

Mental Disorder Assisted VR Navigation

Final Project Report

WSU College of Education



CougDirect



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I. Introduction

Our project is with the WSU ROAR program, a program for students with mental disabilities that helps them learn to live independently and they gain an education along the way. We are designing a mobile application that will help these students navigate the campus at WSU, and help them find their way around Pullman. Our client's name is Katie Abrams, and she is the main supervisor of this program. She came up with the idea for our application after a student had been lost on campus until 3 AM last year, and had no cell battery and could not find their way home. The application will be incredibly useful to students of all backgrounds, but it is intended for students in the ROAR program. The students will be able to use the app to help them find easy and accessible routes around the WSU campus and utilize the Pullman Transit system.

Additionally, we have a coach for this project, Dr. Ananth Jillepalli. He helps us with a lot of our planning and keeps us on track with many deadlines and other various tasks we must do to ensure our project is completed smoothly.

II. Team Members & Bios

Yurun Han is a computer science student interested in software development and human-computer interaction production. His previous projects include data analysis software for restaurant recommendations. His skills include C/C++, Python, Java and some general skills. For this project, his responsibilities included developing the map and video features required for the user experience and handling some reporting.

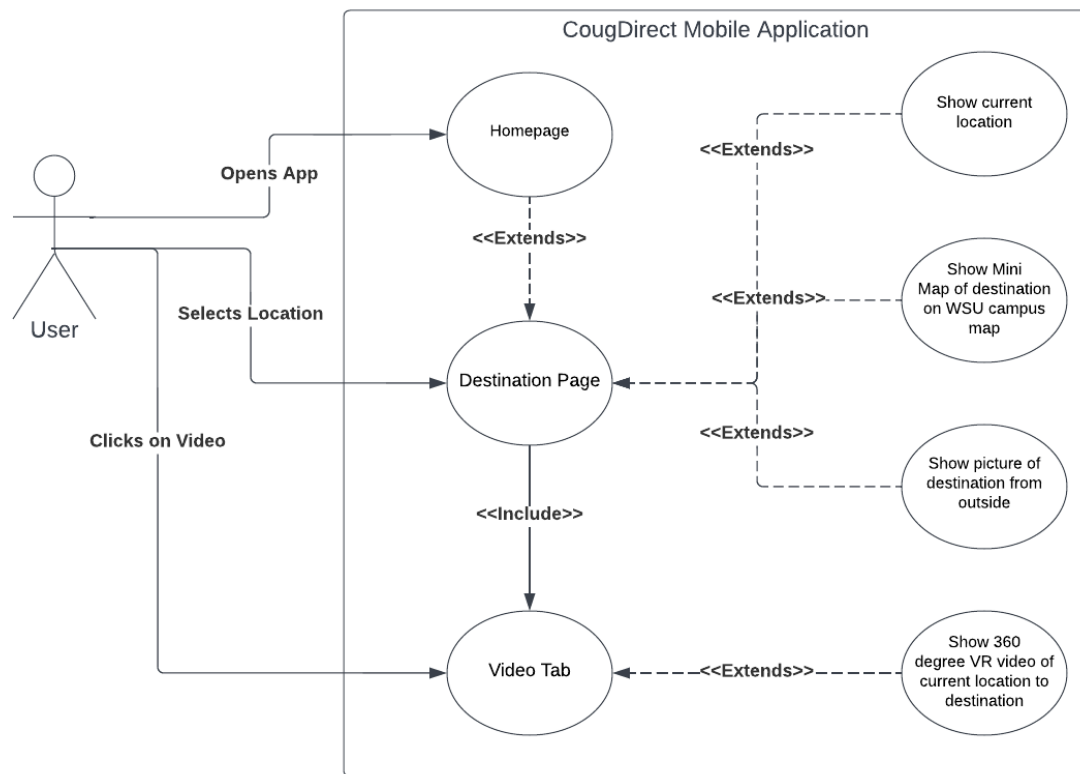
Alex King is a computer science student with a minor in mathematics, and he is interested in the fields of Artificial Intelligence and Mobile Application Development. He has worked on various Data Science and Machine Learning projects before. His skills include C/C++, Python, Java, Kotlin, and project management software. He is the team lead on this project, and is in charge of scheduling, managing the repository, as well as assisting with whatever programming is necessary.

III. Project Requirements Specification

A. Project Stakeholders

Our main clients consist of the WSU ROAR Program, industry sponsor, Katie Abrams, and our mentor, professor Ananth Jillepalli. Our Stakeholders would be anyone who decides to download and use our application while they're on WSU campus. However, our main target is for those with a mental disability.

B. Use Cases



Story: Casey is a first year student at Washington State University who was born with a mental learning disability. She is currently sitting in the lounge watching TV at the Compton Union Building (CUB). Casey almost forgot she has to be at the WSU ROAR meeting room at 1:15pm and the current time is 1:00pm. Casey has about 15 minutes until she has to be in the meeting room. She opens CougarDirect and is greeted with the homepage. Within the homepage, she sees a button with the words “Select your destination”. Casey presses the button and is shown a dropdown menu with a variety of locations. She selects Cleveland Hall and is taken to a different page within the app. Casey is taken to a page dedicated to her destination. Here she is greeted with a text stating her current location, a picture of the campus map which includes where her current location is compared to her destination’s location and a picture of her destination. Casey clicks on the video and she is taken to a video tab. Here she is shown a 360 degree video, instructing her how to get to her destination. The video also includes a narration on how to exactly get from her current location to her desired location. Following the video, Casey makes it to the meeting room at 1:15pm exactly.

C. Functional Requirements

- I. All buttons work as intended.
- II. Video links connect to youtube API correctly
- III. Map correctly shows current location
- IV. Map shows correct locations for accessible entry
- V. Map shows correct bus route stops
- VI. Map shows loops of bus routes in separate map view

D. Non-Functional Requirements

- I. App fonts are pleasing to look at and easy to read
- II. UI is not full and very basic
- III. UI has no more than three buttons per page
- IV. Photos are up-to-date
- V. Walking videos are up-to-date

IV. Software Design- From Solution Approach

A. Architecture Design

I. Overview

About the system overview, we must first understand that this project is based on the support of Android and ios platforms. And follow-up in order to meet the special needs of more in-depth development and optimization. A suitable framework and language need to be picked. So when creating a design for this project, we will consider learning swift. The first area the team needed to adapt was running on iOS and Android. Swift's switch syntax is very similar to Java and C++. Extensions in Swift are powerful and can also extend the classes of the system. We have proposed two hybrid APP development models before: "Native+H5" and "Native+Mini Program". The cost of learning React Native ideas and syntax will be relatively high and requires a certain understanding. It is also to avoid functional differences between Android and iOS products. May be updated to more appropriate versions and technologies as more information becomes available. For example some possible requirements of the client and changes or additions to the project.

The panoramic navigation done by the project adds the functions of scene jump, route guidance and positioning and wayfinding on the basis of panoramic images or videos, thus giving the panorama the role of navigation. It puts the user in a scene that is no different from the real environment, and also solves the problem of unclear orientation recognition. Arrow guidance is more intuitive and effective, and at the same time, the confusion during wayfinding is greatly reduced. There are complex environments distributed on the campus, and ordinary navigation software cannot cope with it at all, and GPS cannot locate the details of the user's location. With the help of Panorama, users can learn more about small functional facilities. Meet the navigation needs within a few hundred meters.

These functional solutions will try to improve and better design the user interface and functional settings through team discussion and thinking. Such as the stability of GPS functions, the integrity of interface information and the availability of mini-maps. To make it have a variety of information without appearing complex, it is necessary to consider the design of the interface. And the most important panoramic video must ensure that users can open more quickly and smoothly.

II. Subsystem Decomposition

The homepage only includes a couple features. The user will be greeted and will have the option to select a desired location. This page will feature a drop down menu with a variety of different locations within the Washington State University campus. Once a desired location is selected, this page will take the user to another page dedicated to the destination. Thus, the Homepage must be able to extend to the Destination Page.

Priority: Level 0: Essential and required functionality

III.2.2. Implement Current Location Tracker

This feature will allow the application to know the exact location of where the user is at the moment. With this information, the application will be able to provide the correct video to show the user. The mini map feature will also require this location tracker to be working correctly and fully functioning.

Priority: Level 0: Essential and required functionality

III.2.3. Implement Mini Map

This feature will be located within the Destination Page. The mini map will allow the user to see where they are currently compared to their destination on the Washington State University campus map. The mini map feature will require the application to have access to the user's current location, thus the Current Location Tracker must be functioning correctly.

Priority: Level 1: Desirable Functionality

III.2.4. Implement a way to include a picture of destination

This feature will be located within the Destination Page. This feature is pretty simple. We want to include a picture of the destination so the user can identify if they have reached their desired location or not. To implement this feature, we just print out a picture of the destination to the user's screen.

Priority: Level 1: Desirable Functionality

III.2.5. Implement Destination Page

The Destination Page will include a fair amount of features. First, stated previously, this page should include a mini map presenting the user where their current location and destination are

located in correlation with each other on the Washington State University campus map. Second, an image of the destination will also be presented to the user to assist them in identifying that the destination is true. Lastly, this page will include and allow the user to watch a 360 degree VR video in fullscreen about how to get to their desired destination from their current location.

This page will need access to a few things to be functioning fully. The page must be able to have access to the user's current location, the mini map feature, a picture of desired location, and the 360 degree VR video of directions from current location to desired location. This video can also be enlarged so the user can watch the video in fullscreen.

Priority: Level 0: Essential and required functionality

III.2.6. Implement the video tab/fullscreen feature

This feature is pretty simple. We want the user to have the ability to watch the 360 degree VR video in fullscreen mode. To implement this feature, we can manipulate how the video file is being played and projected so that it covers the entire screen of the user's mobile device. This feature will only need access to the media file and the destination page, thus it must have access to both features.

Priority: Level 1: Desired

B. Data Design

At this moment, we are not collecting or utilizing any data.

C. User Interface Design

Since our project is a mobile app, it will have a graphical user interface. It will have many different pages and functionalities.

The application will have a welcome/home page; this page contains a few buttons all with different functions. These buttons are as follows: Select a destination (from drop down menu), assign current location, view map. There will also be a tab that the user can toggle to view other various options, such as view specific locations, or watch videos on their own without creating a path.

Once the select a destination button is selected, the user will then choose from a predetermined list of locations where they would like to go. The user will be able to string destinations together as well to create a path. The user will be able to determine the order of the locations in which order they select the item from the drop down menu. This will be indicated by a number indicating the order next to each item. For example, if the user selects both the item "CUB", as well as the item "Chinook Apartments", a 1 will appear next to "CUB" and a 2 will appear next to "Chinook Apartments". A text box on the app will indicate how long it takes to walk from each location to the next, and this will be updated depending on which locations the user chooses. Each page that is not the homepage will have an icon that can direct them back to the home page. The user can also decide to look at specific locations, and on these pages they will see a photo of the building, as well as a preview and link to a 360 tour video of the inside of the building. The user will also be able to view a walking path video to this building.

Once the user selects the view map, if they have selected their current location from a drop down list, they can see where they are in relation to the rest of campus. Otherwise it will be a normal interactive map of WSU.

One major thing the client has stressed to us is to keep the UI as simple, and subtle as possible. The user should not be overwhelmed with a large number of buttons or functions, and they should not be off put by bright and flashy designs. The user should only be noticing the main functionalities of the UI and nothing more. The UI will have a modest color scheme and soft edges for all of the buttons.

V. Test Case Specifications & Results

A. Testing Overview

This document describes the tests currently being used by the team for our purpose of maintaining the integrity of the application. The way we're going to write tests for a system will help us identify the system's biggest points of failure and the small ones within it, and give us the ability to fix those problems. After completing the development of this project, we will provide a robust testing system for quickly testing changes to the application and ensuring that critical functionality is working correctly. Basically divided into Unit Testing, Integration Testing, System Testing and Environment Requirements.

In order to achieve these goals, our team will likely build and write unit and integration tests using some suitable and efficient testing framework or other available means. And may use some tools to do resource hosting and running. Of course, this also requires a strong back-end system test to allocate and manage. For the testing strategy, the team also tests all implementations of customer requirements proofs. This includes testing the creation of read/write/admin views as well as backend components. Some additional requirements may also be tested, but due to the size of the project, may be presented in a more streamlined manner on the testing side of the project.

To achieve these test objectives, the standard test process is:

- a. Code written This includes the different functions of the project subsystem.
- b. To write tests for the code, you will write the actual test program.
- c. Testing the code will check that the test program satisfies the requirements and that no problems arise.
- d. If something goes wrong, the developer needs to fix the bug in the code and retest.
- e. Finally the developer pushes the code into the project repository.

When a bug is encountered in any part of the development, the developer will write a text describing the bug. Future developers will be responsible for fixing, finding and writing tests for future bugs and problems and testing them. This requires developers to be familiar with specific modules and components that will be able to deal with problems more quickly. As will be

mentioned below, developers will focus the project goals on subsets and achieve the purpose of testing in a fast and timely manner. This provides more value to customers and faster feedback.

B. Environment Requirements

Our testing will have a few different environments depending on specific functionalities. Most of the requirements for this project are non-functional, but are more cosmetic. For these we will show them to our client for approval as well as ask peers for their outside opinion as well. For the functional requirements there will be test code written, as well as implementing the apps on both iOS and Android devices to test how well the functions work on either operating system. For Android, all of us have emulators that we are using for testing. For iOS, Alex will be conducting tests on his own iPhone 11 Pro, and installing it from a Mac mini. Once a functioning prototype is available, we will be attending a ROAR class and installing it on many student's devices allowing them to test it out themselves.

C. Test Results

Functional Requirements :

I. All buttons work as intended.

All buttons work as intended on Android, iOS testing yet to be completed.

II. Video links connect to youtube API correctly

Video links connect to correct youtube video, but it is quite slow. If there is remaining time then finding a way to expedite this would be more user-friendly.

Tested on Android, not iOS.

III. Map correctly shows current location

Map shows general area but not precise location, feature still needs to be fine-tuned before prototype is deployed.

IV. Map shows correct locations for accessible entry

Map doesn't show these locations yet.

V. Map shows correct bus route stops

Map doesn't show these locations yet.

VI. Map shows loops of bus routes in separate map view

Map doesn't show these locations yet.

Non-Functional Requirements:

A. App fonts are pleasing to look at and easy to read

Client is satisfied with font choices and typeface sizes. Showed to students and they are also satisfied with choices.

B. UI is not full and very basic

Client is satisfied with UI design after a few mock up designs, is very pleased with prototype design. We have reworked the homepage UI a few times until she was excited with it.

C. UI has no more than three buttons per page

UI has no three buttons on home page, but has four included in the map.

Will show client the map page and ask if this rule can be bent for this page as each button is essential to the functionality.

- D. Photos are up-to-date
All building photos are up-to-date.
- E. Walking videos are up-to-date
Walking videos are mostly up-to-date, but need to be updated for newer apartment buildings for ROAR students. Need to include Chief Joseph and Nez Perce apartment complexes.

VI. Projects & Tools Used

Android Studio- Used to develop app

Youtube-Upload videos

Flutter-Framework to export application to both iOS and Android

Github-Version Control

Dart-Programming language used by Flutter

VII. Description of Final Prototype

Our Alpha prototype will include a set of features we are very excited to introduce. We have implemented a feature in which a user can select from a list of locations, and they can choose to navigate to that location, or learn interesting facts. We plan to implement a feature that will display the total walking time, and the ability to batch locations so they can choose more than one per path.

VI.1 User Menu

- **V1.1 Functions and interfaces implemented**

The user menu is fully functional, and allows the user to navigate to any portion of the application.

- **V1.2 Preliminary Tests**

The user menu has been tested by all of us, and shown to our client. The client approved of the functionality.

VII.2 Location Pages

VIII. V2.1 Functions and interfaces implemented

The locations pages all include photos of the location, but do not include the information or video on navigation to this location.

IX. Product Delivery Status

We are currently in the process of implementing the Google Maps API to our application, and once this is complete we will be able to export and test.

X. Conclusions & Future Work

For the second semester, the main tasks of the WSU-CougDirect project will include the completion of all previously proposed functional additions and modifications for optimization. The addition of functions includes: the improvement of some difficult functions such as GPS positioning and links to Google Maps. Narrow the difference between IOS and Android system and improve the problems. Guarantee that the system is perfectly adapted to the dual platform.

And will use feedback provided by customers to improve any existing design choices and implementations. As of now, the main thing that needs to be done is the paperwork on the plan and the basic framework of the procedure. Testing procedures and complete information will be added in the future. And the problems brought about by improving the readability and maintainability of the code and reducing the update will be discussed and implemented in the next semester. Developing more efficient procedures and methods is something we all need to consider at all times. In addition to completing these tasks, the team will frequently communicate with the client during the next semester to identify and plan additional items or requirements to be added to meet the client's growing needs.

XI. Acknowledgements

A huge thank you to Katie Abrams, supervisor of WSU ROAR, for being our client on this project. She has been incredibly supportive and helpful throughout the whole process. The ROAR program is incredibly valuable and we are honored to be chosen to make an application that will help these wonderful people.

XII. Glossary

GPS: The Global Positioning System, formerly known as Navstar GPS, is a satellite-based radio navigation system used to determine the location of something on Earth.

VR: Virtual reality (VR) is a simulated experience that can be similar to or completely different from the real world. Or refers to virtual reality devices such as: virtual reality helmets, Google glasses, virtual reality sensors, etc.

Android: Android is a mobile operating system based on a modified version of the Linux kernel and other open source software, designed primarily for use in touchscreen mobile devices such as smartphones and tablets.

IOS: iOS is a mobile operating system created and developed by Apple Inc. exclusively for its hardware. The operating system powers many of the company's mobile devices, including iPhones, iPads and Macpros, etc.

"Native + H5": Provide interactive functionality for applications. one of the modes

"Native + applet": Provide interactive functionality for applications. one of the modes

360-Tours: A virtual tour is a simulation of an existing location, usually consisting of a series of videos or still images. It can also use other multimedia elements such as sound effects, music, narration and text. It is different from using live TV to influence remote travel.

Cellular Data: Mobile data (also known as "wireless" or "cellular" data) is how you connect to a network when you're not using WiFi

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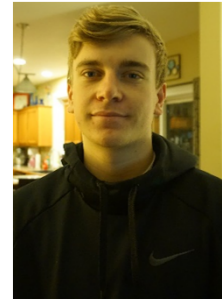
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XIV. Appendix A- Team Info

ALEX KING

Major: Computer Science

Minor: Mathematics



EDUCATION

Kennewick High School

Washington State University

Relevant Coursework:

Advanced Data Structures

Programming Language Design

Machine Learning

Data Science

Systems Programming

Graph Theory

SKILLS:

Experience programming in C/C++, Java, Python, R, and Haskell

Created a few machine learning projects with many different capabilities; i.e. recommendations, ranking, classifying etc.

Experience with project management software such as Asana, and Microsoft Teams

Speaks English and Spanish

BIO & Experience:

My name is Alex King, and I am from Kennewick, WA. I have a few machine learning projects I am very proud of, one in particular is a program that can determine the value of NBA players to their respective teams. Some non-school related hobbies I have are playing basketball, painting, and cooking. I also am a big animal person and love my cat, Luna. I plan to pursue further education in Computer Science after obtaining my Bachelor's. I am also very eager to learn about VR programming, and excited to work on this project.

Yurun Han

Major: Computer Science Minor: Mathematics



Education

Rancho Christian High School (CA)

Washington State University

Relevant Coursework:

Software Engineering

Data Structures

Principle of Automata

Machine Learning

Computer Security

Human-Computer Interaction

Data Mining

Computer Security

Numerical Analysis

Skills:

Writing, Editing, Time Management

Python, Java, C/C++

Data analysis

Awareness and ability to improve quality through tools and platforms

Good communication skills

Speak English and Chinese

Bio & Experience: My name is Yurun Han, and I am from Zhengzhou, China. I have experience as a Data Analyst at China Galaxy Securities. I analyzed company prospects and investment risks and recommendations through Galaxy Securities' database and data algorithms. My other interests are painting, fishing, playing video games, as well as cooking mango pancakes.

Martin Bui

Major: Computer Science



Education:

Whatcom Community College

Washington State University:

Relevant coursework:

Data Structures

Programming Language Design

Advanced Algorithms

Systems Programming

Parallel Programming

Skills:

Understanding of Computer Hardware

Java, C/C++, [Python](#), Haskell

Understanding of algorithms

Efficient in Windows and Linux

Experience with Git and Microsoft Office

Bio & Experience: Hi! My name is Martin Bui, and I am a senior at WSU pursuing a bachelor's degree in Computer Science. I was born and raised in Bellingham Washington. In my free time, I enjoy hanging out with my friends, lifting weights and just being active in general. I'm not sure what field of work I want to get into after school but working with Virtual Reality has always piqued my interest.

XV. Appendix B- Example Testing Strategy Reporting

Most of the requirements for this application do not require, nor have the capability, to have test code written for them. The few instances test code could be used has not been tested yet, but will be by 4/7/23. We plan to have a beta testing day on 4/14/23 where students in the ROAR program will be able to download and try out the application themselves.

XVI. Appendix C- Project Management

Near-Daily communication with teammates on discord. Bi-weekly meetings with client, Katie Abrams. Also have been using GitHub for version control and project planning.