The University of Hong Kong

2018/19 COMP 4801 Final Year Project
Detailed Project Plan

Building an Easy-to-use Ride-sharing App for HK

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1. Background **3**

2. Objectives **4**

3. Scope **5**

4. Approach & Methodology **6**

5. Risks, Challenges & Mitigation **7**

6. Feasibility assessment **8**

7. Project Management **9**

7.1 Deliverables Description 9

7.2 Schedule 10

7.3 Division of work 11

8. Reference **13**

1. Background

Ride-sharing has become more and more popular in recent years. Unlike ride hailing, ride-sharing consists of two or more riders' group which have similar route and usually do not know each others before. The advantage of ride-sharing is multifold. First, the riders can share the cost of the ride and save money. Also the driver can earn more as the idle time is reduced and the driver can charge from two or more groups of riders. In addition, ride-sharing is more environmental friendly because more than two persons are sharing a car. Consequently, there are less cars on the road and traffic congestion can be reduced.

Since ride-sharing has a lot of benefits for both riders and drivers, many ride-hailing app companies such as Uber [1] and Lyft [2] added ride-sharing service for some cities in the recent years . The users in those cities can choose the service they want in each ride. The result of adding the ride-sharing service was quite good, 121000 users has used the ride-sharing services provided by Uber in Metro Manila [3].

However, in Hong Kong, a populated smart city, does not has a popular ride-sharing app. According to a car sharing study in Hong Kong, the transportation system would be improved by exploiting ride sharing and the social responses about ride sharing are mostly positive [4, p.63-64]. Hong Kong's progress in ride-sharing service is lagging behind as cities nearby such as singapore have popularized ride-sharing services already [5].

2. Objectives

This project aims to build a ride sharing app in both iOS and Android platform for Hong Kong. The application is implemented by the existing algorithm for suggest possible match after the users choose their start and end destination. The project tries to compare different algorithm and choose the one have better outcome in different aspect such as running time, route and waiting time etc.

To make the application easy-to-use, it separates the driver and passenger with different function. Drivers can provide their available area or the one way route in particular time. Beside, passengers need to input their start and end destination and the matching will start automatically. After that, they just need to take some time to the target pick up location to have the ride.

The intermediate goal is finishing main function of the application. It include simple layout - login page, google map, selection page - allow identify the user and make the matching. Also, this project will set up the back-end server for implement the algorithm with simple feature. This algorithm only have the simple function which match with one or two people within the same area only.

The ultimate goal is trying to improve the algorithm. Using different algorithm for different situation and choose to using the algorithm with better result. For example, diver can pick up two or more passengers at the different location during a ride and the algorithm help finding the route with only a little additional cost to the driver. This project will use several cutting-edge matching algorithms to make it works. In addition, update the application with a better user interface and attracting the people.

3. Scope

The features of the product can be categorized into two types, basic features and advanced features. As there are two type of features, the development process will be divided into two stages where stage one is implementing the basic features and stage two aims to build the advanced features.

The basic features that will be developed in stage one is a car hailing service which provide real-time one-to-one ride matching. Each driver can only pick one rider (and the rider's companions if any) and give the passenger(s) a ride to his/her destination before picking the next one. The mobile application shall allows the users to register an account and login. After the user are logged in, they are automatically become riders who can make ride matching requests by specifying their departure location and destination. The users can also become a driver by filling some information, such as car capacity, and switch to a driver mode that allow them to enroll into the matching system to find nearby passengers. However, no payment system will be implemented, riders and driver are assumed to negotiate by themselve. For the purpose of the first stage of development is to familiarize with the software frameworks and stabilize the system architecture for both the mobile application and backend server development, the matching algorithm will be a simple and minimal.

Stage two aims to build the advanced features includes carpooling and ride reservation. In carpooling services, drivers is allowed to pick up passengers suggested by the system during a ride until the capacity of the car is full. By the virtue of ride reservation, the riders can make an ride matching request 12 hours earlier than the departure time which allow riders to secure a car. In the other hand, the reservation matching system shall give the matching result to the riders before a latest acknowledge time specified by the rides which must be earlier than the departure time. Several algorithms adopting the recent researches will be implemented and the mobile application and backend server should be updated to integrate with the advanced algorithms supporting those new features in the second development stage. In addition, performance test and functional test will be conducted to compare those algorithms adopted and make the system bug-free.

In short, the first stage of development is to build the skeleton of the product with basic features, and the second stage is to make all the features implemented.

4. Approach & Methodology

The project will be implement using three-tier architecture pattern which consists of Presentation Tier, Application Tier and Data Tier.

For the Presentation Tier, an Android and IOS app will be developed using React Native Expo. Both app handles the users actions such as user registration, riders using carpooling function and driver pick up passengers suggested by the system.

The Application Tier includes a backend server using Node.js and Python. Node.js will be used for API and database access and the matching algorithm will be implemented using Python.

This project will use two databases, which are MongoDB and Redis. MongoDB will be used for the data that will not change frequently such as the users information. Redis will be used to store dynamic data such as the location of the riders and drivers.

The database and the backend will be hosted by a virtual machine running Ubuntu 16.04.

For the software development Methodology, agile method will be used as this projects includes basic and advanced features. Agile method allow us to make all the basic features first and handle the advanced features later. As a result, a working product with basic functions can be delivered sooner and more feature will be added to the product base on the time left.

For the development environment, Visual Studio code will be used for coding. GitKraken will be used for version control and Github will be used for storing the code.

5. Risks, Challenges & Mitigation

magnitude of the risk 1 (very minor) to 10 (catastrophic)	Risk	Mitigation
7	The time required of making the IOS app is higher than expected since the project adopting state-of-the-art framework for mobile development	Revise the scope to find a good enough solution. Allocate more time for IOS app
5	Have difficulties to understand the algorithms in the papers.	Find another paper to read. Ask professor for assistance if problem continues.
6	Have difficulties when comparing the algorithms	Use some basic way to compare the algorithms first.
8	Have difficulties implement the algorithms	Find another algorithm to implement.

6. Feasibility assessment

Technical feasibility

The technologies involved in the project are quite common in the industry. Tutorials and solutions of various problems can be found on the web easily. Although we don't have experience on some of the technologies used in the project, it will not cause big issues in the development.

Operational feasibility

The backend and database will be hosted by Google Cloud virtual machine or the virtual machine of HKU computer science department . Both of the virtual machine service are quite reliable and easy to use.

Financial feasibility

The two virtual machine service mentioned above is free of charge. HKU computer science department provides each Final year project group a virtual machine for free. Google Cloud will give each google account $300 US dollar free credits for the first year user and that is sufficient for the project. Finance will not be a issue for the project

Schedule feasibility

A detailed schedule with deadlines and jobs has been made and we can keep track of the progress during the development and the scope will be adjusted based on the progress.

7. Project Management

7.1 Deliverables Description

Deliverables Description	Deadline
Phase 1 - Inception ● Detailed project plan ● Project web page ○ Hosted on https://i.cs.hku.hk/fyp/2018/fyp18028/	30/09/2018
First presentation	07/01/2019 ~ 11/01/2019
Phase 2 - Elaboration ● Preliminary implementation ○ Source code of mobile application with basic features such as user login & register, driver online/offline status switching, and ride matching ○ Source code of back-end server with preliminary matching algorithm ○ Documentation of architecture and API ● Detailed interim report	20/01/2019
Phase 3 - Construction ● Finalized tested implementation ○ Source code of mobile application with advanced features ○ Source code of back-end server with different cutting-edge matching algorithms ○ Updated documentation of architecture and API ● Final report ○ Functional tests report ○ Performance tests report for several matching algorithms with	14/04/2019

tested dataset	
Final presentation	15/04/2019 ~ 19/04/2019
Project exhibition	29/04/2019
Project competition (if selected)	29/05/2019

7.2 Schedule

Months spent estimation	Expected Progress
1 month (01/09/2019 - 30/09/2019) Phase 1 deadline: 30/09/2018	1. Research on: a. detailed product definition b. tools available to build the system c. academic papers of the matching algorithm 2. Build FYP homepage prototype 3. Write detailed project plan
3 months (01/10/2019 - 31/12/2019) First presentation date: 07/01/2019 ~ 11/01/2019 Phase 2 deadline: 20/01/2019	1. Build the mobile app with limited features 2. Build the backend server with a preliminary matching algorithm 3. Prepare for first presentation 4. Write detailed interim report
2 months (01/01/2019 - 28/02/2019)	1. In-depth study on academic papers of the matching algorithm 2. Advance the mobile app with full features 3. Advance the backend server with several cutting-edge

	matching algorithms
1 month (01/03/2019 - 31/03/2019)	1. Write final report 2. Test and improve the system 3. Compare the performances of different algorithms
0.5 months (01/04/2019 - 14/04/2019) Phase 3 deadline: 14/04/2019 Final presentation date: 15/04/2019 ~ 19/04/2019	1. Write final report 2. Prepare for final presentation
0.5 month (15/04/2019 - 29/04/2019)	1. Prepare for Project exhibition 2. Prepare for Project competition (if selected)

7.3 Division of work

Tasks	**Anthony**	**Elven**	**Eric**	**Man-weeks* estimation**
Inception (01/09/2019 - 30/09/2019, 12 man-weeks)				
FYP homepage prototype			✓	1
Research on the topic (product definition, tools available, matching algorithm)	✓	✓	✓	6
Detailed project plan	✓	✓	✓	3
Total man-weeks				10
Elaboration (01/10/2019 - 31/12/2019, 36 man-days)				
Mobile App UI and project directory structure design	✓			1
Mobile App user login & register feature		✓		3

Mobile App driver online/offline status switching feature	✓			2
Mobile App ride matching feature			✓	3
Database Schema Design	✓			1
Back-end infrastructure design	✓			1
Back-end users login & register API	✓			3
Back-end drivers online/offline status switching API			✓	1
Back-end ride matching API		✓		2
Back-end preliminary matching algorithm			✓	4
Documentation of architecture and API		✓		2
Detailed interim report	✓	✓	✓	6
			Total man-weeks	29
Construction (01/01/2019 - 14/04/2019, 42 man-weeks)				
In-depth study on academic papers of the matching algorithms	✓	✓	✓	6
Implement cutting-edge matching algorithms	✓	✓	✓	6
Advance the mobile app with full features			✓	3
Integrate cutting-edge matching algorithms with backend server			✓	3
Functional test		✓		3
Performance test for matching algorithms	✓			4
Final report	✓	✓	✓	9
			Total man-weeks	34

* for each teammate, 1 week of work = 1 man-week, 1 month of work = 4 man-week. Whole team has 4 x 3 = 12 man-weeks for each month.
# around 20% of man-weeks are reserved as buffer

8. Reference

[1]https://www.businessinsider.com/uberpool-ride-sharing-could-be-the-future-of-uber-2016-6

[2]https://www.theverge.com/apps/2016/3/29/11324610/lyft-carpool-commute-san-francisco-511-ridematch

[3]https://www.uber.com/info/manila/

[4] A. Belz, E. Healey, and K. Hudgins, “Car Sharing: A Feasibility Study in Hong Kong,” Worcester Polytechnic Institute, Hong Kong, rep., 2016.

[5]https://www.grab.com/sg/press/tech-product/grabtaxi-introduces-grabcar-economy-an-affordable-complement-to-taxis-to-ease-your-everyday-commute/