The University of Western Ontario

Department of Electrical and Computer Engineering

Software Engineering Program

SE4450 - Software Design II
Project Proposal

AR We There Yet?

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Introduction and Problem Statement

Navigating to an unfamiliar location can be a source of anxiety and irritation as possible delays or confusion can cost one additional time, money or opportunities. Although technologies such as Google Maps have allowed individuals to confidently travel to a destination, navigating to a specified location within the building or venue still presents a challenge. For example, a candidate for a job interview often arrives early, not only for professional appearances, but to allow themselves time to locate the office within a building. The standard signage and maps are limiting, as they must be interpreted and analyzed, and do not provide real-time feedback. People also want to be independent and do not want to rely on others for direction. Combining the limitations of current tools and desire to be self-reliant, there is an inevitable frustration with onsite navigation.

The anxiety, pressure and difficulty of navigating only mounts when a large crowd is introduced, visibility is significantly reduced, and the flow of people can easily cause misdirection. To address these daunting factors, intuitive and affirming wayfinding techniques or tools should be introduced for large event grounds, improving overall customer experience and allowing attendees to effectively get to their desired attractions.

AR We There Yet? will be an augmented reality based wayfinding solution, available on mobile phones and devices. Using a real-time, real-world overlay, AR We There Yet? will ease the consumer's ability to navigate. It will also provide route planning and optimization given a user's input for desired attractions. Large and multi-site event grounds and venues will benefit from this solution as they can provide an improved customer experience, that will result in better profitability and brand building. The platform will follow a software as a service (SaaS) model and be customized for wayfinding on specific client sites. End users will simply download the universal application onto their devices, and then enter or select from the supported sites, to start using the solution.

Background Information

Consumer Need and Growing Trend for Indoor Wayfinding

In terms of navigation, human history has seen constant evolution and innovation: from constellations to cartography to signage to GPS. However, even with the set of current navigation tools, there is still significant room to improve as inconsistent methods and dated tools are applied when navigating inside. Physical signs and 2D maps are the most common tools, if any are even provided, for on site navigation, but these methods require individuals to interpret, analyze and route themselves with little feedback once they begin their journey. This poses significant difficulty to those who are visually impaired and those who are afflicted with developmental topographical disorientation (DTD), which is a deficiency in the ability to build/retain one's cognitive map. An intuitive solution with real-time affirmation is needed.

One can always ask for a guide or directions from others, however studies have shown that there are psychological barriers to doing so, for example, men are less comfortable or willing to ask, and people generally don't want to impose on others as they believe others are less likely to help.[1] In addition, with the rise in international tourism, 31.3 million international visitors to Canada in 2018 alone,[2] the resultant language barriers can contribute to the difficulty of navigation. These factors confirm the need for independence and self reliance when wayfinding.

Lastly, smartphones are one of the most widely used electronic consumables. According to the data collected by Google on voice assistant searches, the number one question posed by adults, and number two for teens, was related to directions lookup.[3] Innately, people are looking to their smartphone devices for directions, most likely because of habitual practice of using map apps. Providing a solution via a mobile app would be the easiest for end-users to adopt because they are already accustomed to looking there first.

Current Available Technology

Having defined the realm of the solution as a mobile app for on-premise wayfinding, it is important to analyze the existing technology and competitors in this space. It is a trending market and Deloitte analysts are predicting that "as of 2020 at least [25%] of all human and

[1] Rigoglioso, Marguerite. "Studies show people underestimate the willingness of others to help them out". *Stanford Report*, August 6, 2008. https://news.stanford.edu/news/2008/august6/justask-080608.html
[2] Statistics Canada. "From far and wide, people are travelling to Canada!" Government of Canada, Statistics Canada. Government of Canada, Statistics Canada, September 27, 2019. https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2019042-eng.htm.
[3] Sullivan, Danny. "Infographic: Google Study Finds Voice Search Most Used To Ask For Directions". Marketing Land. Last modified October 15, 2014. https://marketingland.com/google-study-voice-search-directions-103985

machine uses of [navigation] will include an indoor leg or be for an entirely indoor journey".[4] As it stands there are no dominant players, however large software development corporations are putting funding towards this market and have already released some solutions. Google via its Maps product division is a competitor within the on-premise/indoor wayfinding sector as it has included a feature called Indoor Maps. As well, Microsoft has released Path Guide.

Current on-premise/indoor wayfinding software utilizes a variety of methods to provide accurate direction. Some use WiFi access points or Bluetooth Beacons to send signals and verify location or proximity. These solutions, however, require additional infrastructure costs and maintenance to the client which owns the building or venue. Solutions currently on the market also provide a varying level of quality in their navigation services from providing simple floor plans overlaid with a dot indicating current position and a highlighted route, to providing navigation via a series of picture snapshots with arrows.

Niche Market and Opportunity

Interactive wayfinding is particularly useful to large scale buildings and venues. Within this category are a wide range of different clientele to service including: malls, airports, railway stations, multi-story office buildings, hospitals and clinics, post-secondary campuses, museums and galleries, hotels and resorts, arenas and stadiums, or amusement parks and fairs/festivals.

For the purposes of this project, the focus will be on servicing large outdoor events such as amusement parks, fairs and festivals as there are several strengths and potentials to this client and type of site. It is beneficial to focus on large outdoor events because there is a large pool of users[5] that are usually more technologically advanced and thus will be more inclined to using a wayfinding app. In addition, large outdoor venues and events have several booths, stages, attractions, rides and facilities spread across their grounds which can exploit the full effect of wayfinding. Current methods usually involve a simple 2D map where the graphics are mere depictions. Only large corporations with excess capital to invest in software, or companies with their own internal software development teams, are able to provide a digital and reliable wayfinding solution for their site. Where we can differentiate further is by incorporating the use of AR into our solution. By integrating augmented reality into our solution, we can offer clients pinpoint-accurate positioning with visual cues on screen, making it easier to navigate through crowded areas.

[4] "Digital Predictions 2017". *The Deloitte Consumer Review*, March 2017. https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/consumer-business/deloitte-uk-consumer-review-digital-predictions.pdf

[5] "These Are the World's Best Amusement Parks." CNN. Cable News Network, May 18, 2018. https://www.cnn.com/travel/article/world-most-popular-amusement-parks-2017/index.html.

Objectives and Scope

Goals and Scope

The goal of *AR We There Yet?* is to provide a user centered, augmented reality solution to navigating and exploring the grounds of a large outdoor festival or amusement park. The mobile application will allow users to overlay their view of the physical world with wayfinding arrows and pathways to direct them through the various attractions and busy crowds in a simple and efficient manner. Having a simple to use and intuitive interface will be imperative to providing a better wayfinding experience for the users as well as maintaining a high level of user interaction.

The scope of the project will include basic visual recognition, but due to the large amount of data that will be unavailable to train the algorithms the visual recognition will not be at the level of accuracy desired. In addition, the ability to customize the use of the application (SaaS) will also not be in scope as the team will not have the time or access to multiple facilities/layouts to test and demo the application. The ability to test and demo the application will be limited by access to resources and budget. The team will not have access to a real amusement park or festival and will only be able to use the Western University campus as a testing ground and representation of the abilities of the application. This should not limit the team's ability to display the effectiveness of the application and its features but will not replicate the desired final product.

Constraints

The first iteration of *AR We There Yet?* will have AR wayfinding with routes to specific buildings on campus to show the UI/UX of the application. Because the purpose of the application is to enhance the users wayfinding experience this will be one of the most important aspects of the application. The AR wayfinding accuracy and attraction recognition will be limited by the quality of the AI visual recognition solution. Future iterations will contain such a solution but in the early stage users will need to input information in order to build an initial data pool. GPS will be the main driver of the wayfinding portion of the app and as such the wayfinding route accuracy will be limited by the accuracy of the sensor as well as the coordinates to the attractions that are mapped. Finally, time, budget and resources will be a major constraint. With only 8 months, 3 people and zero budget, development will be limited to the time and resources at hand.

Risk Mitigation

Possible risks for the project include framework and development environment restrictions. Because the team will be developing for two separate operating system (iOS and Android) there is a risk for the need to separate development into two native applications instead of the desired hybrid framework the team wishes to use. This could result in longer development times and reduced functionality of the application.

Methodology/Process

Throughout the duration of this project, the team will be utilizing the Agile Scrum Model as described by the Software Development Life Cycle (SDLC). The SDLC is a process used by the software industry to design, develop and test high quality software that meets or exceeds customer expectations and reaches completion within the proposed timeline. The SDLC consists of 6 stages: Requirements Elicitation and Analysis, Design, Implementation, Testing, Deployment, and Maintenance.

The Agile Scrum Model is ideal for this project due to its nature of iterative development, where requirements and solutions evolve through collaboration within a team. The team will have multiple, two-week long sprints to align with the Scrum Model. Arianna Basilone will be the designated Product Owner, representing the viewpoint of the client, amusement park and festival operating company, and will manage the product backlog. Each team meeting will begin with a scrum led by Monanshi Shah, the scrum master. During this meeting, team members can discuss what they have worked on since the last meeting, any issues they have encountered along with proposed solutions moving forward.

At the end of each sprint, the team will demonstrate and discuss the progress of the project, bringing forth any goals that were not completed during the sprint and what features can be defined as completed. Following the end of each sprint, the team will hold a scrum planning meeting to discuss what project goals will be focused on in the upcoming sprint.

Deliverables

The following are a list of deliverables and software artifacts expected to be generated during the course of the project and their due dates:

- Wireframes/View Sketches
- **Walkthrough Presentation (November 15, 2019)
- Midterm Report (November 29, 2019)
- SRS Document
- Software Testing Plan Document
- Prototype (January 24, 2020)
- Unit Tests
- Finished Project and Source Code
    - Android mobile application
    - iOS mobile application
- Demo (March 6, 2020)
- **Final Presentation (March 20, 2020)
- User Document
- Final Report (March 27, 2020)

**Includes a Powerpoint or other visuals, as well as concept documents

Project Plan

Milestone Description	Start Date	Duration	Progress
Brainstorming	26-Sep-19	6	100%
Rough Draft	26-Sep-19	5	100%
Final Draft	30-Sep-19	5	100%
Advisor Sign-Off and Submission	04-Oct-19	1	100%
Requirements Gathering	04-Oct-19	14	15%
Software Design	15-Oct-19	5	
Research on Technologies	15-Oct-19	14	
Creation of Test Plan	20-Oct-19	4	
Use Case Specification	25-Oct-19	3	
Walkthrough/Presentation	15-Nov-19	1	
Wireframes	26-Oct-19	5	
Interaction Symbols	26-Oct-19	3	
Design Template	26-Oct-19	3	
Set Up Development Environment	15-Nov-19	5	
IOS Development	20-Nov-19	20	
Andriod Development	20-Nov-19	20	
Database Development	25-Nov-19	30	
Front End Development	25-Nov-19	30	
Sensor Recognition	05-Dec-19	24	
AR Integration	05-Jan-20	20	
GPS Navigation Integration	20-Jan-20	20	
Unit Testing	01-Feb-20	15	
Integration Testing	10-Feb-20	15	
Testing Documentation	10-Feb-20	8	
Creation of Report	20-Feb-20	10	
Creation of Presentation	25-Feb-20	5	
Practise and Review Presentation	19-Mar-20	5	
In Class Demonstration	20-Mar-20	1	
Submission of Final Report	27-Mar-20	1	

Figure 1.0 - Gantt Chart Table

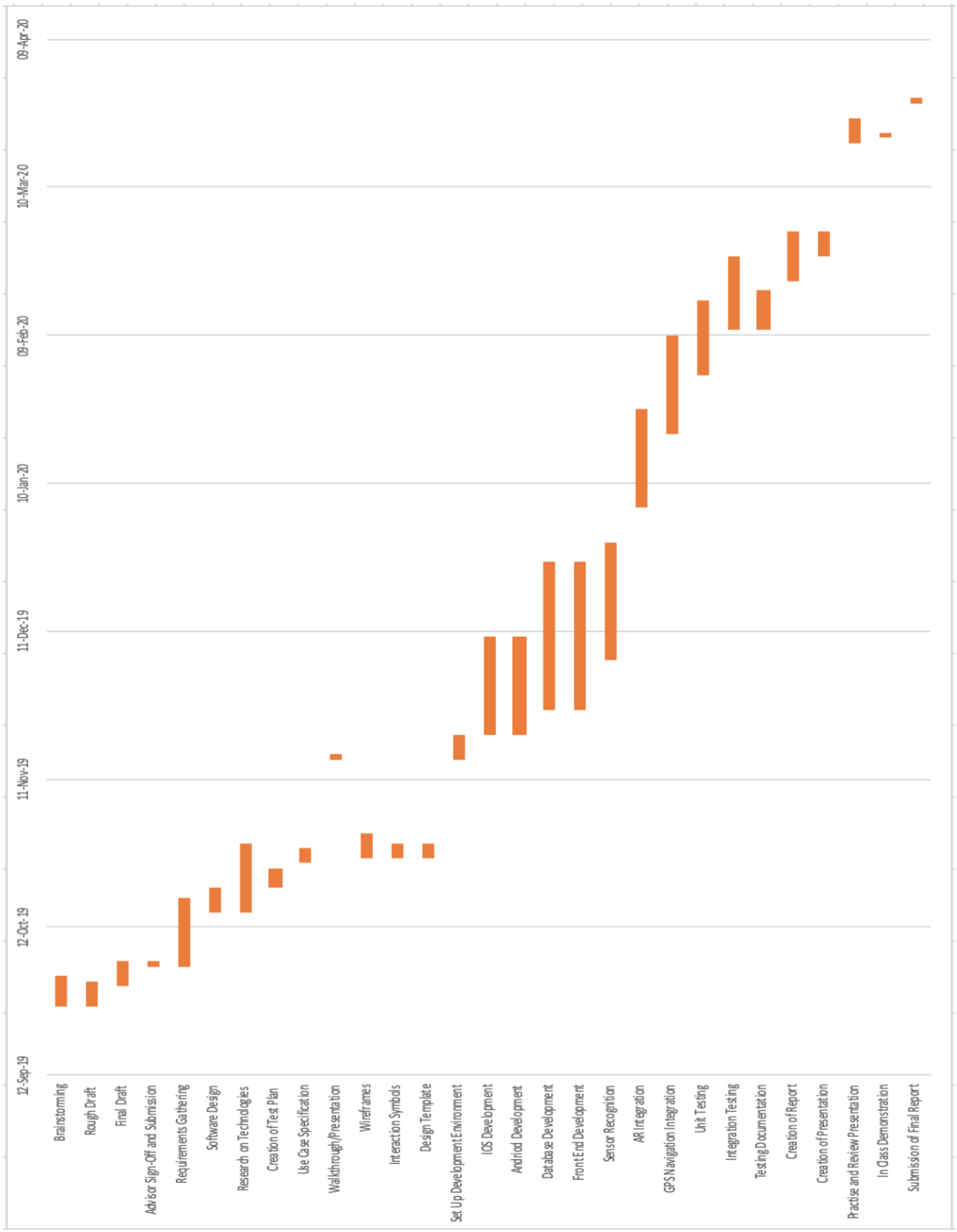

Figure 1.1 - Gantt Chart

Milestone Description	Arianna Basilone	Jake Sakon	Monanshi Shah
Project Proposal			
Brainstorming	X	X	X
Rough Draft	X	X	X
Final Draft	X	X	X
Advisor Sign-Off and Submission	X		
Software Requirements and Design Specification			
Requirements Gathering	X	X	X
Software Design	X	X	X
Research on Technologies	X	X	X
Creation of Test Plan	X	X	X
Use Case Specification	X	X	X
Walkthrough/Presentation	X	X	X
UX Design			
Wireframes	X	X	X
Interaction Symbols	X	X	X
Design Template	X	X	X
Build			
Set Up Development Environment	X	X	X
IOS Development	X	X	X
Andriod Development	X	X	X
Database Development	X	X	X
Front End Development	X	X	X
Sensor Recognition	X	X	X
AR Integration	X	X	X
GPS Navigation Integration	X	X	X
Testing			
Unit Testing	X	X	X
Integration Testing	X	X	X
Testing Documentation	X	X	X
Final Report and Presentation			
Creation of Report	X	X	X
Creation of Presentation	X	X	X
Practise and Review Presentation	X	X	X
In Class Demonstration	X	X	X
Submission of Final Report	X		

Figure 1.2 - Matrix of Responsibilities