CS 491 Senior Design Project I

High-Level Design Report

Project short-name: Pigeon's Map

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pigeon-s-map.github.io

1. Introduction

1.1 Purpose of the system

Choosing an efficient path to a destination point may not be easy. If there is more than one destination to be reached, it is even more complicated. Postal workers have to think of paths with multiple destinations every day and if they choose an efficient path, they can save both time and fuel.

Moreover, Covid-19 pandemic increased the number of online orders, so there are more packages to be delivered [1]. Being more efficient is essential nowadays.

Anyone can use Pigeon's Map to find an efficient path but mainly the purpose is to help postal workers to find efficient paths in their delivery with multiple destinations. This android application will take a start point and multiple destinations with priorities to find a delivery order with the shortest distance in total. The time to think of an efficient path and the time that will be spent on the delivery will be reduced dramatically with Pigeon's Map.

1.2 Design goals

Performance: The key to this application is to save time. It needs to be fast enough to find an efficient path starting from learning the addresses to the beginning of the delivery time. The resulting path may not be the most efficient path in a given time but it must be close to the most efficient path.

Usability: This application is to be used by anyone so it should be easy to be used. The starting point and the multiple destinations will be entered and the application will handle the rest.

Reliability: This application should be reliable to suggest efficient paths every time and should avoid unnecessary sub-paths.

Sustainability: Circumstances about the roads may be changed in time. In order to have updated information, we have a pointing system for the roads. Users can submit points about specific roads and the application calculates alternative paths by avoiding the roads with low points as much as possible.

1.3 Definitions, acronyms, and abbreviations

Optimal Path: The most efficient path possible.

Efficient Path: A path close to the optimal path in saving time.

Destination: An address to stop by to deliver a package.

Point: Users can point the circumstances of a road to be considered as good or bad in future searches.

Circumstances: Infrastructure or environment of the neighbourhood about a road.

2. Current Software Architecture

There are some applications for navigation such as Google Maps [2], Speedy Route [3], and MapQuest [4] but they do not provide all features as Pigeon's Map.

Speedy Route does not have a mobile application. Google Maps and MapQuest have mobile applications and in addition to that Google Maps is the most popular navigation application by a high margin (67%) [5] with the most extensive resources. All of the mentioned applications require the user to enter the order of the destinations. Pigeon's Map does not need this option because the order entered by the user may not provide an efficient solution and we handle this part of the problem.

3. Proposed System

3.1 Overview

In this part, the design of the proposed system will be explained. Model-View-Controller architecture will be used. This way, it will be possible to separately implement and create a connection between server and application. The user will only

interact with the application but there will be a connection behind with server. Route calculation and display operations will be done on the user's device. The server will be used for warnings and ratings.

3.2 Subsystem decomposition
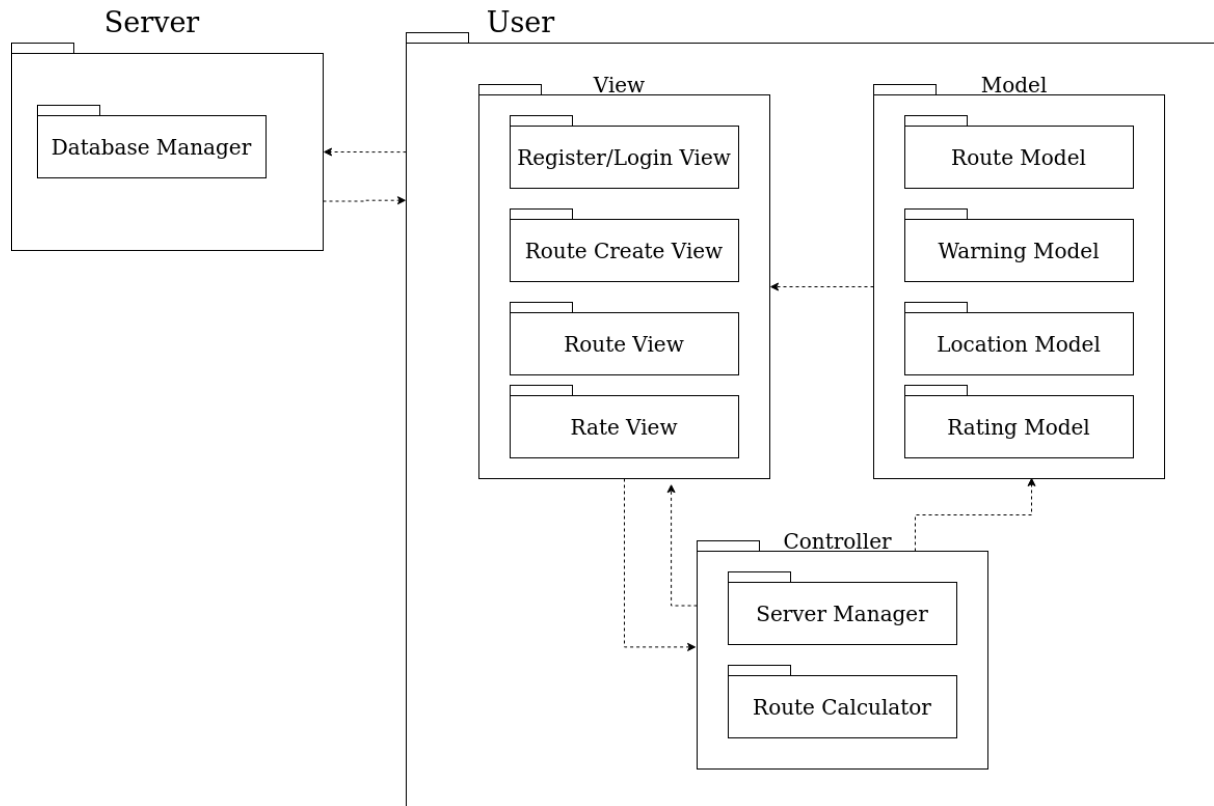
Figure 1: Subsystem decomposition

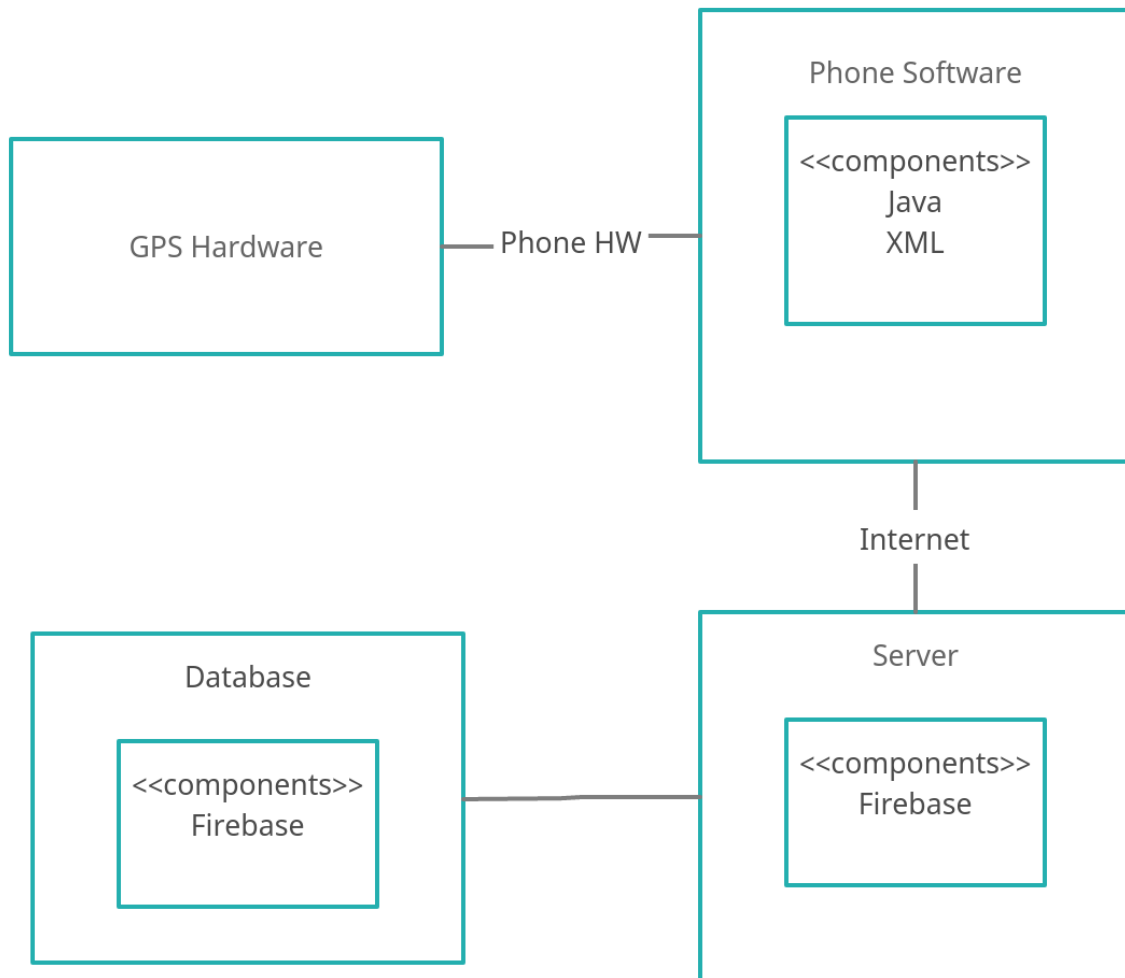## 3.3 Hardware/software mapping

Figure 2: Hardware/Software mapping

3.4 Persistent data management

Login information(username, email, password), warnings, and reported warnings will be stored in the database using the following structures:

LoginInfo(ID, username, email, password)

Warning(ID, date, text, expirationDate, visibility)

ReportedWarning(ID)

StreetRating(ID, streetName, streetID, rating)

Route calculation operation will be operated on the user's device after getting the necessary information.

3.5 Access control and security

Users will be able to use the app without register but customization features require login. Access of non registered users to these features should be prevented.

Personal information and passwords of users will be stored in the database and will not be shared with anyone else for security. Also, users have the option to create a warning as private or public. This way, a user can create a warning only for himself/herself. Other users' access to these private warnings will not be possible.

3.6 Global software control

In the application, there is a global software control that creates communication between users and server. The required information for warnings and ratings are going to be managed by a single server and going to be stored in a single database. All users will connect to this server and server will connect to that database. The user sends a request to the server and gets a reply from the server according to the job that will be done. Differently, it is possible to use the application without any server communication. Since route calculation, which is the main feature of the application will be operated on the user's device, it is possible to calculate a route without connecting to the server. If a user does not have an internet connection, the user still will be able to use the application without using warning and rating features.

3.7 Boundary conditions

3.7.1 Initialization

The user can use the application without registering but to be able to use some features, the user needs to register. If a user clicks a button that requires login, a register/login screen will be shown to the user. After registering, the user can use these features. Once the user is logged in, he/she will not need to log in again.

3.7.2 Termination

If a user taps the log out button or deletes the application, he/she will need to log in again. Also, users can stop a running process by closing the app.

3.7.3 Failure

In case of an error, users will see an error message and the process will be stopped. But the other processes will continue. If a process ends unexpectedly, the app will continue from the previous state.

4. Subsystem Services

4.1 Android Subsystem

Android subsystem will be dealing with the communication with the server depending on the requests of the user. It will communicate with the server and depending on the information it gets from the server, it will update its views.

4.2 Server Subsystem

Server subsystem will be providing communication between the android subsystem and the rest of the subsystems. It will get requests from the android subsystem and direct these requests to the relevant subsystem, then return the relevant information back to the android subsystem.

4.3 Database Subsystem

Database subsystem will be responsible for maintaining persistent data by storing relevant data such as users, ratings of the streets and warnings about the roads. It will supply and store data depending on the requests coming from the server.

4.4 Route Calculating Subsystem

Route calculating subsystem will be calculating the optimal route depending on the destinations that are provided. It will get the required destinations, and requests from the server, then get relevant warnings from the warning subsystem and the relevant ratings from the rating subsystem to calculate the optimal route. Finally, it will return the optimal route back to the server.

4.4 Warning Subsystem

Warning subsystem will be responsible for returning the warnings in a road such as car crashes and construction works. It will get an optimal route calculated by the route calculating subsystem, then return relevant warnings regarding the route back to the server so that they can be displayed to the user through the android system. It is also possible to add a custom warning as a user such that the server subsystem will provide the warning along with a street to the warning subsystem for it to associate that warning with the provided street in the database subsystem.

4.5 Rating Subsystem

Rating subsystem will be responsible for providing a rating to the desired road by the user. The server will supply a street and a rating to the rating subsystem so that it can associate the rating with that street in the database subsystem.

5. Consideration of Various Factors in Engineering Design

With the Covid-19 outbreak, public health has become one of the biggest concerns in the world. In our case, to address the needs of public health, our application can only decrease the probability of people, mostly postal workers, getting the virus. This can be achieved. As well as minimizing the time, we can optimize the route to select emptier streets. The idea is that the worker will have less human contact by going through empty streets resulting in less likelihood of getting the virus. The effect of public health factors is 7.

To address the needs of public safety, our application can decrease the probability of a traffic accident. This can be done by choosing safe routes. The users of the application can determine the safeness of a route. After using the route, users can rate the safety, and maybe other aspects of the route as well. By continuously rating, users can change the status of the route continually. The effect of public safety factors is 5.

Besides, global factors affect our application. Since we can not launch our own satellite and use images from it, we are constrained to use globally available sources

such as Google Maps. Therefore, any error in these sources will directly affect our calculations. The effect of global factors is 8.

Environmental concerns also affect our application. We would like to create an application that does not cause any pollution but, even, decreases pollution. Since our application is merely a little software, it does not create too much pollution to the environment. However, by using our application, our users, mostly postal workers, can decrease the amount of pollution, the carbon dioxide released by vehicles. By optimizing the time needed to cover all the routes, the users will use their vehicles less. Lesser usage of vehicles will result in lesser air pollution to the environment. Since our main goal satisfies our environmental concerns, the effect of environmental factors is 5.

	Effect level	Effect
public health	7	selecting empty routes
public safety	5	rating of routes
global factors	8	correctness of results
environmental factors	5	optimizing the time needed (main goal)

Table 1: Effect levels on various factors

6. Teamwork Details

6.1 Contributing and functioning effectively on the team

At the beginning of the project process, after we met teammates, we have been aware of the importance of the workload distribution because the efficiency of the work we would do for the project is highly related to well collaboration and communication among the team members.

Making a project team effective can be considered in a few factors such as coordination communication, decision making, conflict management, etc. Both as students and team members we have a common aim which is competence in the Senior Project and this factor has an important effect not only individually but also as a group. Firstly, we determine a clear purpose for the project in terms of each member's expectations for the course. This step actually is the beginning of the team process of the project group because mostly all works are structured for that purpose. "Teams require tasks that make a tangible contribution to the organization and are consistent with the team's purpose, abilities, and attitudes."[6] Determining the work distribution has been solved by specifying the tasks.

We investigate the actual problems of postal workers and possible solutions to these problems while they transport the packages in terms of the time-consumption.

6.2 Helping to create a collaborative and inclusive environment

In order to create an environment that is successfully collaborative and inclusive, the main concern was how to achieve this with high performance. So one of the key ideas for this to create an environment that is accepting of the discussions about the expectation from each other. Another key concept was to act as a colleague rather than taking it as a responsibility. Providing respect to the team members as well as demonstrating this respect, opens up the exchanges of ideas and thoughts about the project. This way every member of the team feels included and gets comfortable sharing their concerns along with their ideas. What's more, this way everybody can get a chance of showing how they want to be successful.

As the responsibilities of each are set the research is carefully conducted. When topics are studied, in order to keep up with others. the respective topics that each studied are shared with each other. This way every member of the team has an idea about the whole process and has a right to state their opinion. By encouraging the team members to do that it is easier to state intensity and the intent without any misunderstanding. With that being said, it is also easier to discuss the expectations of each other. Also by seeing each other study, the positive influence is achieved as well as including each other in a performative way.

6.3 Taking lead role and sharing leadership on the team

Leadership is a crucial function, as the leader inclusiveness encompasses behaviors that promote the inclusion of all team members in discussions and decisions and in which their divergent perspectives are explicitly valued and encouraged.[ ] One of the importance is that with someone taking a leadership role in the team, it initiates the action as well as the communications between team members. This helps where to work starts and motivates the remaining members. By taking the lead role in the member it provides guidance and confidence to every member of the group. Sharing this role with others, every member feels included and encourages teamwork. Furthermore, the work environment is safe and sound as the leader mostly builds this environment by initiating actions. Coordination between members is easily satisfied this way and with healthy communication, the workload is distributed equally. Senior projects are a crucial part of university life in terms of management. This is positive for taking the lead as it improves the leaders' abilities about management issues. By sharing the lead with other members in specific areas, every member of the team is getting benefit out of it.

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