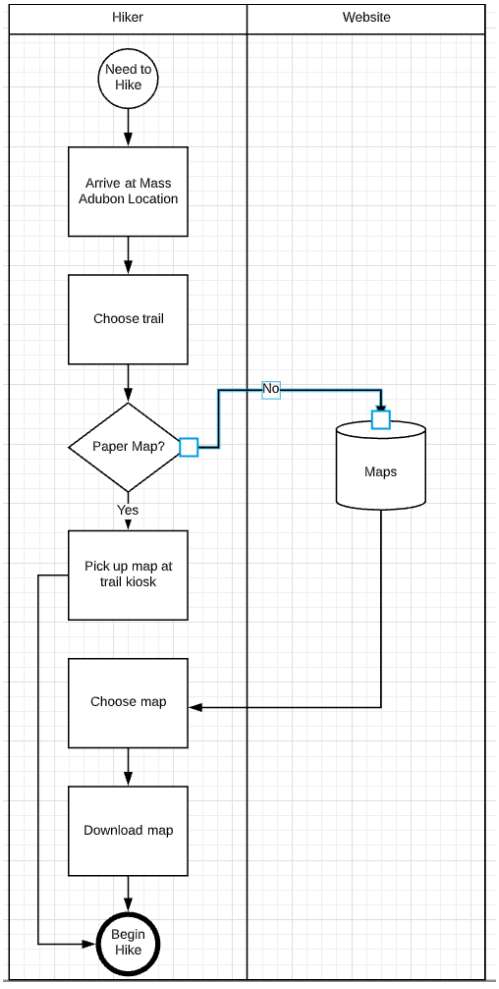
Submit

Phase 3: Systems Design

Inputs to System Design:

- Statement of Work (**Refer to Phase 1**)
- Requirement Determination Plan (**Refer to Phase 2**)
- Current Situation Analysis

Current Wayfinding Business Process Map

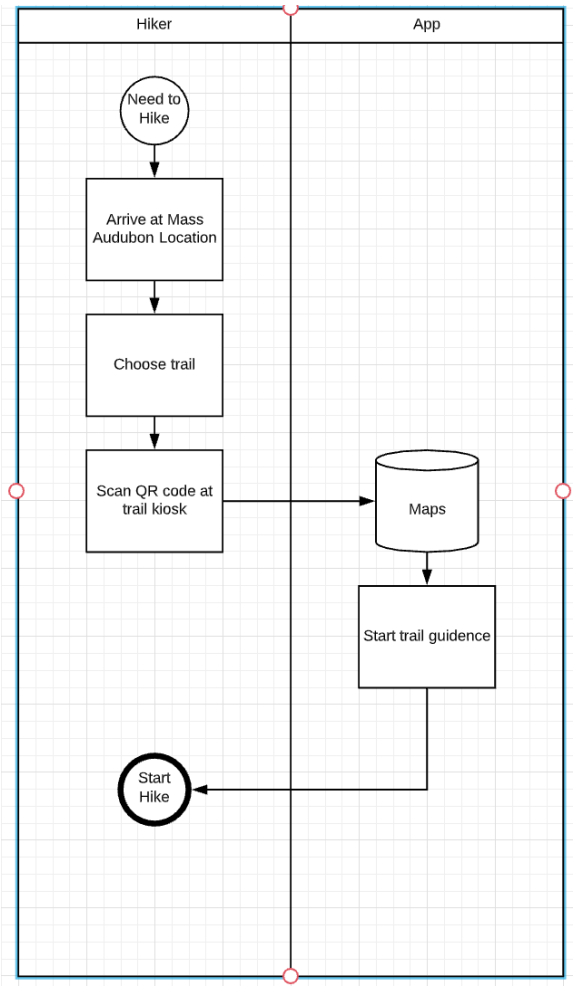


The BPM above shows the process of starting a hike given the current means of wayfinding at each trail kiosk. This means that each hiker will have to decide if they would like to use a paper map or take it upon themselves to access the sanctuary's website and download a PDF version of the paper trail map.

Outputs for System Design:

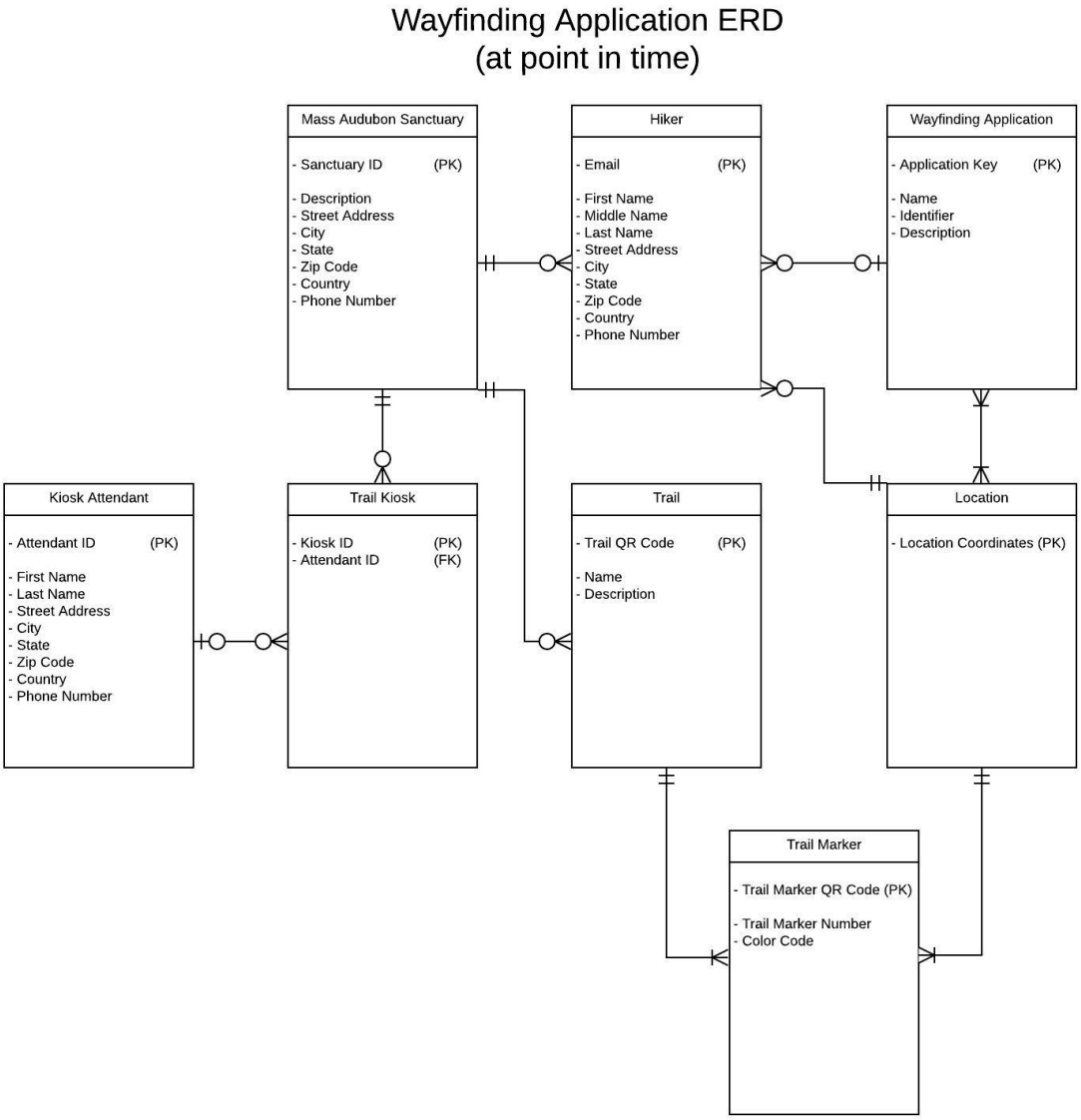
- Proposed System

Proposed Wayfinding Business Process Map



Our team as previously stated has decided to improve the current wayfinding measures by creating an app that contains a map of each trail at the sanctuary which will have a GPS indicator that marks the hikers location in real time on the trail. This will simplify the process of starting a hike as it removes the need for a hiker to make a decision as to which map type they would like to use. This will also reduce the likelihood of human error through forgetting to take a paper map or download the PDF version. In the event that someone still does forget to scan the QR code posted at the trail kiosk to access the GPS mapping for the trail the upgraded trail markers will allow for easier navigation of the trail without a map.

Proposed Entity Relationship Diagram



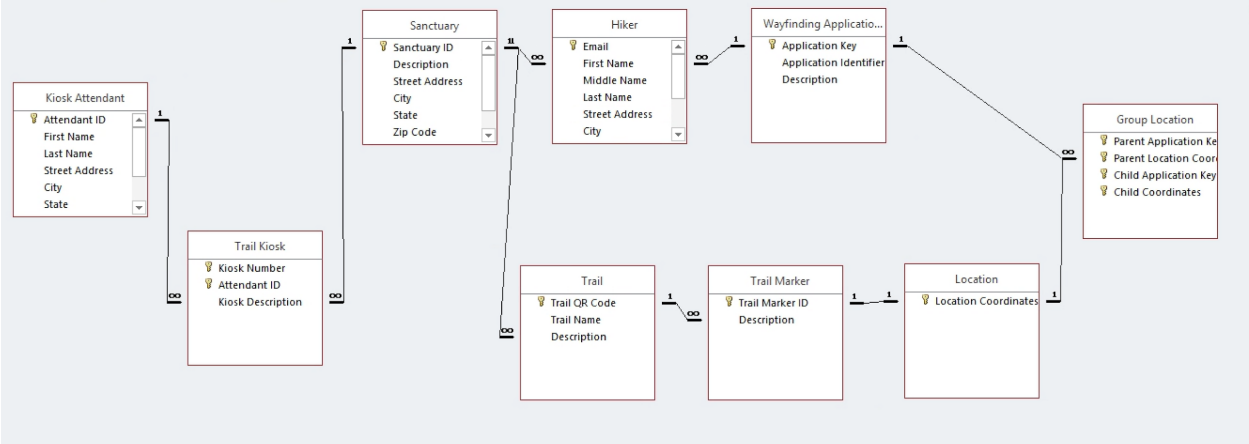
The central focus of this entity relationship diagram lies with the **wayfinding application** and its relationship to the **hiker** and **geolocation** services and tracking (less to no reliance on cellular data). The **kiosk attendant** is an optional addition to our proposed system, for the scanning of QR codes will provide the **hiker** with information regarding the trail and highlight to the hiker their location. This would essentially help cut down the need to employ **kiosk attendants** and classify them as a variable expense; ultimately, reducing the cost of the business. **Trail markers** will possess identification in the form of a QR code and color coding. This will allow **hikers** to not only digitally track their location by scanning the QR code through the **wayfinding application,** but also give **hikers** the ability to physically track their locations and trail that they

are on without use of the app using the color coding. The proposed system will give hikers a more comprehensible sense of their location at any given time.

Below are the descriptions of all entity relationships featured in the diagram above:

- A **hiker** can be hosted by **one and only one sanctuary**, and a **sanctuary** can host **zero or many hikers** (at a point in time)
- A **sanctuary** can have **zero or many trail kiosks** established, and a specific **trail kiosk** can be established in **one and only one sanctuary** (at a point in time)
- A **trail kiosk** can (or should) be attended by **zero or one kiosk attendant,** and **kiosk attendants** can attend **zero or many kiosk** (at a point in time)
- A **sanctuary** can feature **zero or many trails,** and a specific **trail** can be featured by **one and only one sanctuary**
- A **trail** can feature **one or more trail markers**, and a specific **trail marker** can be featured by **one and only one trail**
- A **trail marker** can be indicated by **one and only one location,** and **location** can indicate **one or many trail markers** (at a point in time)
- A **hiker** can install **zero or one wayfinding application** (assuming he uses only one digital mobile device to navigate), and the **wayfinding application** can be installed by **zero or many hikers**
- A **hiker** can be indicated by **one and only one location,** and **location** can indicate **zero or many hikers** (at a point in time)
- A **wayfinding application** can convey **one to many locations**, and **location** can be conveyed by **one to many wayfinding applications**

Proposed Database



The only additional table added is the **intermediary table** that accommodates for the **many to many relationship** between the **wayfinding application** and **location** tables. This table is labeled as **group location**. This indicates a feature whereby if a hiker were to hike with a group of people, if all individuals in the group also have the **wayfinding application,** they would be able to track each other's geolocation using the application. This will help hikers keep track of each other in the instance one or more people get lost or the group is separated. The system will work whereby a single individual's mobile device will be assigned as the **Parent**, and the remaining mobile devices will be assigned as **Child(s)**. The physical address or location of the **Parent** device will be labelled as the **Parent key**, and the **Child** devices will be labeled as the **Child Key.** All locations will have their names featured on the app when separated, but when together, only the name of the **Parent** device will be highlighted.

- File Organization and Access

The file organization method for tracking the locations of hikers will be **Direct (relative)** whereby each record is stored based on the physical address or location on the device. The address will be calculated from the value stored in the device's key field. Records are located via **Direct (Random) Access**, by knowing the physical locations or addresses on the device rather than their positions relative to other records.

(Optional) The file organisation method for recording hikers that visit the sanctuary and attempt a specific trail will be **Sequential.** The records will be stored in chronological order (in order as they are input or occur). Every record on the file is processed via **Sequential Access,** starting with the first record until End of File (EOF) is reached.

Systems Implementation

We have opted to introduce the new system using the **parallel conversion strategy** first. Not every hiker will readily have the app once it is introduced, and not every hiker will know to bring their mobile devices with them. As such, once more and more people become less dependent on physical maps, we can remove the old system altogether.

Trail Marker Maintenance

With the implementation of new Trail Markers, maintenance requirements will increase for these markers. People will be employed specifically for the task. We will have funds to reassign to the maintenance process as we cut back on Trail Kiosk attendants. Once hikers become less reliant on trail kiosk attendants, we will remove the position variably. Attendants need to be present during working hours, whereas Trail Marker maintenance staff will only be required on site bi-annually or at your discretion. This will inherently reduce costs.