

# Background and Specification Report

## Introduction

Indoor GPS System has always been rare compare to Outdoor GPS. The development of it can bring many benefits to users.

I want to develop a app that has practical application on University. In my research, I have not found any existing app that can provide user with point-point direction within any building. My goal is to create such application that can help new students with finding their way around campus. Research into existing indoor system is hard because there are not many literature on this.

I will focus on the design of algorithm for this application. Existing algorithms on application including Dijkstra algorithm and A\* search which are commonly found in outdoor GPS system like Google Map. Due to time limits constraint, I will only build map system for King's College London Bush House as domain.

## Review

I choose to use Unity Platform to implement the app because it offer advantages in:

- Better Display and Layout
- Support Integration of Animation
- Allow user to interact with the system more directly

I have used the Unity Doc online and book Unity in Action by Joseph Hocking to aid my app development. In addition to grasp the knowledge of programming in C#, I have also used the book C# in depth by Jon Skeet.

I have done a lot of research into implementation of the shortest distance algorithm. Given the language supported by Unity is C#, which is similar to Java, I have used two books: Data Structures and Algorithms in Java by Goodrich and Tamassia and Algorithm design manual by Skiena.

There were many approaches suggested to solve this problem. One approach is to use virtual reality to map user's location in the building. Given this is a individual project and complexity of building a virtual reality environment, I decide not to pursue this approach. An alternative approach is using Wifi signals to track user's location within the building. However, the main issues with this approach is consider what happens when user does not have access to wifi or data? How much data will this approach consume? And there are also privacy issues arises from using wifi signals. The approach I think is the best and decide to settle on is using waypoint or qr code that user can scan with their phone to track their location. This approach is suggest by my supervisor Dr Odinaldo Rodrigues, and it's a nice way to track user's location inside the building.

Given the complexity of the project, I decide to take a iterative development approach for implementing the project. First, I will model the buildings as to lay foundations to the map. Then I will create a Graph class that will model all the offices inside each building and specify

their distance as weighted edge. The next part is to implement the algorithm that take as arguments a destination and then provide a path( direction instruction) visually allow user to see how they can reach their destination in shortest distance. Note the graph will be bi-directional in most cases, however, in certain cases, it can only be single direction. E.g. Enter the building through one point and leave the building in another point.

With regards to visual design of the lay out of the app. I will model the user as a humanoid object, which user can see on the graph. User can follow the direction and can see themselves on the map moving, and once they reached an qr code, they can scan it to update their location on the map. The map also allow user to see other offices around them, so it provided more than just the destination object.

The app require display of information for user: the shortest path between nodes in form of point to point direction and estimated time for the journey. These are the functional requirements for the System. On the non-functional side, there are requirement such as colour of nodes of map to represent different floor, choice of database system to store the map and I also want to include features such as allowing user to contact developer in case of error. However, since I'm focusing on the algorithm side, i will spend less time on implementing features like this and this will be one of the limitation of the app.

I will use class diagram to represent the main component of my app in the form of abstract data type. For example, I will have a class for representation of the map as adjacency matrix and I will have another separate class for A\* algorithm. I will use state machine diagram to shows what user can do from home page and how system will function with time.

### Specification

Below is a list of specification for my app:

#### Functional Requirement:

- Finding the shortest route between any two nodes inside the bush house
- Display Time and Distance required for a particular given route
- Able to model the different sections of universities as Node
- Able to change the map, so having setters and getters for graph class.
- Allow user to choose their destination
- Create a contact page for user
- Provide step by step instruction for user to reach their destination

#### Non functional Requirement

- User can distinguish different building by their colour
- Algorithm able to run fast enough to ensure reasonable performance of the app
- Map should be flexible enough to make changes to it in the future
- App is available for download on Android devices

- Implementing the map using 3 classes: Graph, Node and Edge

It's a good idea to have a definition for what path actually means. In the case of a graph problem, it should be a list of vertices in a certain permutation. This means that the algorithm will produce a list of vertices. The list will be represented as arrows on the map.