VIETNAM NATIONAL UNIVERSITY
UNIVERSITY OF ENGINEERING AND TECHNOLOGY

Requirement Engineering INT3133 20

RIDESHARING SYSTEM

Group 3

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A. DOMAIN UNDERSTANDING

1. Introduction

1.1. Purpose

This document is used to define terminology specific to the problem domain, explaining terms, which may be unfamiliar to the reader of the use-case descriptions or other project documents. Often, this document can be used as an informal data dictionary, capturing data definitions so that use-case descriptions of other project documents can focus on what the system must do with the information.

1.2. Scope

This ridesharing system is designed to speed up the procedure of finding a suitable traveller for staff and students within the VNU area. The system allows drivers to sign up for rides - passengers meanwhile have access to the list of available drivers and then, per request, ask for permission to join the ride.

1.3. Glossary of terms

Introduction

This document is used to define terminology specific to the problem domain, explaining terms, which may be unfamiliar to the reader of the use-case descriptions or other project documents. Often, this document can be used as an informal data dictionary, capturing data definitions so that use-case descriptions of other project documents can focus on what the system must do with the information.

Definitions

The glossary contains the working definitions for the key concepts in the ridesharing system.

Account

A record about a driver/passenger containing information about his/her name, account name, password. Each account name and ID is unique, which are used to identify the user/administrator and grant them access to secure parts of the system. Accounts are only granted to staff and students in VNU.

Administrator

A person manages the ridesharing system.

Driver
An account of a person in a ridesharing group who has their own transportation & wants to find passengers to rideshare.
Passenger/Rider
An account of a person in a ridesharing group who wants to find a driver that meets their needs.
Traveller
An account of a person in a ridesharing system.
Ride
The activity of a driver traveling from an origin to a destination.

1.4. Definitions and Acronyms

No	Keywords	Definition
1	UET	University of Engineering and Technology
2	VNU	Vietnam National University

1.5. Intended Audience

Definition
Intended audience is defined as the group of people for which this system is designed.
Intended Audience
The intended audience for this system are students and staff of VNU who have ridesharing demand in and out of campus. As described, the software intended is a mobile application, so the user should have a mobile phone with connectivity to the internet.

1.6. Content Summary

This document presents an overview of the system-as-is (structure, components, concept, tasks, problems,...); define the problems and opportunities to propose system-to-be, pinpoint the real demand of stakeholder and solutions in system-to-be; appendix to summarise all techniques learned from the course.

2. System-as-is

2.1 Real situation

2.1.1 Overview

Private transportation has become the predominant transport mode globally that steadily worsened traffic congestion and fuel emissions. The burning of fuels adds about 6.3 Gigatons of carbon to the atmosphere each year and twenty-three percent of world energy-related CO2 emissions originate from the transport sector. Usage of public vehicles (e.g. buses and vans) eradicates these environmental issues, however, they boost social issues (i.e. privacy threat, inflexibility in usage (e.g. with whom a traveler wants to share a ride) and unavailability of rides at passenger desired places. To earn high revenue public transport owners usually fill up their vehicles more than their space which is an obstacle, providing comfort and ease to travelers.

2.1.2 Mission

VNU has the missions include: Producing high quality human resources and cultivating talents, promoting advanced science, technology, renovation and knowledge transference, and playing the role of a pioneer in the reforming of Vietnam’s higher education system. VNU is expected to be one of the leading interdisciplinary, multidisciplinary research universities in the world, which can contribute significantly to the national industrialization and modernization. One of VNU's strategic tasks is to establish and develop undergraduate and graduate programs to meet international standards, which ultimately transforms VNU into a research university center, reaching international standards. This will help to improve Vietnam’s scientific, technological and socio-economic basis.

2.1.3 Survey

2.1.3.1 Design

This survey was conducted online on Facebook in 10.2020 and designed to take approximately 2 minutes to complete. The main respondents are UET’s undergraduate students.

The survey was divided into two sections: personal information section and ridesharing demand section. The first section of the questionnaire collected information on the personal attributes of the respondents and their commuting trip habits and characteristics. The personal attributes consisted of the sociodemographic characteristics of respondents, such as gender, age, income, transportation ownership, and occupation. The section on ridesharing demand presented a series of questions related to the passenger’s ridesharing

characteristics and a few journey-based factors (i.e., frequency, purpose, travel safety, driving enjoyment, traveller's requirements).

2.1.3.2 Result

The total sample size was 58 respondents. The sampling size was determined to represent our current university socio-demographics with a ratio of undergraduate, graduate students, and employees of 10:1:1.

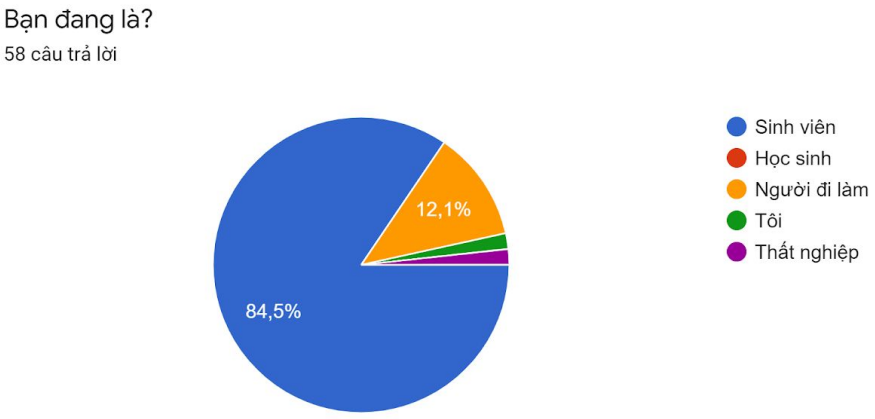


Figure 2.1.1 Respondent's occupations

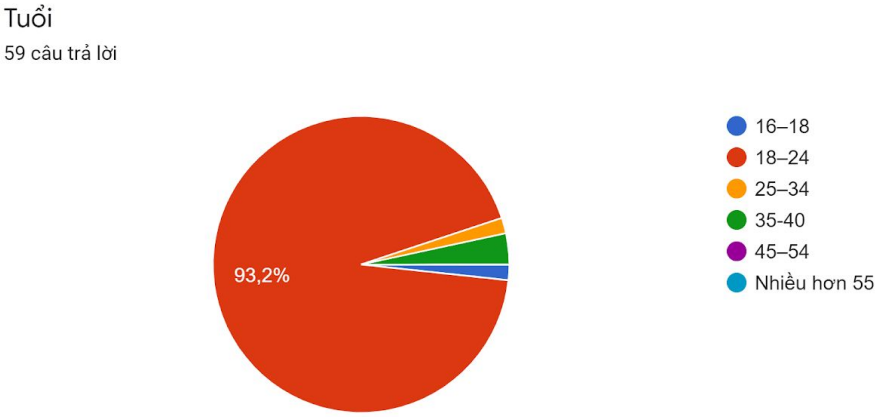


Figure 2.1.2 Respondent's age

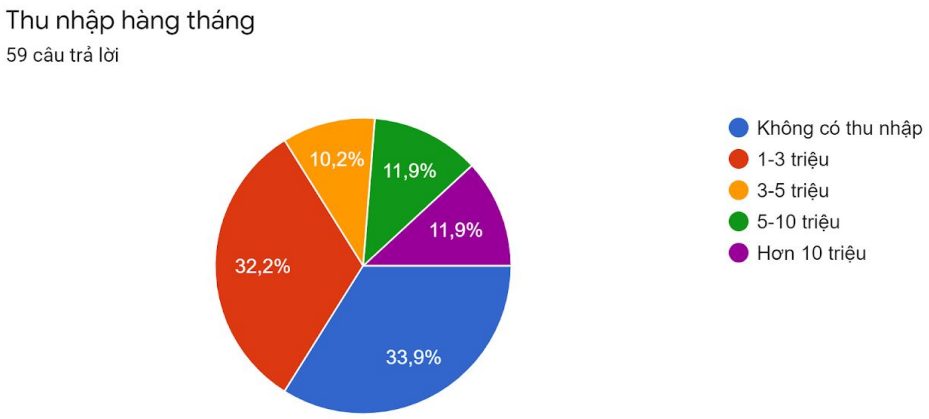


Figure 2.1.3 Respondent's income

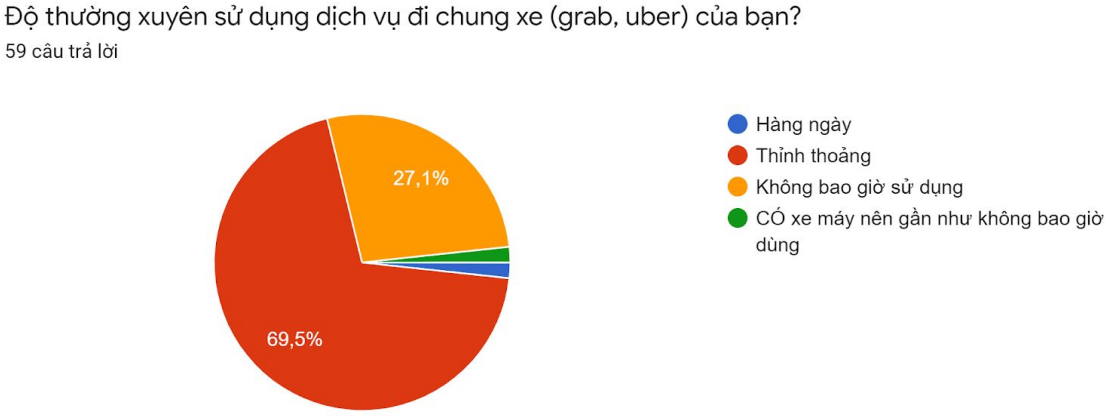


Figure 2.1.4 Rideshare' frequency

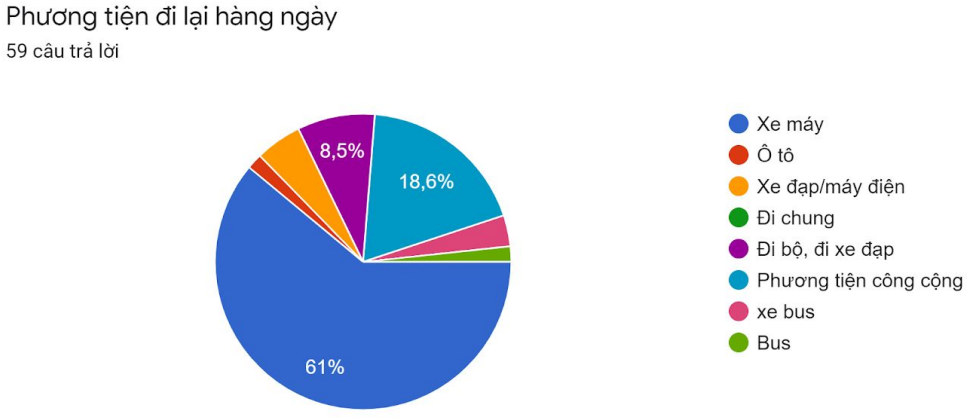


Figure 2.1.5 Respondent's transportation

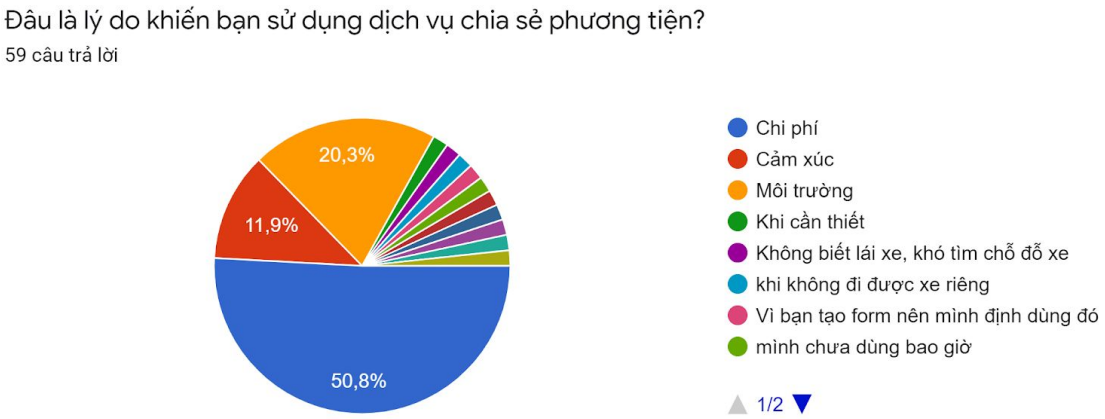


Figure 2.1.6 Rideshare's purpose

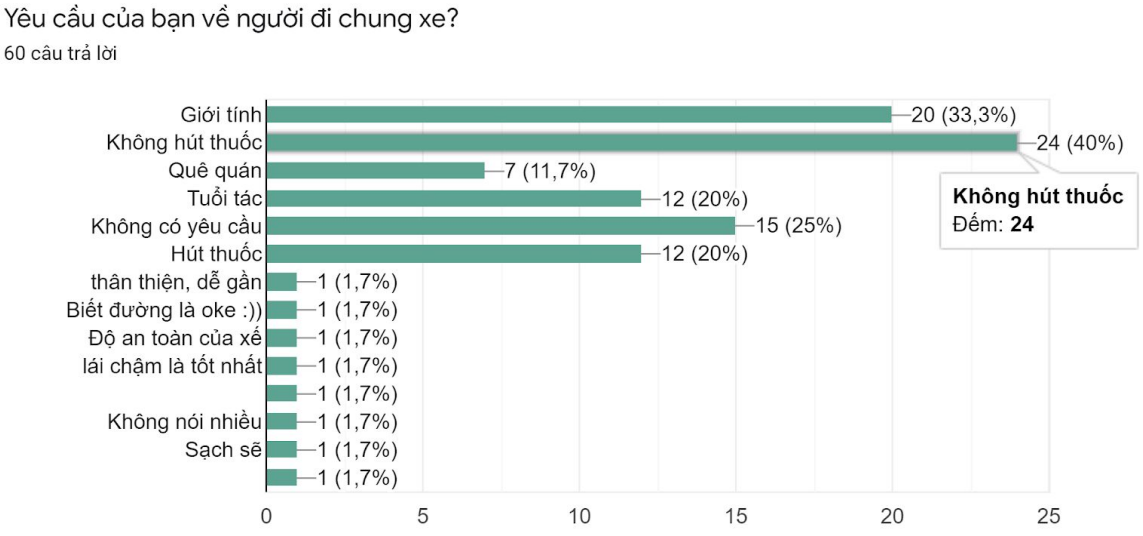


Figure 2.1.6 Traveller constraints

2.1.4 Interview

2.1.4.1 Design

Purpose of the interview is to understand what services interviewee need, know problems that they have in the system-as-is and need of a system-to-be. Datas were collected from students by answering predetermined sets of questions. The interviewers consist of a group of 5 people.

These questions are designed as the table below.

Question	Subject

What is your usual mode of transport?	All
Do you own a vehicle? If yes, which kind of vehicle is it?	All
How many passengers do you have normally?	Driver
What are your requirements for travellers?	All
What are the problems you have when travelling?	Passenger
Are you willing to share your ride with someone who matches your requirements?	All

2.1.4.2 Result

Question	Answer
What is your usual mode of transport?	80%: motorbike 20%: public transportation
How many passengers do you have normally?	100%: 0 person
Are you willing to share your ride with someone who matches your requirements?	100%: yes

2.1.5 Conclusion

The binomial model calibration shows that undergraduate students who are between 18 and 24 years old with a relatively low income level; that is, less than VND 5M per month, were more willing to use the social network-based ridesharing system. This outcome corroborates previous research findings indicating youngsters, especially those with lower earnings, as a group that would actively participate in carpooling. Pricing is the most important factor that leads to ridesharing. Motorcycles are the most popular transportation within UET' students and staff. Commuters who do not rideshare often state difficulty finding someone with a compatible schedule and destination and needing a vehicle during the day as the main reason. High fuel costs, lack of public transportation, and lower-income levels increase the likelihood of people ridesharing. The ability to choose the gender of their matching rider/passenger in the pool is also a factor affecting the decision to share a ride.

→ **Idea**: Ridesharing System helps in matching suitable students and staff in schools as a group to ridesharing in order to reduce prices and find new friends.

2.2 System

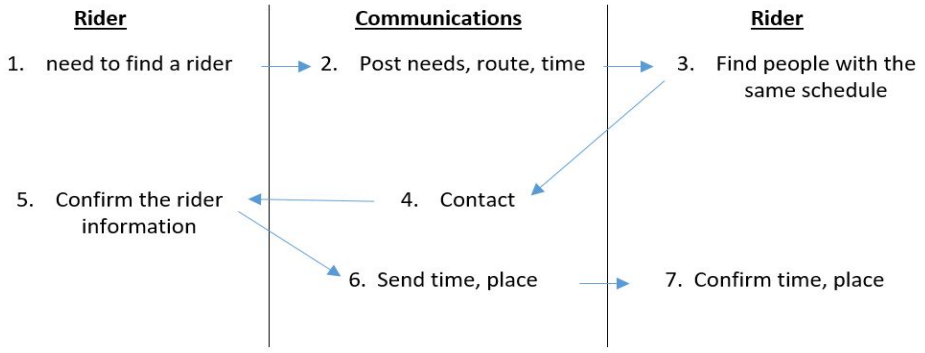
2.1.1 Components

There are two main components in the system: drive and passenger. Drivers are staff and students of VNU who have their own transportation & want to find passengers to ride sharing. Passengers are staff and students who want to find a driver match with their constraints.

2.1.2 Concepts

Two concepts used in this system-as-is are: Drivers and passengers are usually friends; both good and bad information are usually spread amongst social networks.

2.1.3 Flow Diagram



2.1.4 Tasks

Drivers share their ride information amongst their group of friends or through a social network, such as Facebook. Travellers, being in the same group of friends or in the passenger's friend list, may catch this information. They may ignore it for many reasons. The ones that share the same destination and time constraint accept that ride request and start contacting the driver. They negotiate to reach an agreement. If accepted, the ride is being executed as agreed.

2.1.5 Tasks' Problems

This task raises a couple of unresolved problems within the system-as-is: It's hard to reach people in need because of limited information exposure in most cases. Only those who share the same acquaintance network are able to share their vehicles. Travellers need to be tracked usually and are not updated so

most of the time and the only way to get the latest information is to ask the traveller. The exposure of this task is limited. Only those who share the same acquaintance network are able to connect to each other. Most of the time, the information fails to spread outside of the circles in time, or at all. Moreover, those tasks are hard to manage, as online posts do not have a verification mechanism. Long-term ridesharings are limited in the system-as-is. Only a small part of acquaintances who are familiar with each other's schedule for a long time is able to do long-term ridesharing.

3. System-to-be

3.1. Problem with system-as-is

From the analysis of the system-as-is, some of its main problems could be identified. There is no destination-based ridesharing system on the market. Some ridesharing systems had/have been deployed, but to little success. Vietnamese riders have the tendency to opt for a traditional, one-time ride instead of a long-term shared one. This is due to the fact that it is relatively easy to book a cab in most city centre's areas, and the distance between destinations is not too unjustified in relation to the amount of available vehicles. Motorbike, the most popular transportation means amongst the intended market, is relatively cheap and could get to most places. Riders are usually lukewarm to the idea of ridesharing with a stranger. Both drivers and riders are not willing to sacrifice for a delay at the beginning/end of their usual ride. Existing groups on social media have attempted to achieve the same effect, but usually there is no security protocol between drivers and riders - the responsibility is simply put on mutual agreement.

3.2. Opportunities

Arise from the problems with the system-as-is, a ridesharing system targeting VNU staff and students has the potential to great success. The intended market has great readiness for our system-to-be (youth), providing there is enough economical and time incentive trade-off provided. Security level is more controlled. As the users are predetermined to be staff and students in VNU, contacts of any parties are easily retrieved once any problem arises. Campus location change. In the near future, VNU campus is moved to Hoà Lạc, a location that is currently quite deserted in terms of distance from city centre and public transportation. There exists an opportunity for a system looking to encourage solo riders to convert to sharing their vehicles. The system is cost-effective, especially for riders. Last but not least, most vehicles to and from campus are owned by solo riders.

4. Real demands of stakeholder in system-to-be

4.1. Driver

The real demand of drivers in system-to-be is to decrease travel expenses; be able to choose amongst options for the best time arrangement; get verified information of passengers and expand their own social network.

4.2. Passenger

The real demand of passengers in system-to-be is to find a low-cost, fast and comfortable daily transportation; be able to choose amongst options for the best time arrangement; get verified information of drivers and other passengers and expand their own social network.

4.3. System Administrator

The real demand of system administrators in system-to-be is to receive and update information, reports, complaints, and feedback from drivers and passengers in real-time. Moreover, they want to use administrator rights easily, quickly and effectively in appropriate cases.

4.4. VNU

The real demand of organization in system-to-be is to stand its mission, vision, motto, and strategy.

5. System-to-be meets stakeholder' demand

5.1. Driver

In the system-to-be, the driver will be provided information about passengers; able to choose amongst options for the best time arrangement; automatically calculate expenses and approximate travel time and provide a communication tool between driver and passenger.

5.2. Passenger

In the system-to-be, the driver will be provided information about passengers; able to choose amongst options for the best time arrangement; automatically calculate expenses and approximate travel time and provide a communication tool between driver and passenger.

5.3. System Administrator

In the system-to-be, the administrator will be provided an interface to receive feedback, requests and notifications from stakeholders; given permissions to block users, delete accounts, given permissions to edit a ridesharing group in case an error occurs.

5.4. VNU

In the system-to-be, the organization will be able to collect data anonymously and their students will have a better quality of life'.

6. Appendix

6.1. Artifact-drive elicitation techniques

6.1.1. Background study

By collecting, reading and synthesizing documents in the VNU homepage, we understand the mission, vision, motto, and strategy of the organization.

6.1.2. Questionnaires

Collect data & numbers through VNU student survey questionnaires (Data collected: 60 people).

6.1.2. Scenarios

Scenario explained for ridesharing system-as-is represented by text in task.

6.2. Stakeholder drive elicitation techniques

6.2.1. Interviews

Datas are collected from students by answering predetermined sets of questions (structured interview). Interviewee include (end-user, manager). Record answer available in drive’ folder.

6.2.3. Group sessions

We use unstructured group sessions to brainstorming ideas. All members of the group generated ideas based on collected datas in a period of time. After that, we open a meeting to evaluate ideas (according to agreed criteria about feasibility, value,..) then come up with the most suitable one.

B. Software Requirement Specification

I. Requirement Evaluation

1. Agent’s Requirements

1.1. Driver

In the system-to-be, the driver will be provided information about passengers; able to choose amongst options for the best time arrangement; automatically calculate expenses and approximate travel time and provide a communication tool between driver and passenger.

1.2. Passenger

In the system-to-be, the driver will be provided information about passengers; able to choose amongst options for the best time arrangement; automatically calculate expenses and approximate travel time and provide a communication tool between driver and passenger.

1.3. Administrator

In the system-to-be, the administrator will be provided an interface to receive feedback, requests and notifications from stakeholders; given permissions to block users, delete accounts, given permissions to edit a ridesharing group in case an error occurs.

1.4. VNU

In the system-to-be, the organization will be able to collect data anonymously and their students will have a better quality of life'.

1.5 Requirements Summary Report

This report displays all of the requirements defined for the current project in the order they appear in the requirements list. The requirement's details and coverage status are displayed in a summary list form.

	A	B	C	D
	Driver	**Passenger**	**Administrator**	**VNU**
1	The driver will be provided information about passengers	The passenger will be provided information about the driver and other passengers	The administrator will receive feedbacks, requests and notifications from stakeholders	Verify data anonymously
2	Able to choose amongst options for the best time arrangement	Able to choose amongst options for the best time arrangement	Given permissions to manage accounts	Improve student' quality
3	Automatically calculate expenses	Automatically calculate expenses	Given permissions to edit a ridesharing Group in case an error occurs	
4	Automatically calculate approximate travel time	Automatically calculate approximate travel time	Provide system' communication tool	
5	Provide system' communication tool	Provide system' communication tool		
6	Send feedback to administrator	Send feedback to administrator		
7	Automatically get recommended passengers	Automatically get recommended drivers		
8	Driver's information is confidential	Passenger's information is confidential		

2. Inconsistency Management

2.1 Types of inconsistency

Terminology clash: None
Designation clash: None
Structure clash: None
Strong conflict: None
Weak conflict:

No	Conflict statements 1	Conflict statements 2
1	A1	B8
2	A8	B1, D1
3	B1	A8, B8
4	B8	A1, D1
5	D1	A8, B8

2.2 Interaction matrix

Statement	A1	A8	B1	B8	D1	Total
A1	0	1000	1000	1	1000	**3001**
A8	1000	0	1	1000	1	**2002**
B1	1000	1	0	1000	1000	**3001**
B8	1	1000	1000	0	1	**2002**
D1	1000	1	1000	1	0	**2002**
Total	**3001**	**2002**	**3001**	**2002**	**2002**	**12008**

2.3 Managing conflicts

2.3.1 Identifying overlapping statements

	A1	A8	B1	B8	D1
Conflict	1	2	1	2	2
No conflict	4	3	4	3	3

2.3.2 Generating conflict resolutions

For the first conflict couple: **The driver/passenger will be provided information about passengers (A1,B1) and Passenger/Driver's information is confidential (B8, A8)** we can solve the problems by changing those requirements into: Passengers/Driver's information only shared with other users in the group. the information must be permitted before sharing.

Other conflict requirements: **Verify data anonymously (D1) and Passenger/Driver's information is confidential (A8, B8)** can be changed into: Passengers/Driver's information which shared with VNU must be anonymous.

3. Risk Management

3.1. Risk identification

We use artefact-driven elicitation techniques to identify risks in our project.

Background study:

Domain-wise, surveys and papers collecting interested parties' data from existing systems + proposals in similar environments (university campus) were used to conclude objectives. System-as-is-wise, current well-known carpooling systems in the Vietnamese market, specifically Grab and Be; and Uber previously reports on customer's complaints and feedback were cited to make out some of the risks associated with the termination of the carpooling feature.

Questionnaire:

Response to our survey (collected from 65 respondents) included qualitative questions (from "none" to "very high") to determine the impact of each previously theorized risk on the propensity of the user's frequent application usage. Note that the sample space is relatively small due to time constraint, and may not reflect the actual condition amongst VNU 's campus.

Results and weights associated were pulled as below.

	Statement	Weight
Risk	Failure to find appropriate match	0.5
	Non-optimal recommendation algorithm	0.4
	Increasing request processing time	0.2
	Personal information leaked	0.2
	System penetration	0.1
	Imposter within users	0.2
	User with special requests	0.4
	Incorrect user-provided information	0.3
	Inability to attract members' usage	0.3
Objectives	Reduced amount of traffic in campus	0.1
	Decreased transportation cost	0.3
	Optimized group matching	0.15
	Engaged frequent usage from members	0.15
	Serving as a transportation alternative for campus	0.3

3.2. Impact matrix

		Weighted Risks									
Objectives		Failure to find appropriate match	Non-optimal recommendation algorithm	Increasing request processing time	Personal information leaked	System penetration	Imposter within users	User with special needs	Incorrect user-provided information	Inability to attract members' usage	**Loss of objective**
		0.5	0.4	0.2	0.2	0.1	0.2	0.4	0.3	0.3	
Reduced amount of traffic in campus	0.1	0.2	0.2	0.2	0	0	0.1	0.1	0.1	0.5	**0.05**
Decreased transportation cost	0.3	1	0.4	0	0	0	0.6	0.1	0.6	0	**0.3**
Optimized group matching	0.15	0.7	1	0.7	0	0.1	0.1	0.3	0.4	0.7	**0.21**
Engaged frequent usage from members	0.15	0.6	0.5	0.6	0.1	0.1	0.6	0.3	0.5	1	**0.20**
Serving as a transportation alternative for campus	0.3	0.3	0.3	0.3	0.3	0.1	0.3	0.1	0.3	1	**0.267**
Risk criticality		**0.30**	**0.24**	**0.06**	**0.02**	**0.01**	**0.08**	**0.06**	**0.12**	**0.18**	

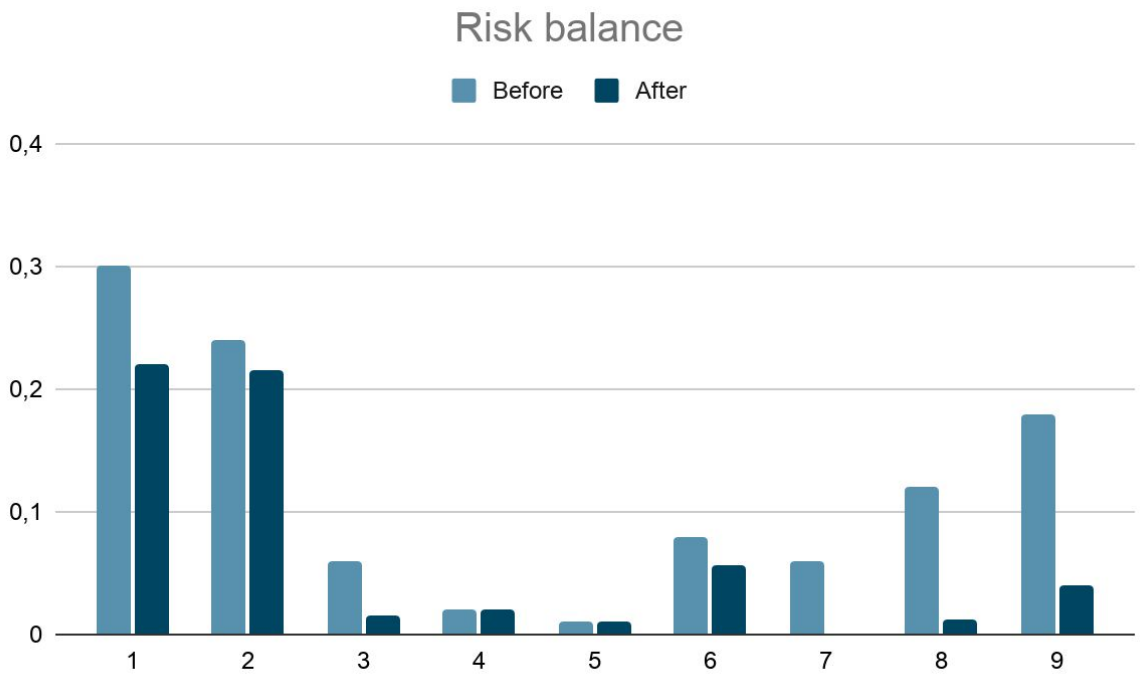
3.3. Effectiveness matrix

	Weighted Risks									
Counter-measures	Failure to find appropriate match	Non-optimal recommendation algorithm	Increasing request processing time	Personal information leaked	System penetration	Imposter within users	User with special needs	Incorrect user-provided information	Inability to attract members' usage	**Overall effect of counter-measure**
	0.5	0.4	0.2	0.2	0.1	0.2	0.4	0.3	0.3	
Confirm reminder (blacklisted if violated) after filling information	0.1	0.1	0.1	0	0	0.7	0.1	0.9	0.5	**0.32**
Time reminder before searching	0.3	0	0.7	0	0	0	0	0	0.1	**0.15**
Blockchain application in information storage	0	0	0	0.5	1	0	0	0	0.3	**0.02**
Opt-out preference in search settings	0.5	0	0	0	0	0	1	0	0.5	**0.3**
Complete profile	0	0	0	0	0	1	0.8	0	0	**0.128**

publicized within group											
Combined risk reduction		**0.685**	**0.1**	**0.73**	**0.5**	**1**	**1**	**1**	**0.9**	**0.843**	

3.4. Risk balance chart

Taking cost and time budget for each countermeasure into consideration, countermeasures were selected to implement include confirm reminder (blacklisted if violated) after filling information; time reminder before searching and opt-out preference in search settings.



4. Evaluating alternative options for decision making

4.1. Evaluating alternative options for group matching

Group matching process: Passenger provides the system with a pick-up time, pick-up point and destination. System would automatically recommend the passenger with coordinate drivers. Passenger sends a join request to the driver. Driver accepts the request, passenger joins the group, group matching is complete.

A. System did not successfully detect any compatible driver to the passenger. System asks the passenger if they want to extend their walking distance. Passenger accepts, group matching proceeds as intended.
B. System did not successfully detect any compatible driver to the passenger. System asks the passenger if they want to change their pick-up time. Passenger accepts, group matching proceeds as intended.

C. System did not successfully detect any compatible driver to the passenger. System asks the passenger if they want to change their arrival time. Passenger accepts, group matching proceeds as intended.

4.2. Weighted matrix for evaluating alternative options in recommend notification

Evaluation criteria	**Significance weighting**	**Option scores**		
		A	B	C
Information security	0.3	0.3	0.9	0.6
Fast response	0.5	0.6	0.6	0.9
Comfortable	0.2	1	0.3	0.6
Total	1	0.59	0.63	0.91

5. Requirements prioritization

Requirements Prioritization using Analytic Hierarchy Process (AHP) Method
Note: The requirements of driver (column A) can be considered as the same requirements of passenger (column B); C4 and A5 are the same requirement.

5.1. Comparison matrix

5.1.1 Saaty scale of relative importance levels

Importance Definition Explanation	Importance Definition Explanation	Importance Definition Explanation
1	Equally important	Both elements have equal contribution in the objective
3	Moderately important	Moderate advantage of the one element compared to the other.
5	Strong important	Strong favoring of one element compared to the other.
7	Very strong and proven importance	One element is strongly favored and has domination in practice, compared to the other element.
9	Extreme importance	One element is favored in comparison with the other, based on strongly proved evidence and facts.

5.1.2 Comparison matrix with relative contributions of the requirements

	A1	A2	A3	A4	A5	A6	A7	A8	C1	C2	C3	D1	D2
A1	**1**	1/5	1/5	3	1	5	1/5	1	1	1/3	1/3	1	1/3
A2	5	**1**	1	7	5	9	1	5	3	1	1	5	1
A3	5	1	**1**	7	5	9	1	5	3	1	1	5	1
A4	1/3	1/7	1/7	**1**	1/3	3	7	1/3	1	1/5	1/5	1/3	1/5
A5	1	1/5	1/5	3	**1**	5	1/5	1	1	1/3	1/3	1	1/3
A6	1/5	1/9	1/9	1/3	1/5	**1**	1/9	1/5	1	1/7	1/7	1/5	1/7
A7	5	1	1	1/7	5	9	**1**	5	1	1	1	5	1
A8	1	1/5	1/5	3	1	5	1/5	**1**	1	1/3	1/3	1	1/3

C1	1	1/3	1/3	1	1	1	1	1	**1**	1/5	1/5	1	1/3
C2	3	1	1	5	3	7	1	3	5	**1**	1	5	1
C3	3	1	1	5	3	7	1	3	5	1	**1**	5	1
D1	1	1/5	1/5	3	1	5	1/5	1	1	1/5	1/5	**1**	1/3
D2	3	1	1	5	3	7	1	3	3	1	1	3	**1**

5.1.3 Comparison matrix with relative costs of requirements

	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**C1**	**C2**	**C3**	**D1**	**D2**
A1	**1**	1/5	1/5	3	3	1	1/7	1/3	1	1	1	3	1/3
A2	5	**1**	1	1/7	1/7	5	1/3	1	5	5	5	1/7	1
A3	5	1	**1**	1/7	1/7	5	1/3	1	5	5	5	1/7	1
A4	1/3	7	7	**1**	1	1/3	1/9	1/5	1/3	1/3	1/3	1	1/5
A5	1/3	7	5	1	**1**	1/3	1/9	1/5	1/3	1/3	1/3	1	1/5
A6	1	1/5	1/5	3	3	**1**	7	3	1	1	1	1/3	3
A7	7	3	3	9	9	7	**1**	1/3	7	7	7	1/9	1/5
A8	3	1	1	5	5	3	3	**1**	3	3	3	1/5	1
C1	1	1/5	1/5	3	3	1	1/7	1	**1**	1	1	1/3	3
C2	1	1/5	1/5	3	3	1	1/7	3	1	**1**	1	1/3	3
C3	1	1/5	1/5	3	3	1	1/7	3	1	1	**1**	1/3	3
D1	1/3	7	7	1	1	1/3	9	1	1/3	1/3	1/3	**1**	3
D2	1/3	1	1	5	5	1/3	5	3	1/3	1/3	1/3	1/3	**1**

5.1.4 Normalized comparison matrix and relative contributions of requirements

	A1	A2	A3	A4	A5	A6	A7	A8	C1	C2	C3	D1	D2	Relative Value
A1	0,03	0,03	0,03	0,07	0,03	0,07	0,01	0,03	0,04	0,04	0,04	0,03	0,04	**0,04**
A2	0,17	0,14	0,14	0,16	0,17	0,12	0,07	0,17	0,11	0,13	0,13	0,15	0,13	**0,14**
A3	0,17	0,14	0,14	0,16	0,17	0,12	0,07	0,17	0,11	0,13	0,13	0,15	0,13	**0,14**
A4	0,01	0,02	0,02	0,02	0,01	0,04	0,47	0,01	0,04	0,03	0,03	0,01	0,03	**0,06**
A5	0,03	0,03	0,03	0,07	0,03	0,07	0,01	0,03	0,04	0,04	0,04	0,03	0,04	**0,04**
A6	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,04	0,02	0,02	0,01	0,02	**0,01**
A7	0,17	0,14	0,14	0	0,17	0,12	0,07	0,17	0,04	0,13	0,13	0,15	0,13	**0,12**
A8	0,03	0,03	0,03	0,07	0,03	0,07	0,01	0,03	0,04	0,04	0,04	0,03	0,04	**0,04**
C1	0,03	0,04	0,04	0,02	0,03	0,01	0,07	0,03	0,04	0,03	0,03	0,03	0,04	**0,03**
C2	0,1	0,14	0,14	0,12	0,1	0,1	0,07	0,1	0,19	0,13	0,13	0,15	0,13	**0,12**
C3	0,1	0,14	0,14	0,12	0,1	0,1	0,07	0,1	0,19	0,13	0,13	0,15	0,13	**0,12**
D1	0,03	0,03	0,03	0,07	0,03	0,07	0,01	0,03	0,04	0,03	0,03	0,03	0,04	**0,04**
D2	0,1	0,14	0,14	0,12	0,1	0,1	0,07	0,1	0,11	0,13	0,13	0,09	0,13	**0,11**

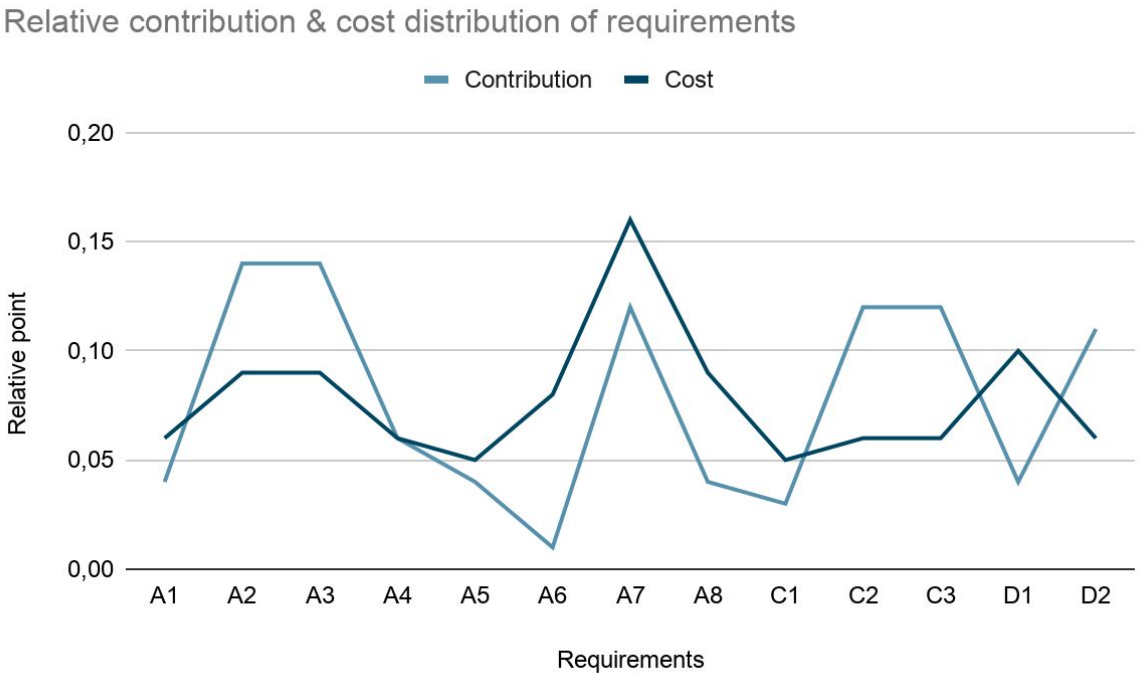
5.1.4 Normalized comparison matrix and relative costs of requirements

	A1	A2	A3	A4	A5	A6	A7	A8	C1	C2	C3	D1	D2	Relative Value
A1	0,04	0,01	0,01	0,08	0,08	0,04	0,01	0,02	0,04	0,04	0,04	0,36	0,02	**0,06**
A2	0,19	0,03	0,04	0	0	0,19	0,01	0,06	0,19	0,19	0,19	0,02	0,05	**0,09**
A3	0,19	0,03	0,04	0	0	0,19	0,01	0,06	0,19	0,19	0,19	0,02	0,05	**0,09**
A4	0,01	0,24	0,26	0,03	0,03	0,01	0	0,01	0,01	0,01	0,01	0,12	0,01	**0,06**
A5	0,01	0,24	0,19	0,03	0,03	0,01	0	0,01	0,01	0,01	0,01	0,12	0,01	**0,05**
A6	0,04	0,01	0,01	0,08	0,08	0,04	0,26	0,17	0,04	0,04	0,04	0,04	0,15	**0,08**

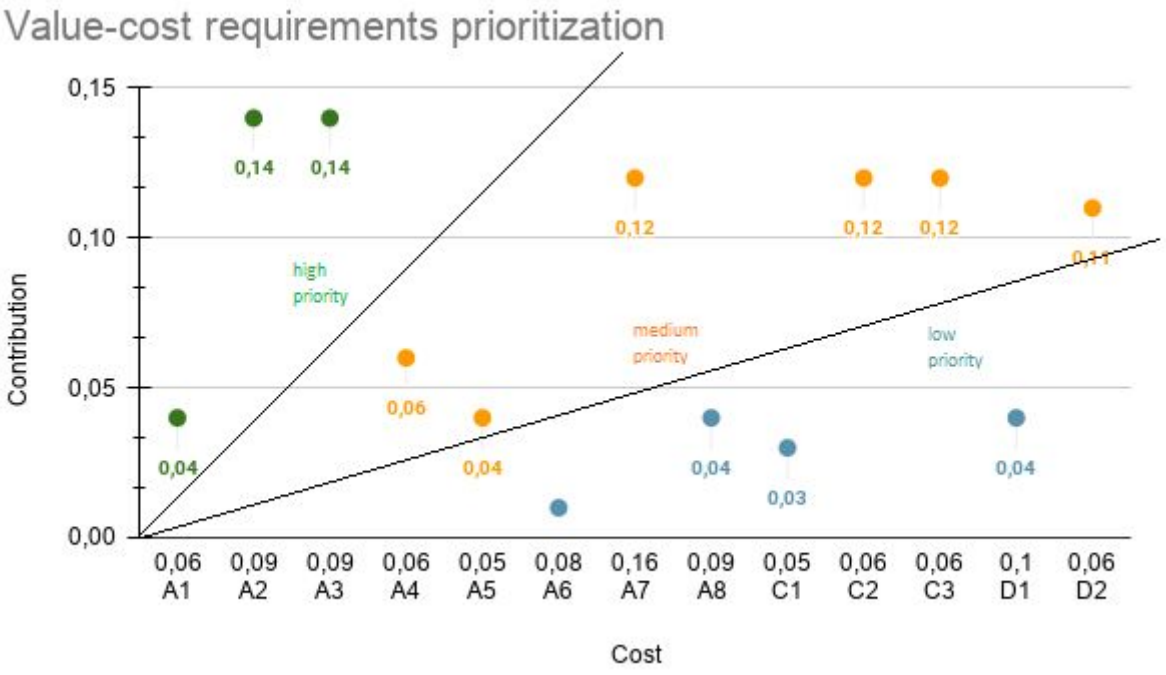
A7	0,27	0,1	0,11	0,24	0,24	0,27	0,04	0,02	0,27	0,27	0,27	0,01	0,01	**0,16**
A8	0,11	0,03	0,04	0,13	0,13	0,11	0,11	0,06	0,11	0,11	0,11	0,02	0,05	**0,09**
C1	0,04	0,01	0,01	0,08	0,08	0,04	0,01	0,06	0,04	0,04	0,04	0,04	0,15	**0,05**
C2	0,04	0,01	0,01	0,08	0,08	0,04	0,01	0,17	0,04	0,04	0,04	0,04	0,15	**0,06**
C3	0,04	0,01	0,01	0,08	0,08	0,04	0,01	0,17	0,04	0,04	0,04	0,04	0,15	**0,06**
D1	0,01	0,24	0,26	0,03	0,03	0,01	0,34	0,06	0,01	0,01	0,01	0,12	0,15	**0,1**
D2	0,01	0,03	0,04	0,13	0,13	0,01	0,19	0,17	0,01	0,01	0,01	0,04	0,05	**0,06**

5.2. Value-cost requirements prioritization

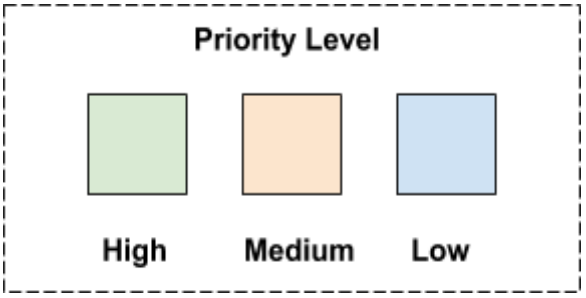
5.2.1 Relative contribution & cost distribution of requirements



5.2.2 Value-cost requirements prioritization



5.3. Requirements prioritization



	A	B	C	D
	Driver	**Passenger**	**Administrator**	**VNU**
1	The driver will be provided information about passengers	The passenger will be provided information about the driver and other passengers	The administrator will receive feedbacks, requests and notifications fr om stakeholders	In the system-to-be, the organization will be able to collect data anonymously
2	Able to choose amongst	Able to choose amongst	Given permissions to	Improve student’

	options for the best time arrangement	options for the best time arrangement	manage accounts	quality
3	Automatically calculate expenses	Automatically calculate expenses	Given permissions to edit a ridesharing Group in case an error occurs	
4	Automatically calculate approximate travel time	Automatically calculate approximate travel time	Provide system' communication tool	
5	Provide system' communication tool	Provide system' communication tool		
6	Send feedback to administrator	Send feedback to administrator		
7	Automatically get recommended passengers	Automatically get recommended drivers		
8	Driver's information is confidential	Passenger's information is confidential		

II. Software Requirement Specification

1. Introduction

1.1. Purpose

This document is used to define terminology specific to the problem domain, explaining terms, which may be unfamiliar to the reader of the use-case descriptions or other project documents. Often, this document can be used as an informal data dictionary, capturing data definitions so that use-case descriptions of other project documents can focus on what the system must do with the information.

1.2. Scope

This carpooling system is designed to speed up the procedure of finding a suitable carpooler for staff and students within the VNU area. The system allows drivers to sign up for rides - passengers meanwhile have access to the list of available drivers and then, per request, ask for permission to join the ride.

1.3. Definitions, acronyms, abbreviations

No	Keywords	Definition
1	UET	University of Engineering and Technology
2	VNU	Vietnam National University

2. Overall description

2.1. Product perspective

This carpooling system is intended to be used by staff/students of VNU as a lightweight companion in daily transportation. Thereby, the system would be developed as a mobile application, and would only require an active internet connection to fully function. As a full package enclosed to ensure privacy matters between the paired driver and passenger, the application is planned to include not only the "matchmaking" function, but also a means for both parties to communicate after grouping - and multiple payment methods encapsulated for the users to choose from.

2.2. Product features

The following are the main features that are included in the Ridesharing System.

Sign Up: The system allows the user to create their accounts in the system and provide features of updating and viewing profile.
Log In: The system allows the user to login to their accounts in the system.
Create Groups: The system allows the user to create groups in the system as driver roles.
Delete Groups: The system allows the user to delete groups in the system as driver roles.
Get Recommended Riders: The system allows users to find suitable riders in the system, resulting in a recommended list.
Choose Rider: The system allows users to choose suitable riders in the recommended list.
Communication Between Riders: The system allows the user to communicate with each other.
Send Feedback: Users send reports and feedback to the administrator.
Manage accounts: Administrator chooses to edit a user account.
Manage groups: The administrator chooses to edit a group.
Validate accounts: The VNU email system sends a verification code to the user's email.

2.3. User characteristics

The three following types of users are envisioned to be using the system.

Drivers: These are users with a motorbike, driver license and knowledge of proper phone usage. Besides the knowledge of how to perform basic application functionality (such as chat and make/receiving a call), these users may have some training if they have to use google map to mark location or use the system to find appropriate riders.
Passengers: These are users with knowledge of proper phone usage. Besides the knowledge of how to perform basic application functionality (such as chat and make/receiving a call), these users may have some training if they have to use google map to mark location or use the system to find appropriate riders.
Administrators: These are individuals who are entrusted by the stakeholder to manage the ridesharing system. They are assumed to have a relatively advanced knowledge of telephony, computer systems and the chosen hardware platform in particular. These individuals have been trained in how to use the software (particularly the administrator user interface) and are familiar with all its aspects.

2.4. Constraints

The Ridesharing System shall be developed under the following constraints:

Functional: The system is expected to open for registering to all VNU staff and students. Upon registration, a confirmation email with a verification code is expected to arrive at the intended user's mailbox. The system shall be able to recommend riders upon the provided date and location of the trip. Consequent to successfully matching riders, the system shall be able to provide all parties with a private chat box to discuss further details. After completing a trip, riders shall be able to provide feedback for each other. Average feedback score shall be displayed on every rider's profile, along with their name and basic information. The user would have the option to change their basic information if wished.

Non-functional:

Architectural: The application shall be developed on React Native, running on both iOS and Android-based devices. The application interface shall run on both Vietnamese and English, distributed for free via each platform's specific application market.

Development: The initial version of the application shall be delivered within three months. Shall new insight be gained from collected data during the running period, customized features shall be implemented accordingly.

2.5. Assumptions and dependencies

The system assumes that every VNU staff and student has at least one smartphone/tablet with a stable internet connection. The record of the user's email shall match with the email used to complete registration. The basic information of the vehicle provided by the driver shall match the actual vehicle.

3. Specific Requirement

This section describes in detail the requirements and specifications for the ridesharing system software.

3.1. External Interfaces

3.1.1 Sign Up

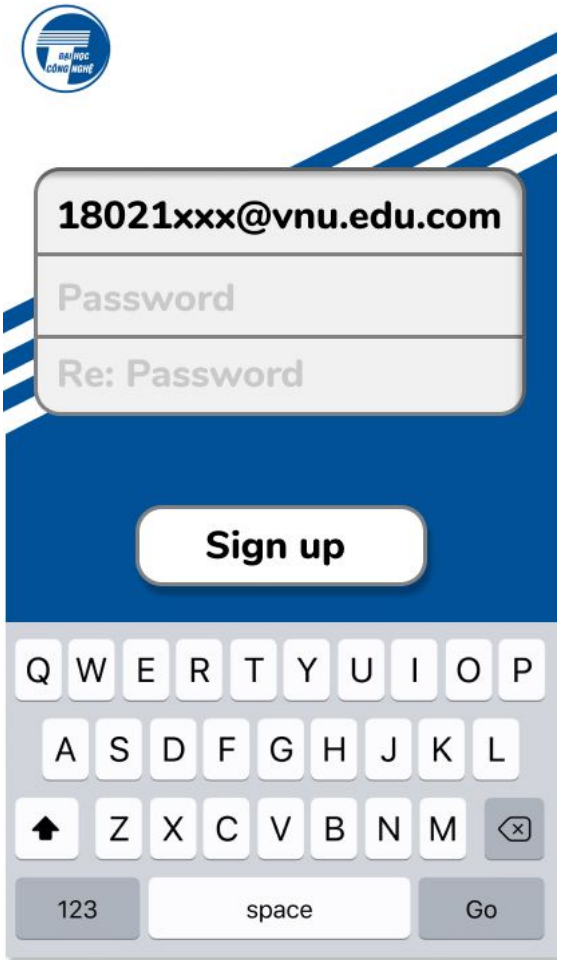


Figure 3.1.1. Sign Up Interface

3.1.2 Sign In

Figure 3.1.2. Sign In Interface

3.1.3 Main Screen

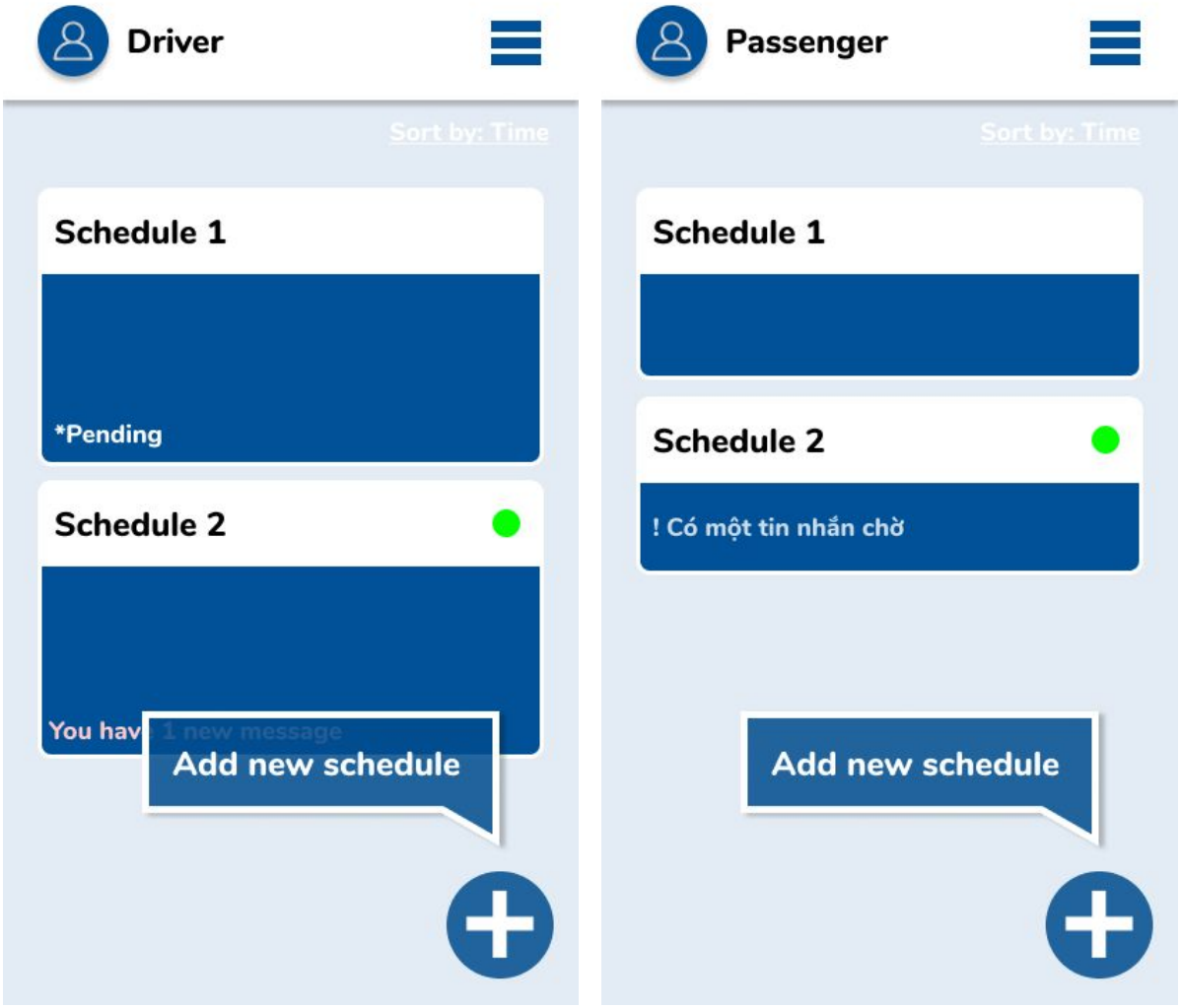


Figure 3.1.3. Main Screen Interface

3.1.4 Create Group

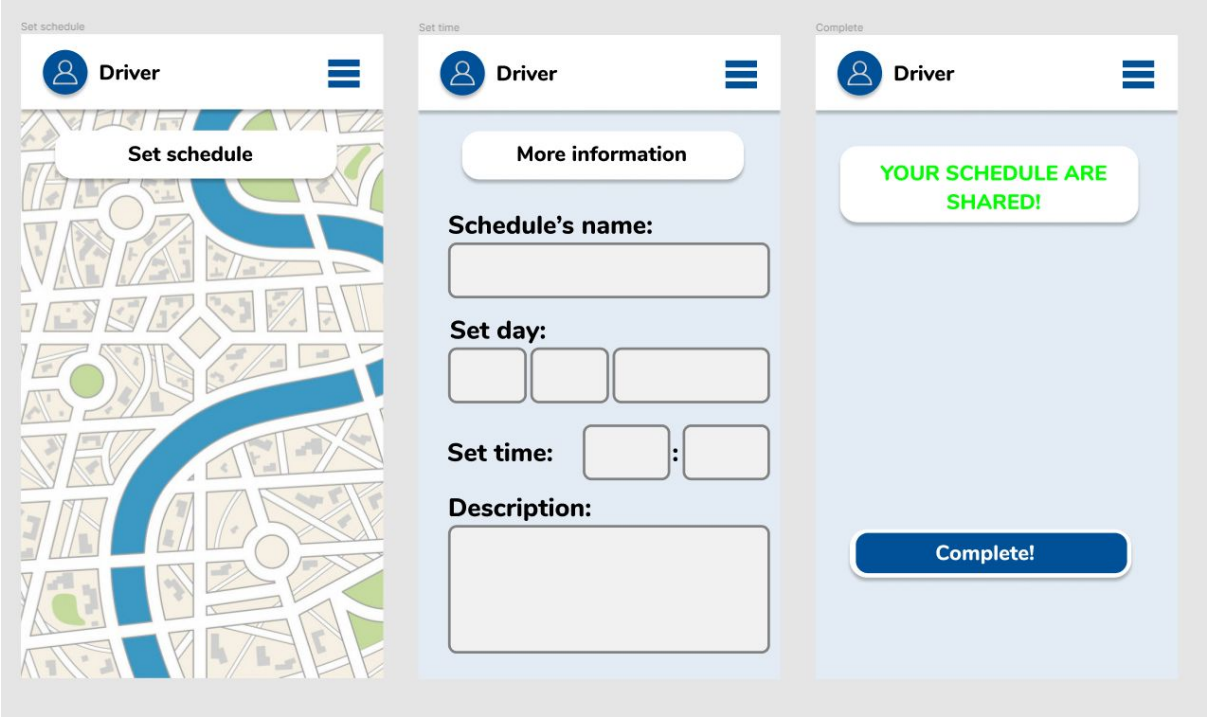


Figure 3.1.4. Create Group Interface

3.1.5 Get Recommendations

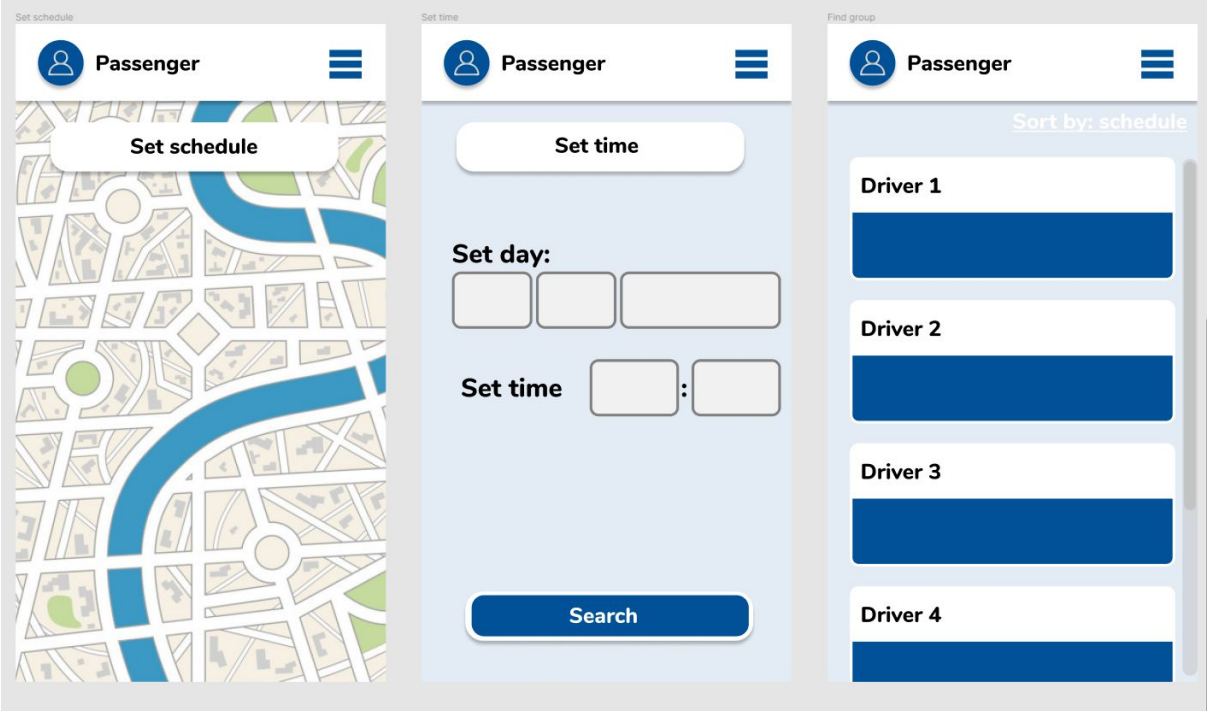


Figure 3.1.5. Get Recommendations Interface (1)

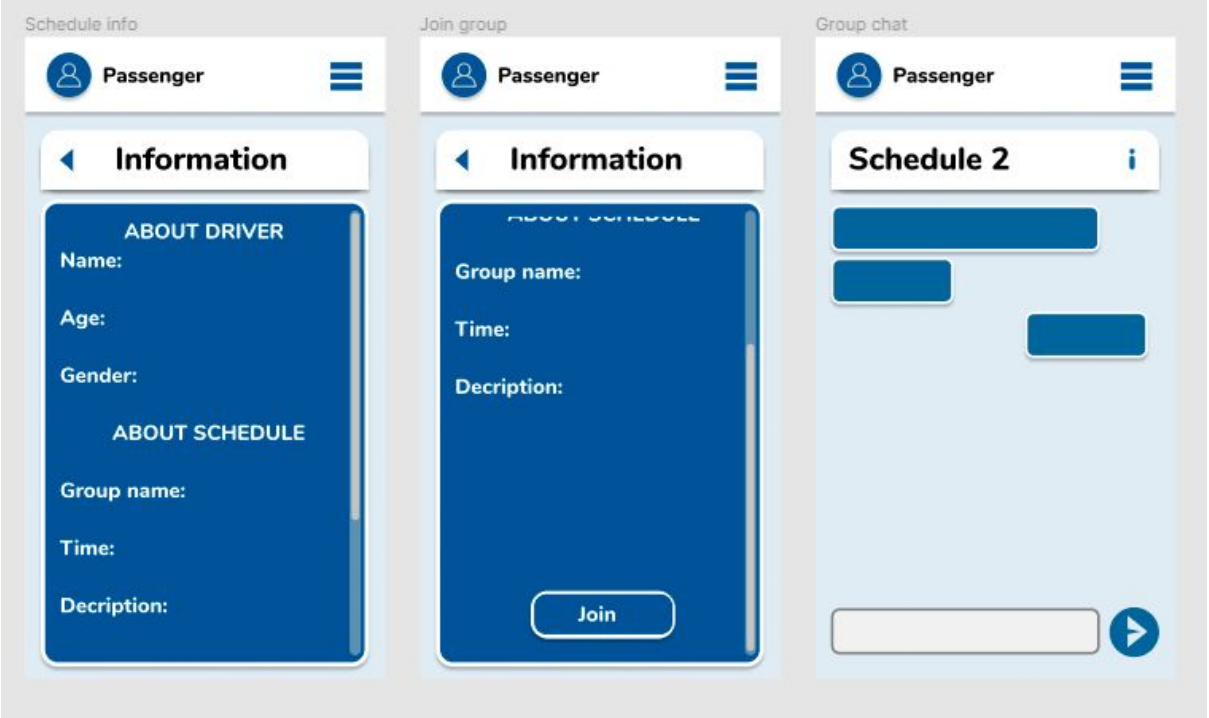


Figure 3.1.5. Get Recommendations Interface (2)

3.1.6 Send Feedback

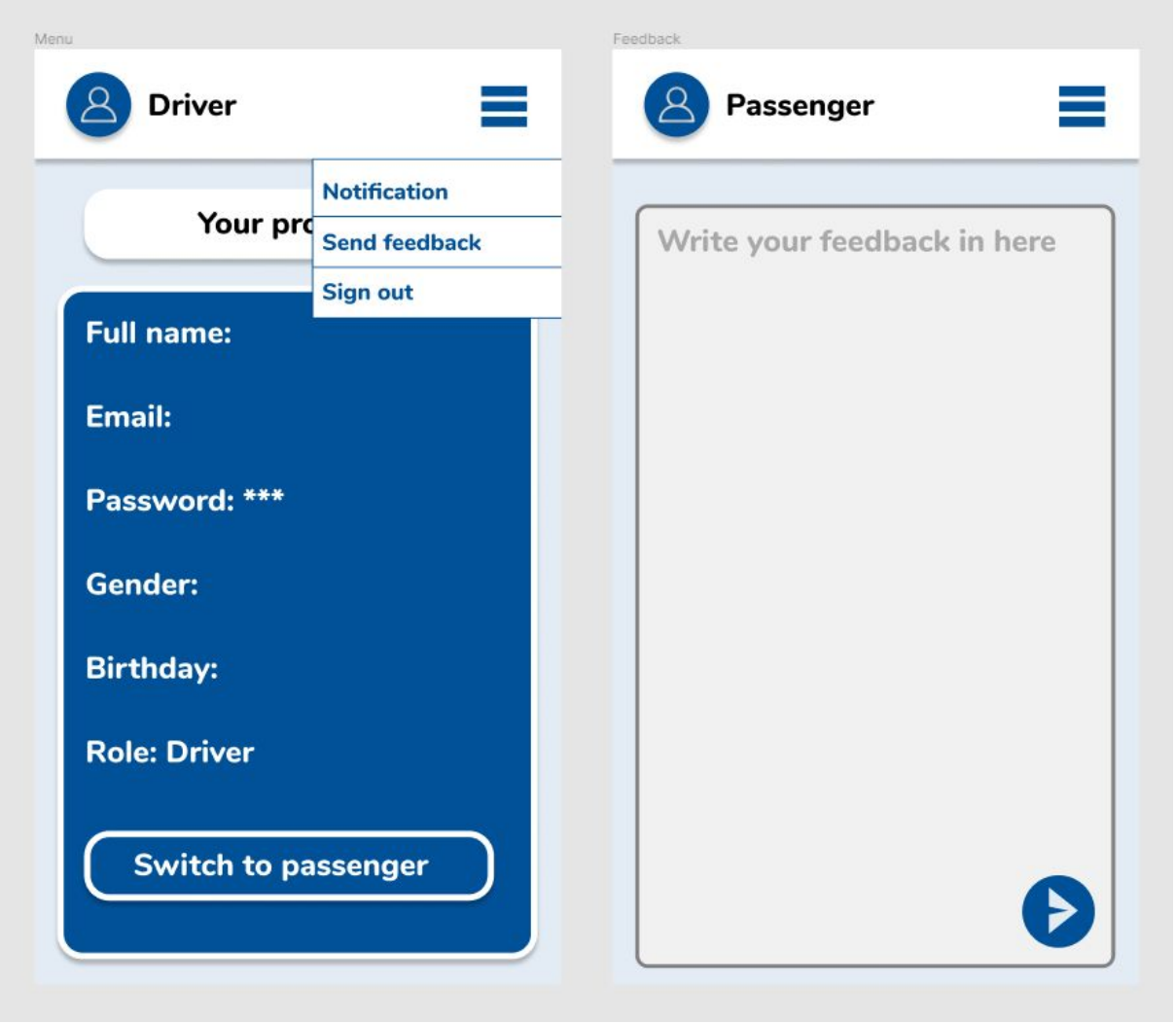


Figure 3.1.6. Send Feedback Interface

3.1.7 Communication

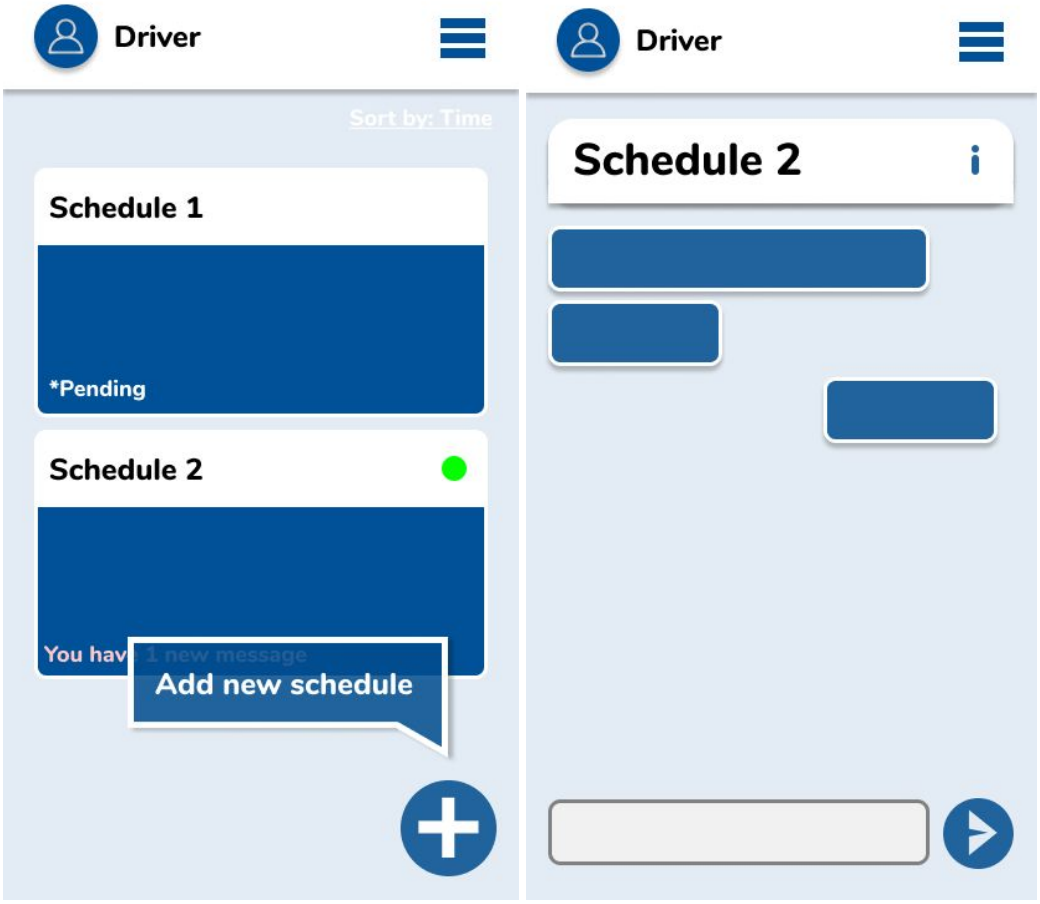


Figure 3.1.7. Communication Interface

3.1.8 Manage Account

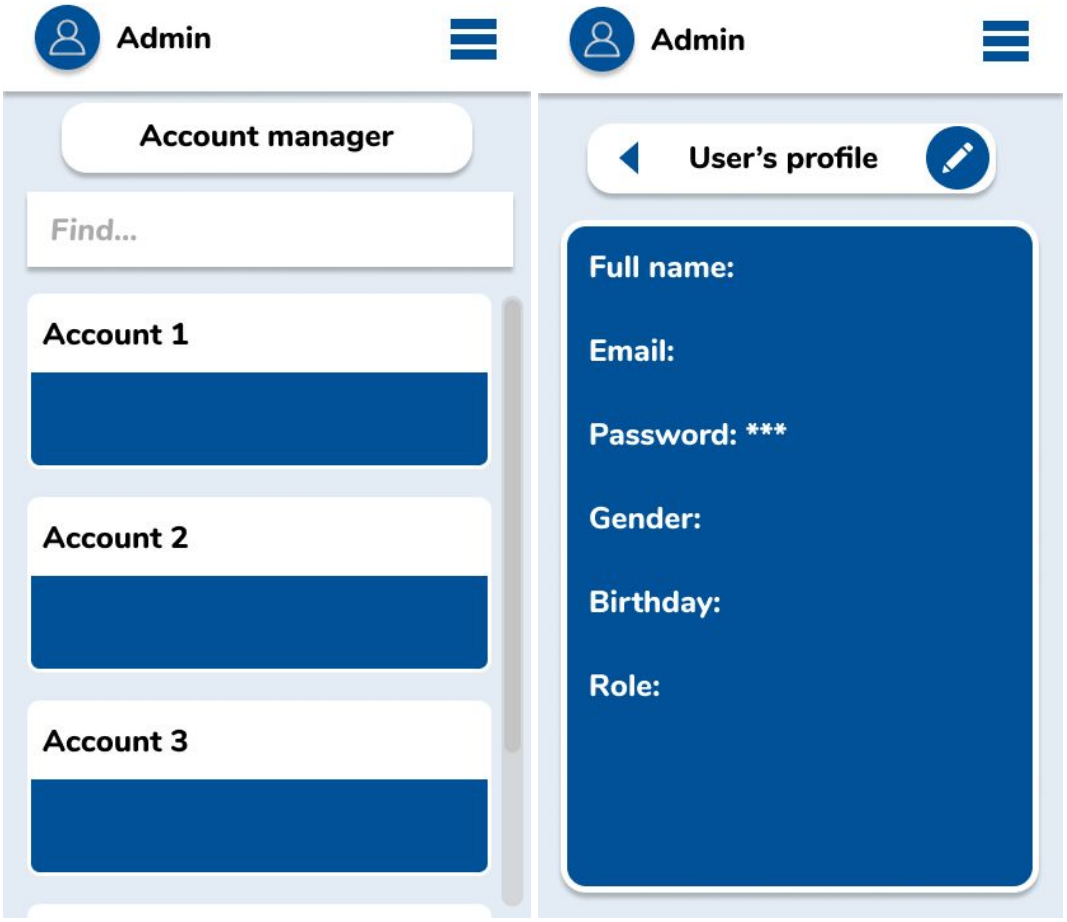


Figure 3.1.8. Manage Account Interface

3.1.9 Manage Group

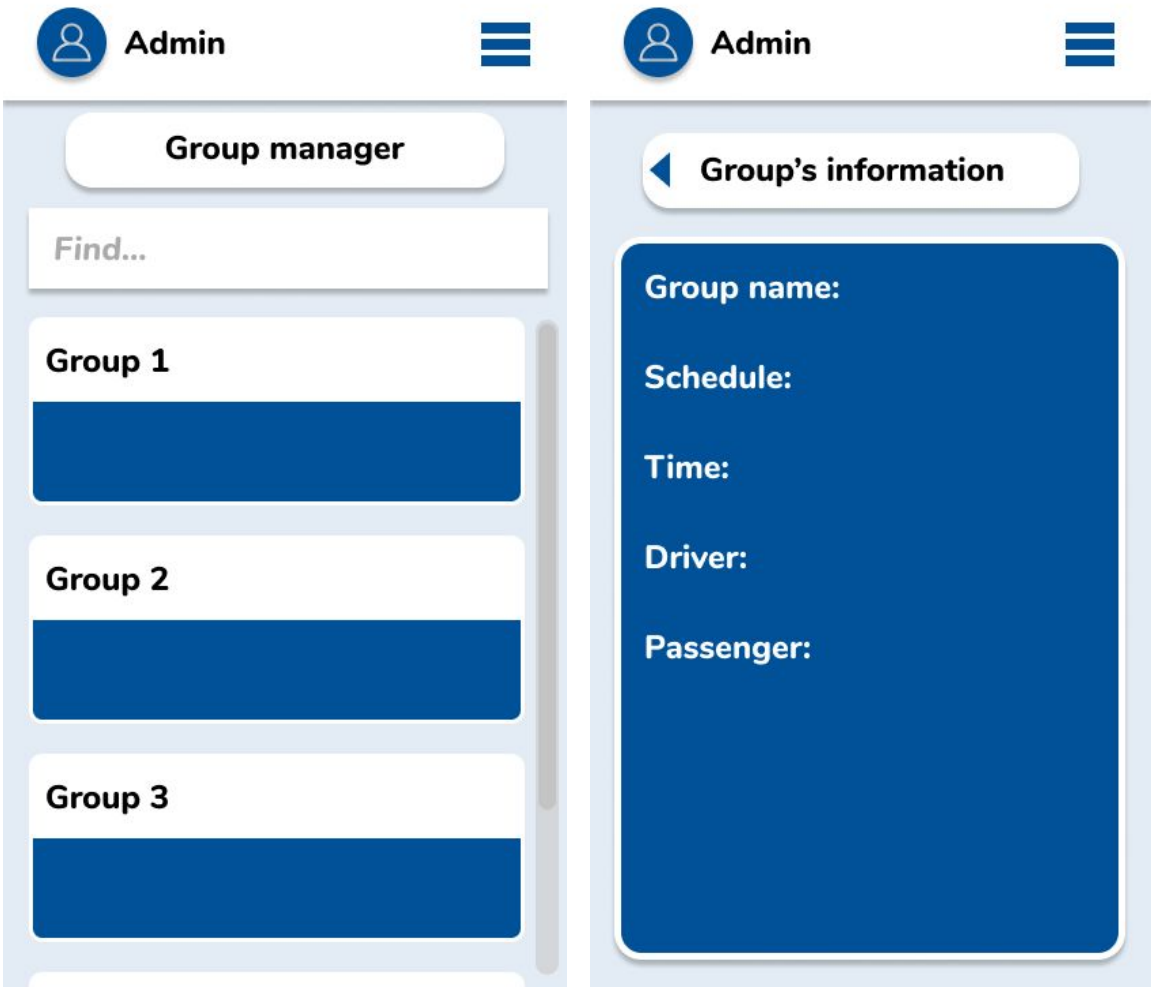


Figure 3.1.9. Manage Group Interface

3.2 Functional Requirements

3.2.1 Use Cases

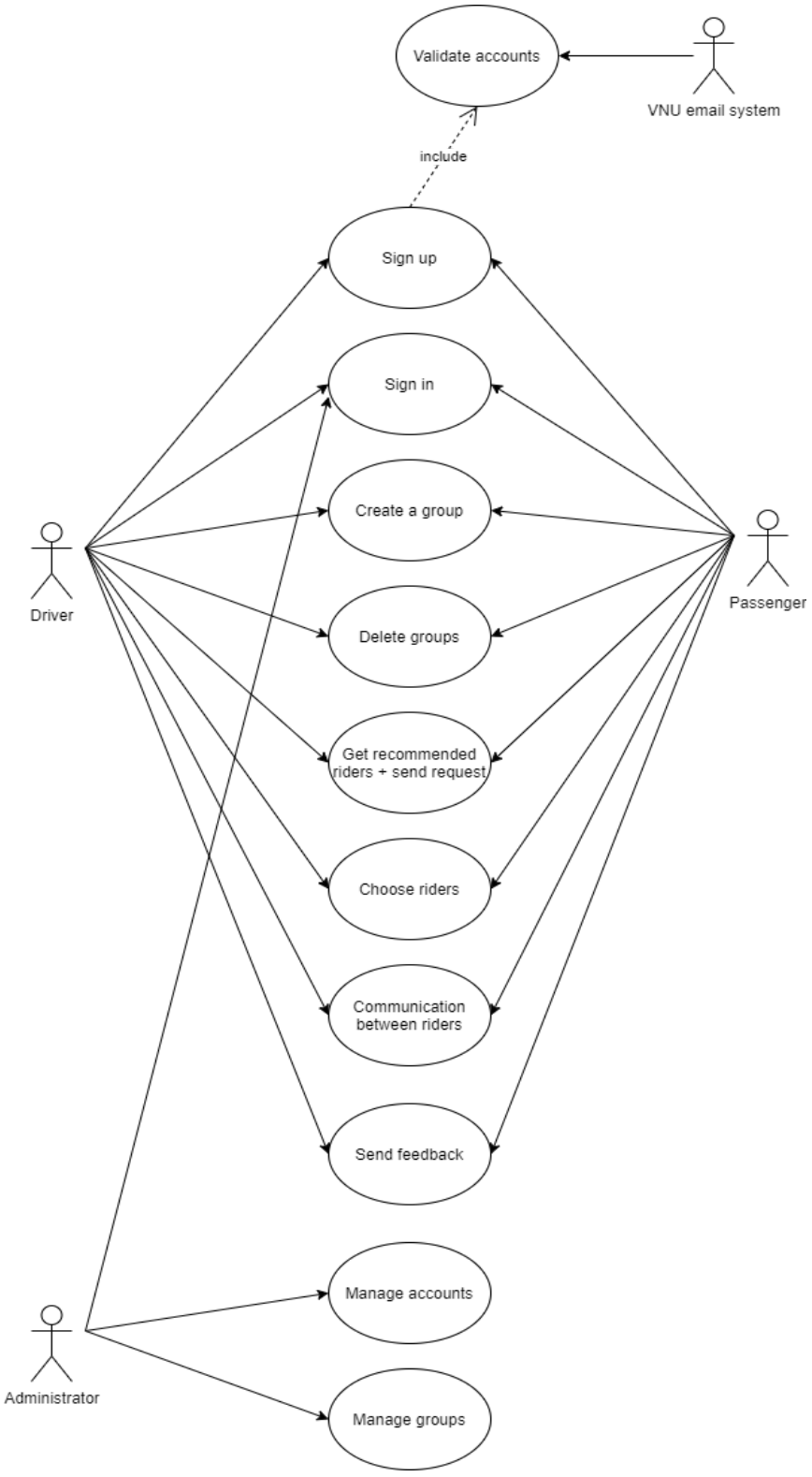


Figure 3.2.1. Use case Diagram

3.2.1.1 Sign up

Number: RS01
System: Ridesharing system
Actors: Driver, Passenger
Event/Precondition: The user has not logged into the system.
Overview/Postcondition: The user becomes a member of the system/no new account is created.
Related Use Cases: RS11
Activity Diagram:

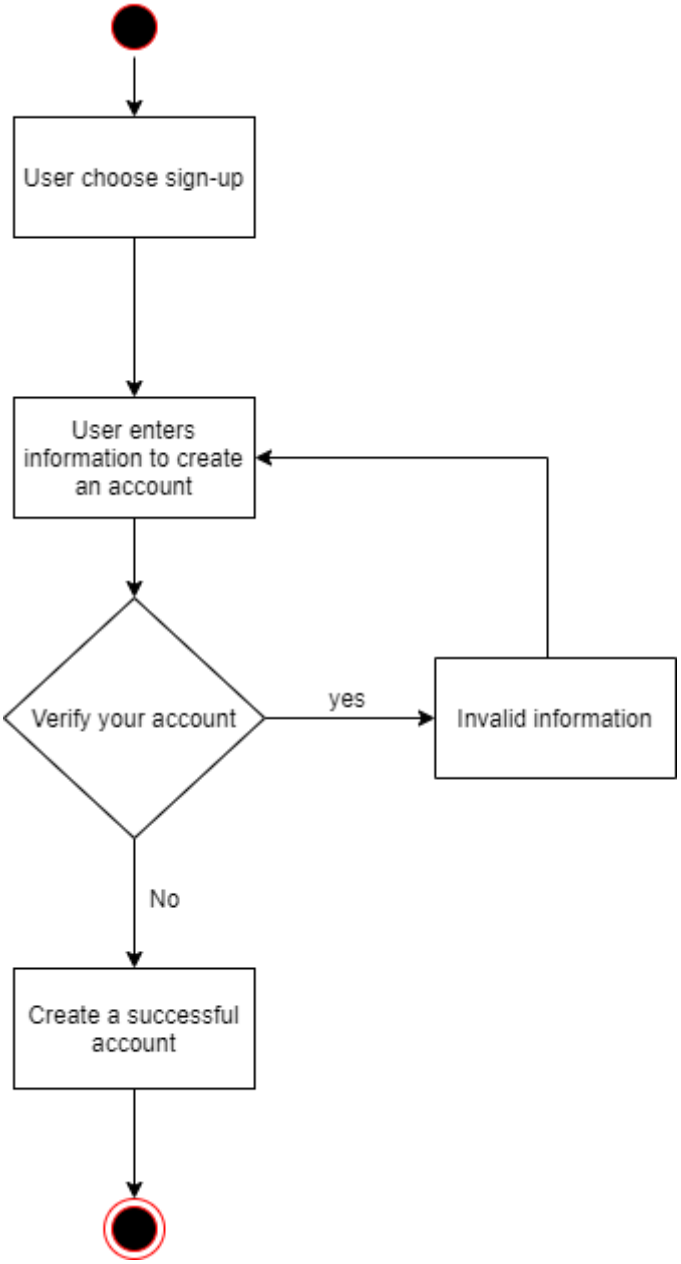


Figure 3.2.1.1. Signup Activity Diagram

3.2.1.2 Sign in

Number: RS02
System: Ridesharing system
Actors: Driver, Passenger, Administrator
Event/Precondition: The user has not logged into the system and has an existing credential in the system.
Overview/Postcondition: The user is logged in successfully.
Related Use Cases: None
Activity Diagram:

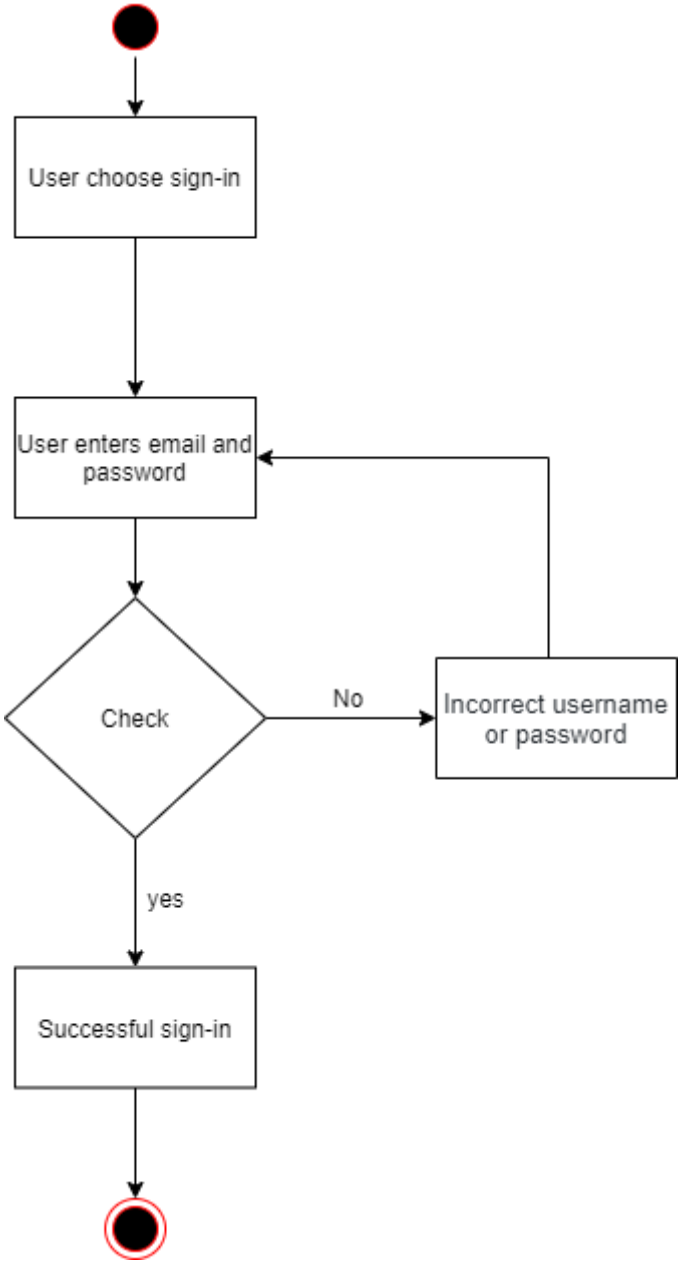


Figure 3.2.1.2. Sign In Activity Diagram

3.2.1.3 Create groups

Number: RS03
System: Ridesharing system
Actors: Driver
Event/Precondition: Driver is logged into the system. Driver chooses to create a group.
Overview/Postcondition: A new group is created in the system/failed to be created in the system
Related Use Cases: RS02
Activity Diagram:

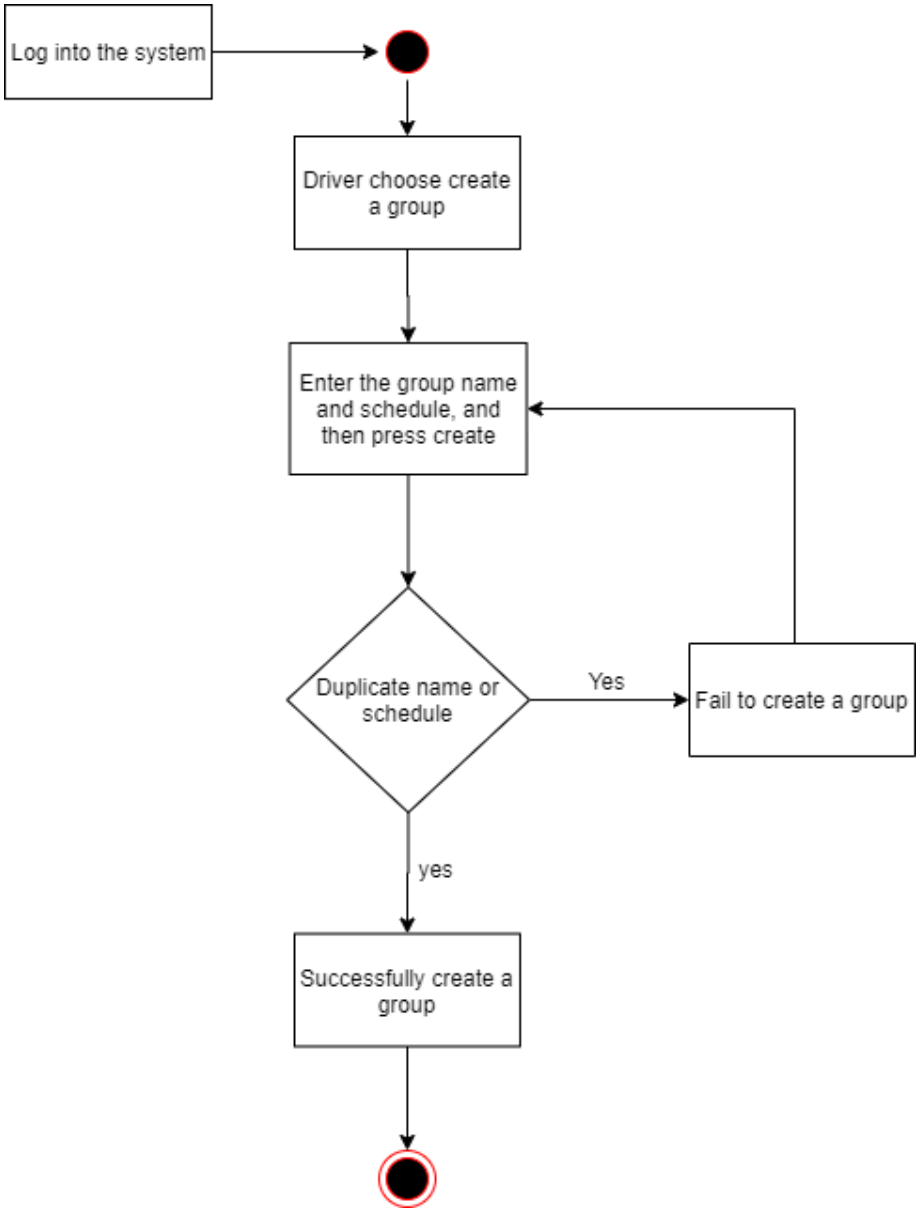


Figure 3.2.1.3. Create Groups Activity Diagram

3.2.1.4 Delete groups

Number: RS04
System: Ridesharing system
Actors: Driver
Event/Precondition: The driver has been logged into the system. At least a group has been created by the driver.
Overview/Postcondition: The group is deleted from the system/failed to be deleted from the system.

Related Use Cases: RS02, RS03
Activity Diagram:

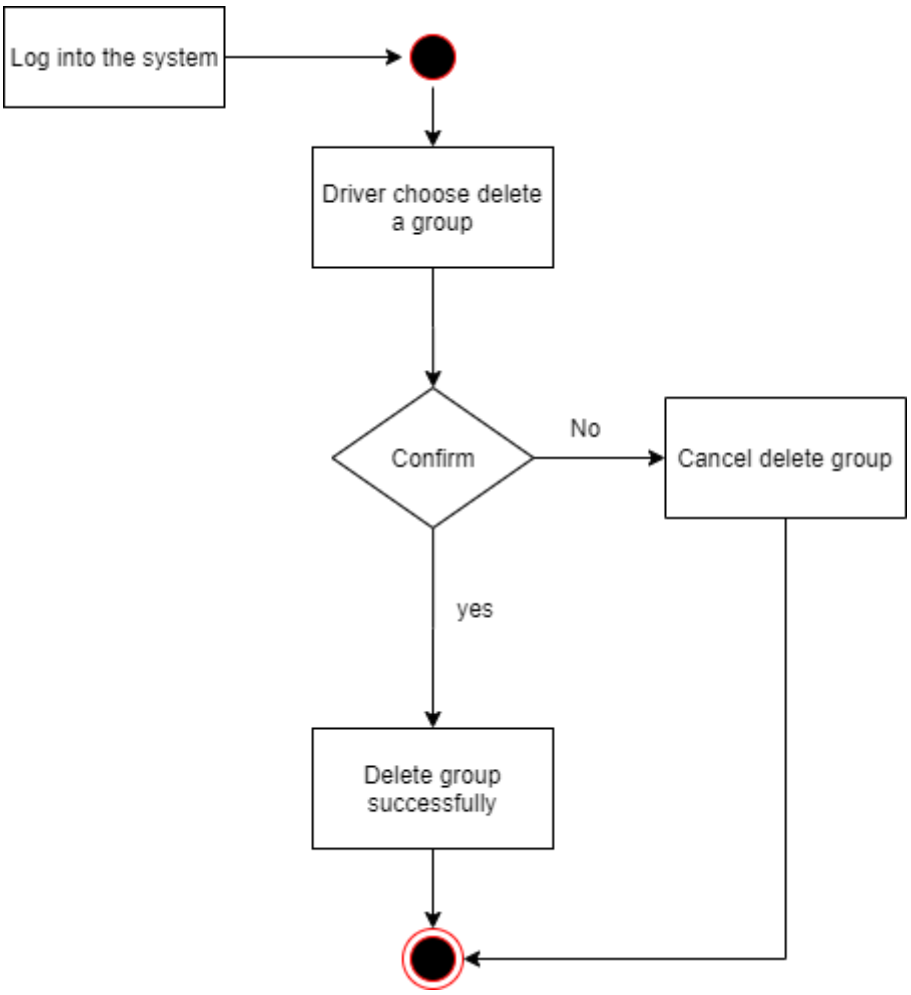


Figure 3.2.1.4. Delete Groups Activity Diagram

3.2.1.5 Get recommended riders & send a request

Number: RS05
System: Ridesharing system
Actors: Passenger, Driver
Event/Precondition: The passenger is logged into the system.
Overview/Postcondition: The passenger is able to send a carpooling request to at least one driver with matching time and points/The passenger is not able to send any carpooling request.
Related Use Cases: RS02
Activity Diagram:

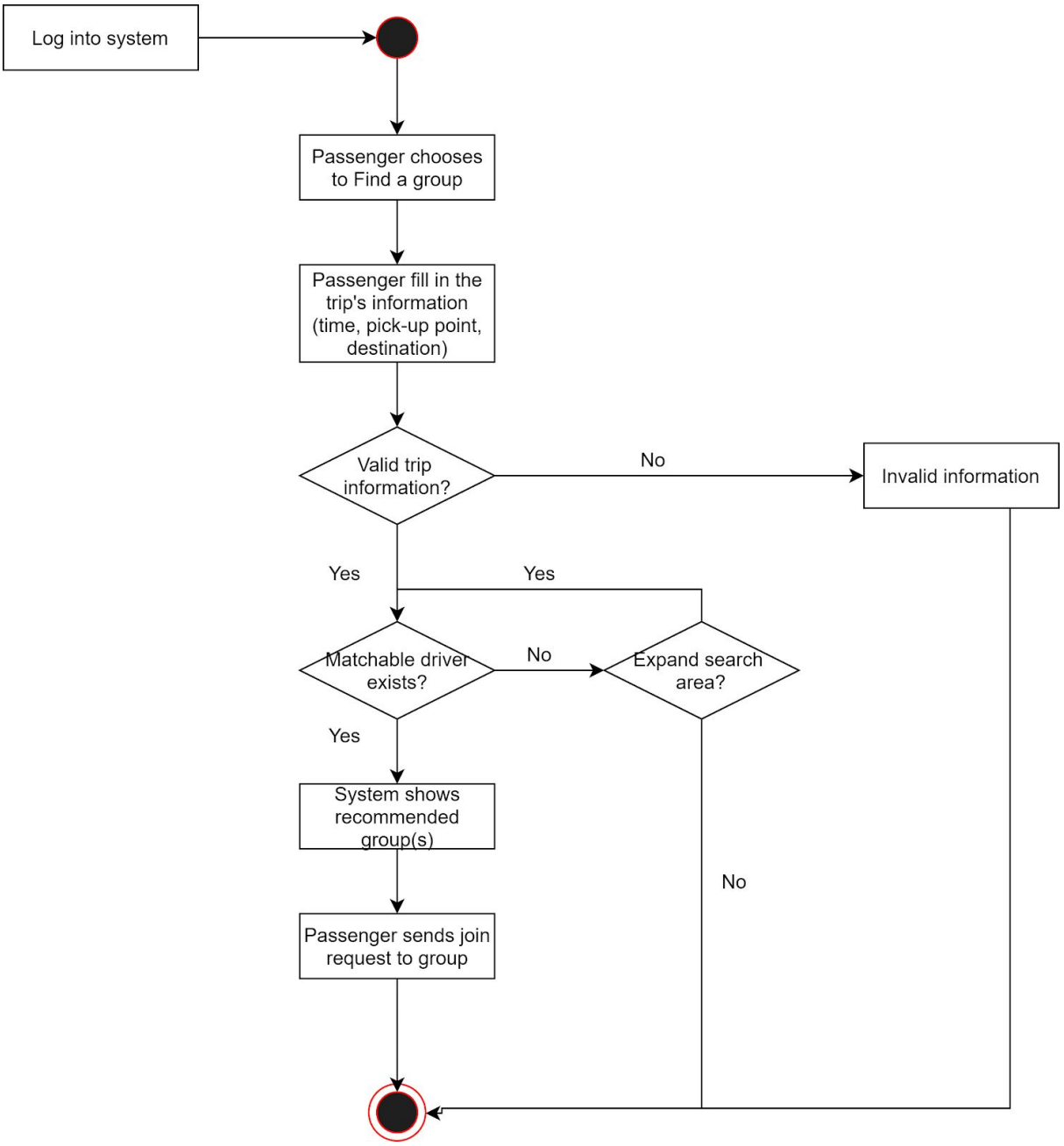


Figure 3.2.1.5. Get recommended riders & send a request Activity Diagram

3.2.1.6 Choose riders

Number: RS06
System: Ridesharing system
Actors: Driver, Passenger
Event/Precondition: The driver is logged into the system. The driver has created at least a group. The group has at least one or more passenger carpool requests from passengers.

Overview/Postcondition: The driver accepts the request from an appropriate passenger/The driver was not able to pick a passenger.
Related Use Cases: RS02, RS03, RS05
Activity Diagram:

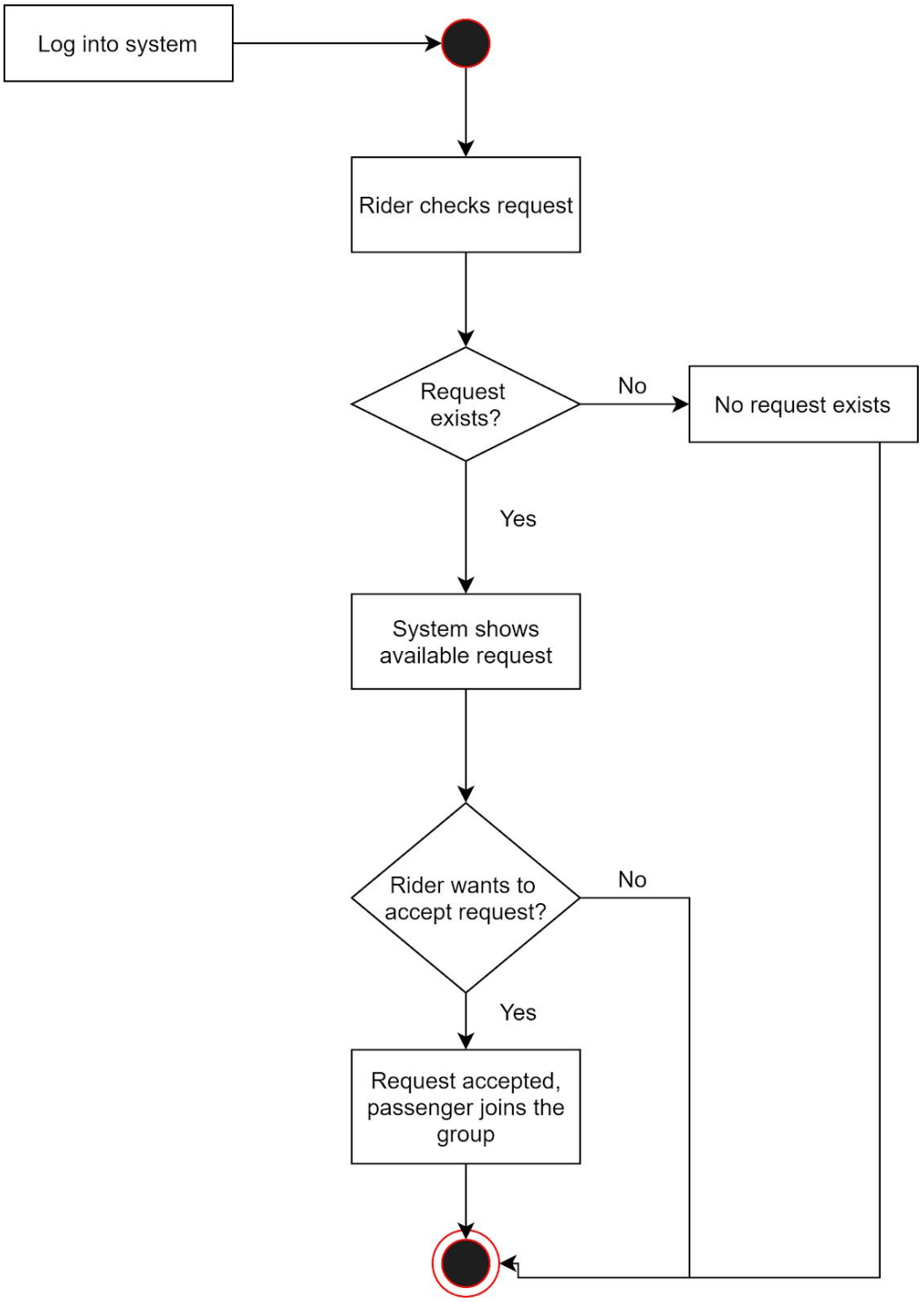


Figure 3.2.1.6. Choose Riders Activity Diagram

3.2.1.7 Communication between riders

Number: RS07
System: Ridesharing system
Actors: Driver, Passenger
Event/Precondition: Driver and passenger are logged into the system. Rider chooses to chat. Text messages have been put into the chat box by the rider.
Overview/Postcondition: The message is sent to other members in the group.
Related Use Cases: RS02, RS03
Activity Diagram:

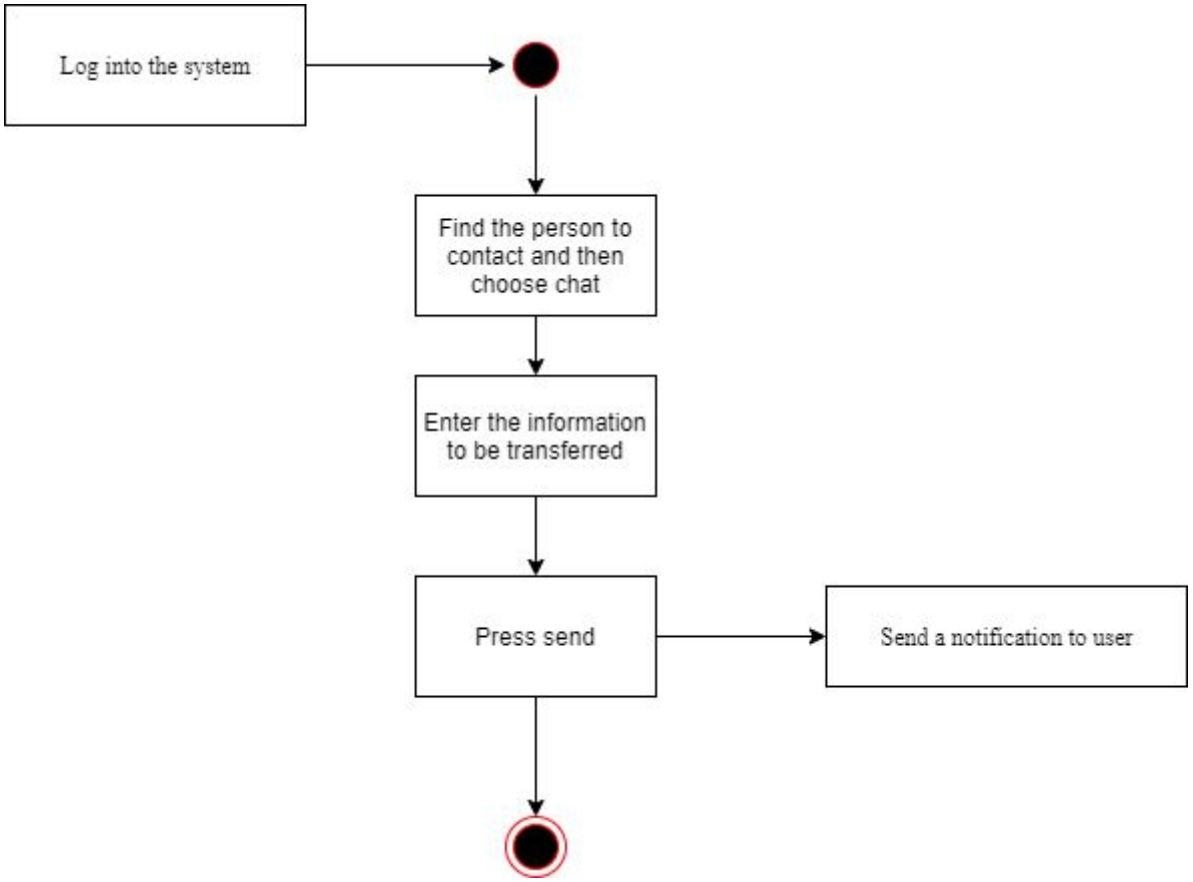


Figure 3.2.1.7. Communication Between Riders Activity Diagram

3.2.1.8 Send feedback

Number: RS08
System: Ridesharing system
Actors: Driver, Passenger
Event/Precondition: Driver and passenger are logged into the system. They send a report and/or feedback to the processing administrator.
Overview/Postcondition: A notification is sent to the administrator.
Related Use Cases: RS02
Activity Diagram:

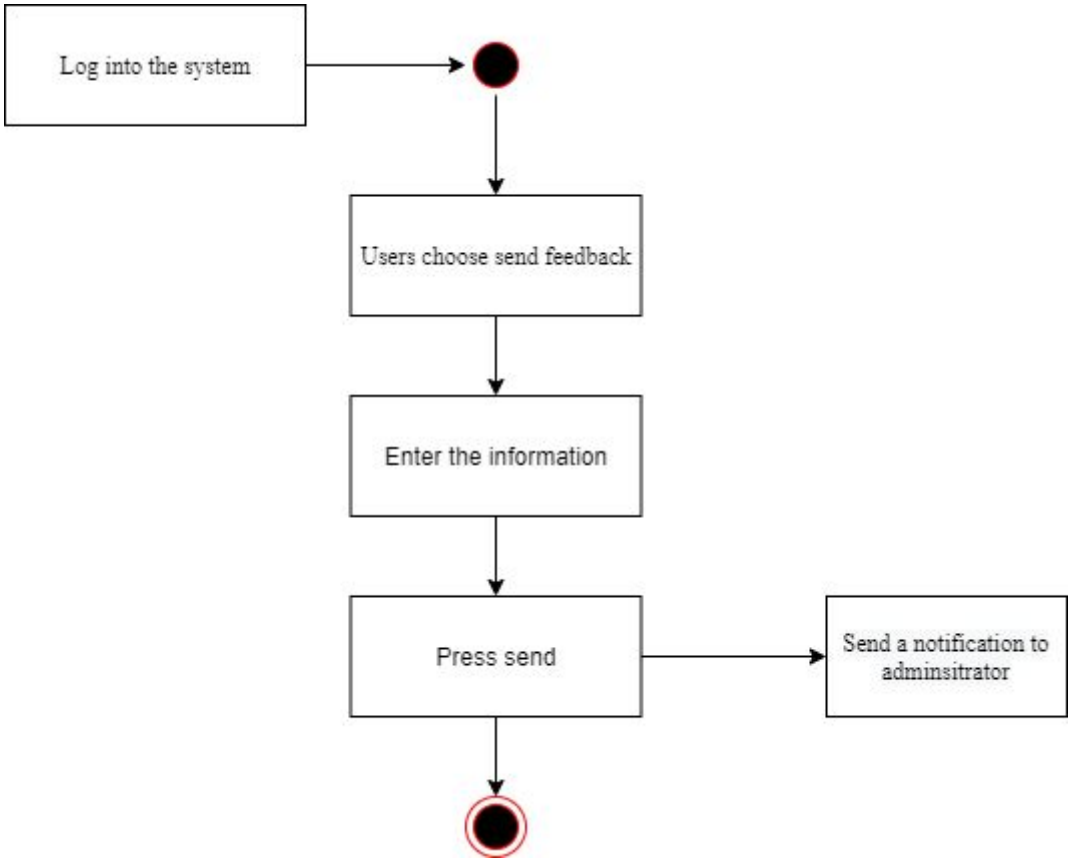


Figure 3.2.1.9. Send Feedback Activity Diagram

3.2.1.9 Manage accounts

Number: RS9
System: Ridesharing system
Actors: Administrator

Event/Precondition: The administrator is logged into the system.The administrator chooses to edit a user account. The input is the user account that the administrator wants to modify.
Overview/Postcondition: The change(s) to the user account is saved.
Related Use Cases: RS02
Activity Diagram:

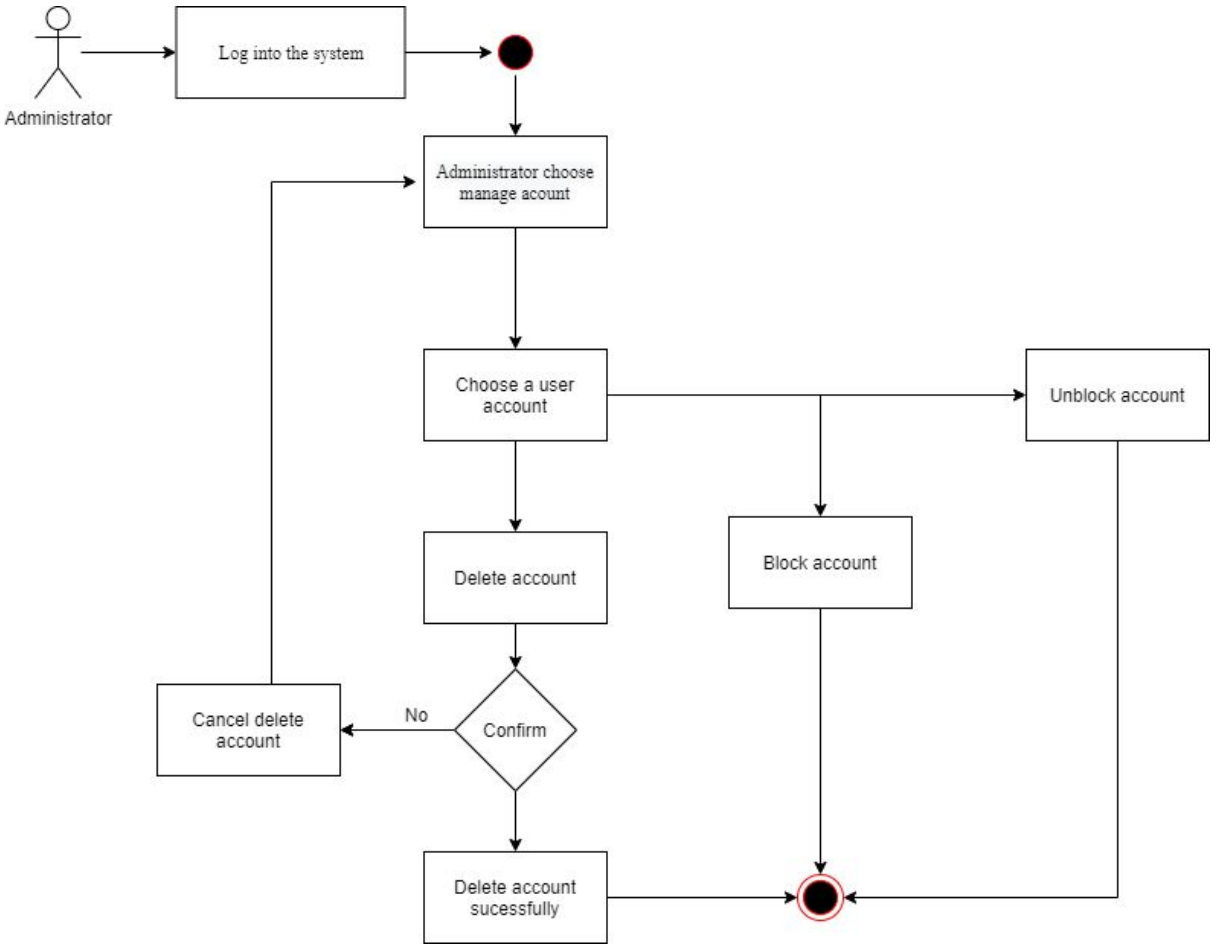


Figure 3.2.1.10. Manage Accounts Activity Diagram

3.2.1.10 Manage groups

Number: RS10
System: Ridesharing system
Actors: Administrator
Event/Precondition: The administrator is logged into the system.The administrator chooses to edit a group. The input is the group that the administrator wants to modify.

Overview/Postcondition: The changes to the group have been saved.
Related Use Cases: RS02, RS03,RS08
Activity diagram:

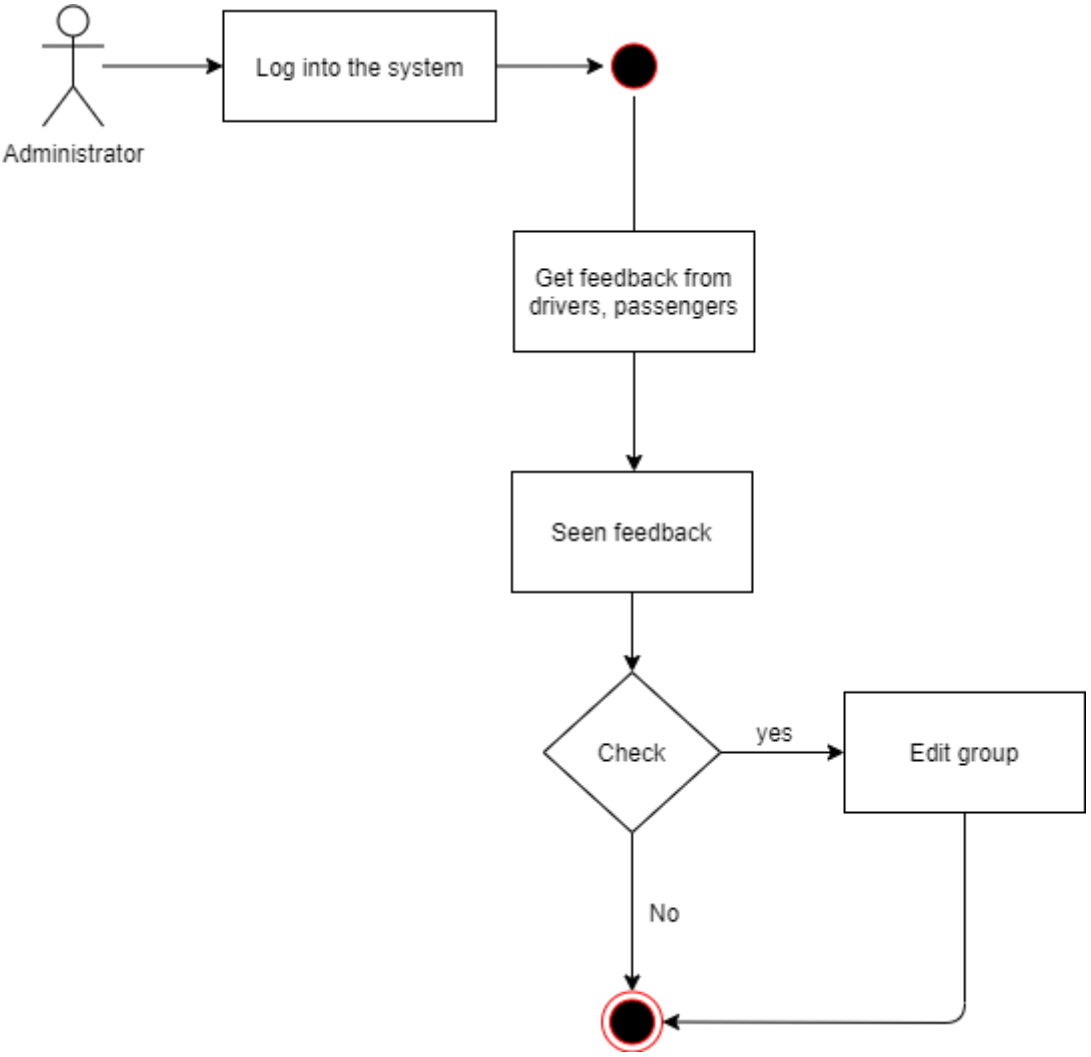


Figure 3.2.1.10. Manage Groups Activity Diagram

3.2.1.11 Validate accounts

Number: RS11
System: VNU email system
Actors: VNU email system
Event/Precondition: The system sends a verified code to the user's email.
Overview/Postcondition: Verification successfully.

Related Use Cases: RS01

Activity diagram:

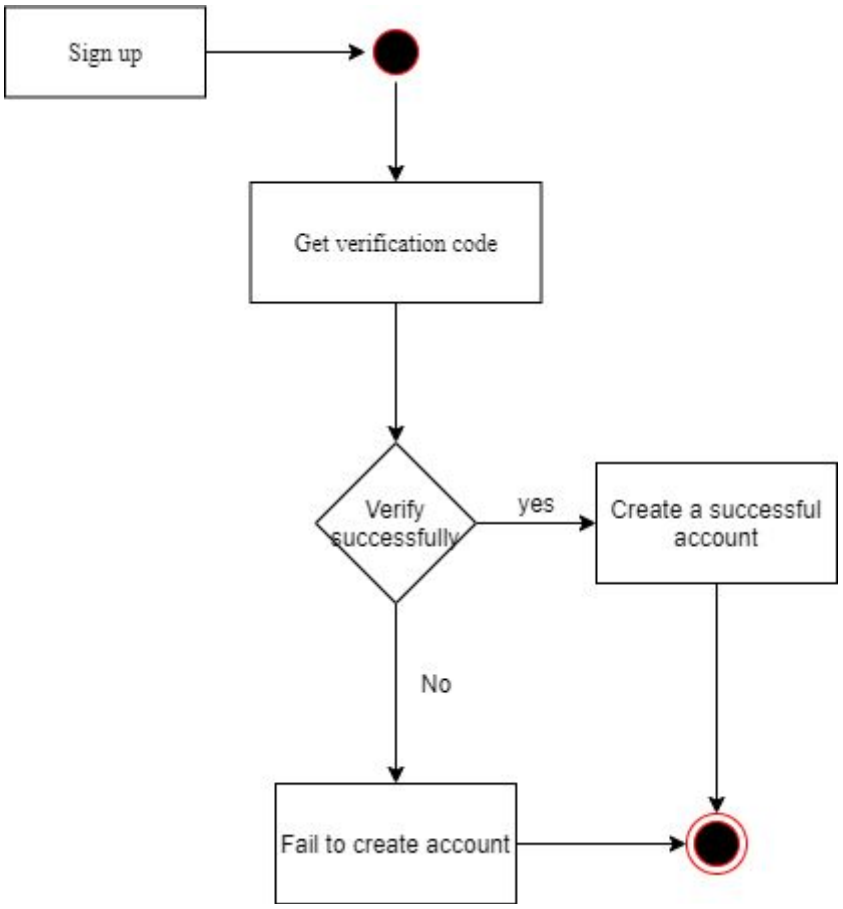


Figure 3.2.1.11. Validate Accounts Activity Diagram

3.2.2 State Machines

3.2.2.1 Ridesharing System State Machine Diagram

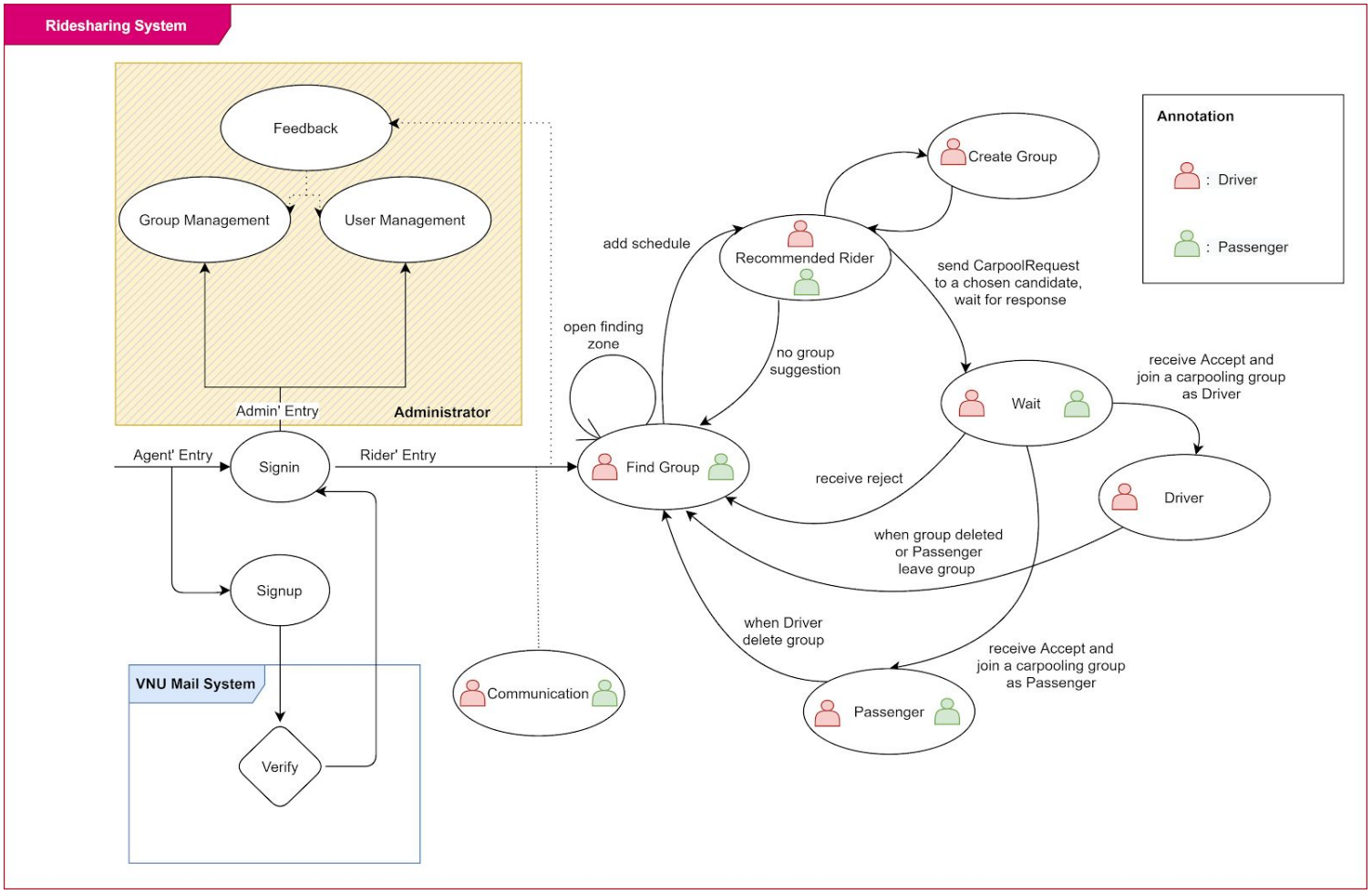


Figure 3.2.2.1. Ridesharing System State Machine Diagram

3.2.2.2 Administrator State Machine Diagram

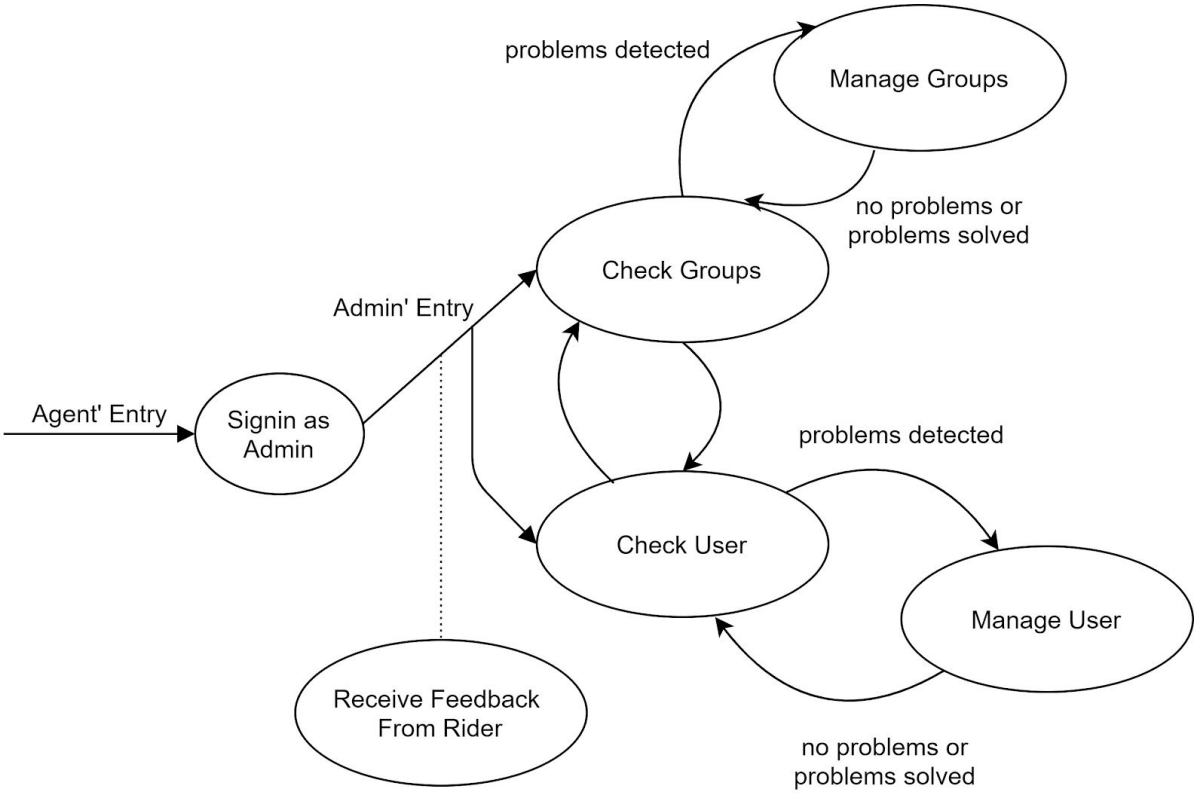


Figure 3.2.2.2. Administrator State Machine Diagram

3.2.2.3 Passenger State Machine

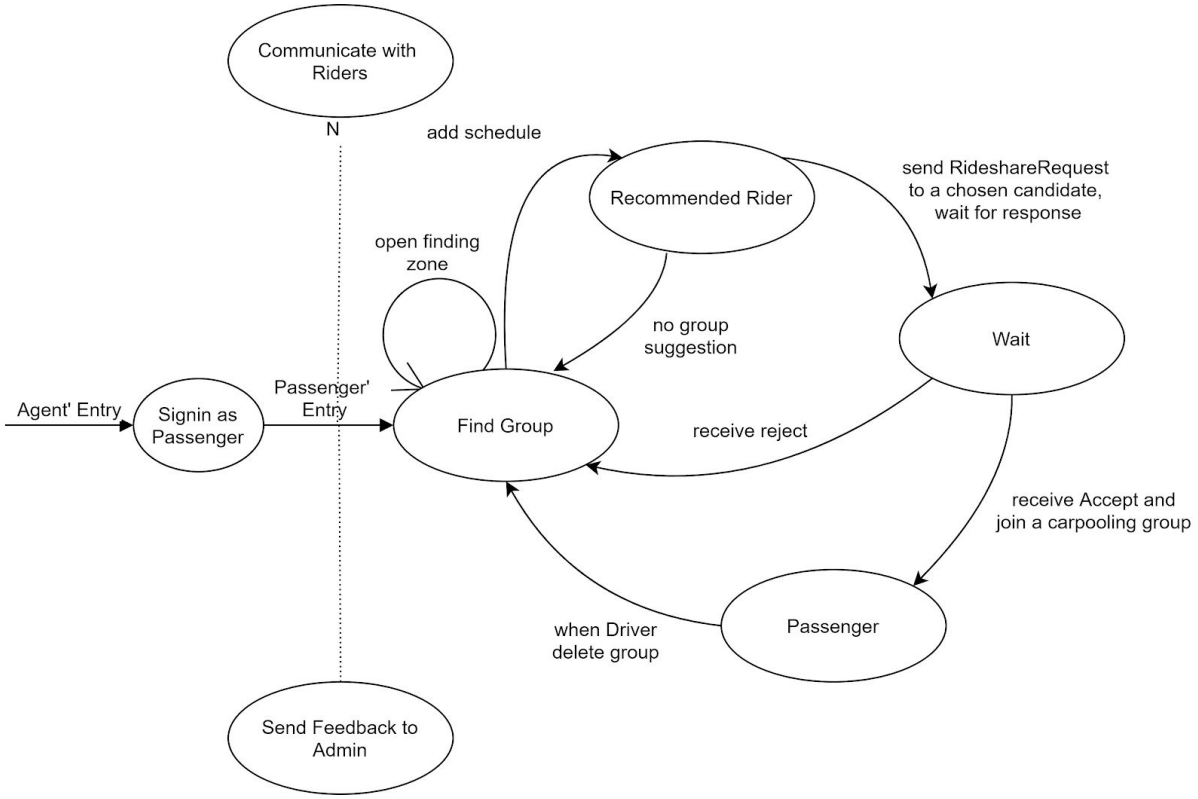


Figure 3.2.2.3. Passenger State Machine Diagram

3.2.2.4 Driver State Machine

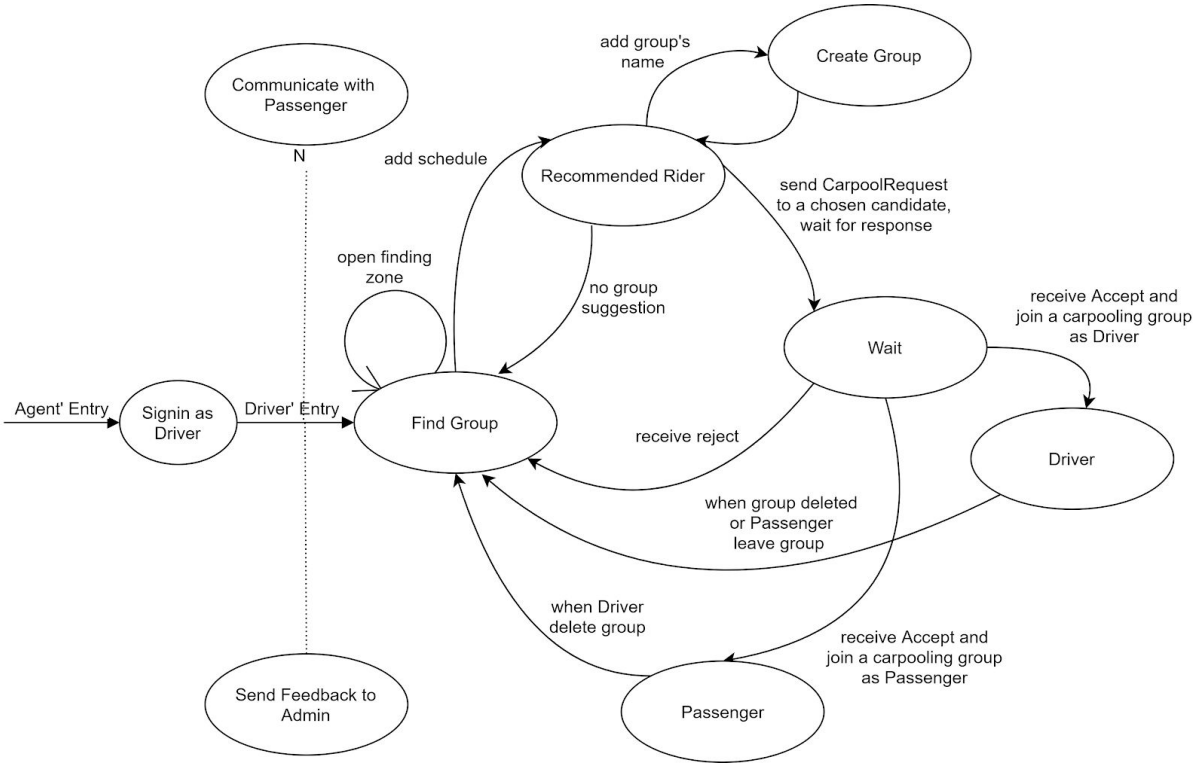


Figure 3.2.2.4. Driver State Machine Diagram

3.2.2.5 VNU Mail System State Machine

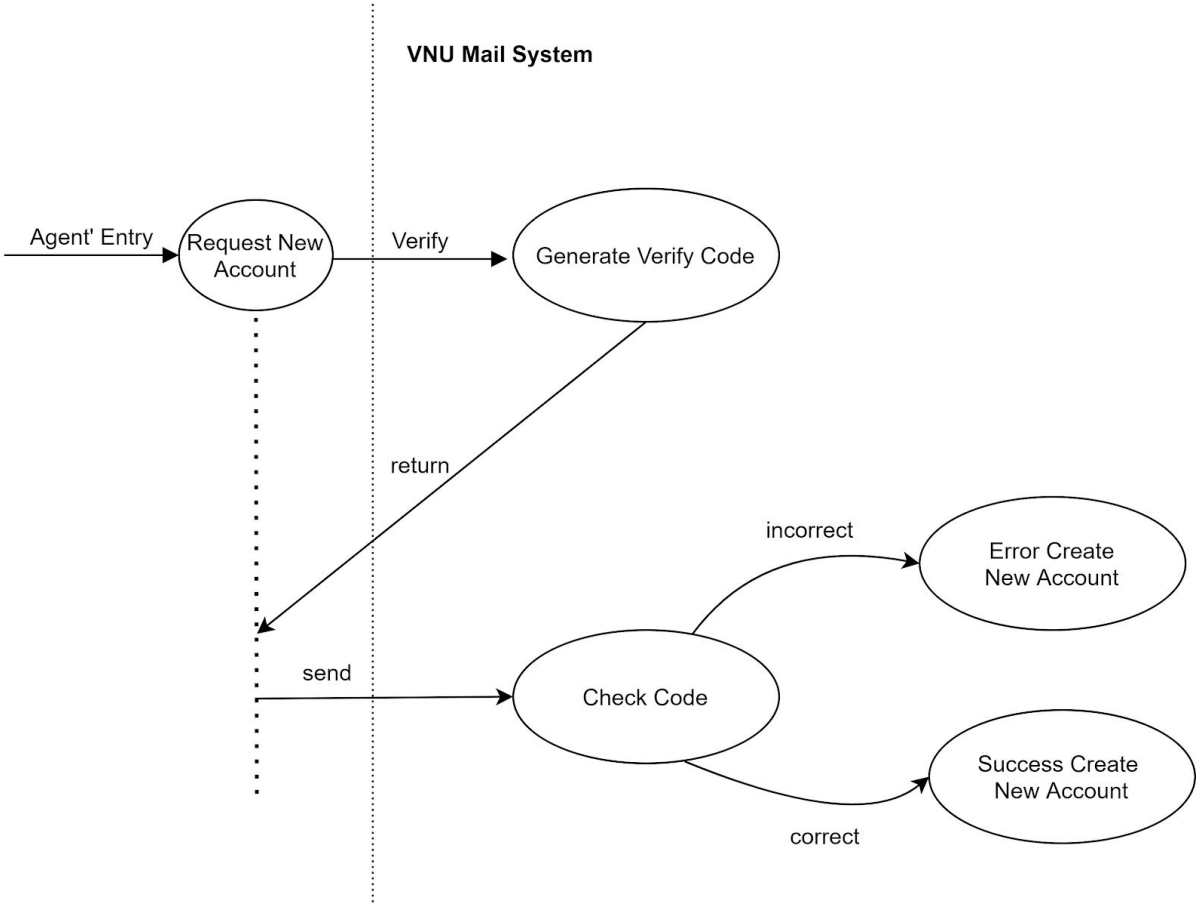


Figure 3.2.2.4. VNU Mail System State Machine Diagram

3.3 Performance

Request Waiting			
Overview: Time waiting for each request made.			
Fit Criteria	Outstanding	Target	Minimum
	1s	30 minutes	24 hours

Riders Match Time

Overview: The median time required to show recommended list.			
Fit Criteria	Outstanding	Target	Minimum
	1s	30s	120s

User Data			
Overview: The initial number of user accounts and expected growth of user accounts supported by the system.			
Fit Criteria	Outstanding	Target	Minimum
	100 +(-) 20/day	50 +(-) 10/day	50 +(-) 5/day

Group Data			
Overview: The initial number of groups and expected growth of groups supported by the system.			
Fit Criteria	Outstanding	Target	Minimum
	50 groups/day	25 groups/day	5 +(-) 5/day

Maximum Administrator Accounts			
Overview: Maximum number of total administrator accounts supported by the system.			
Fit Criteria	Outstanding	Target	Minimum
		10	

Notification of Errors			
Overview: Time required for administrators to be notified of detected errors.			
Fit Criteria	Outstanding	Target	Minimum
		10s	

Cost Calculate Time

Overview: The median time required to calculate travel expense.			
Fit Criteria	Outstanding	Target	Minimum
	1s	10s	60s

Distance Calculate Time			
Overview: The median time required to calculate travel expense.			
Fit Criteria	Outstanding	Target	Minimum
	1s	10s	60s

Modification of Travel Roles			
Overview: Time required to save modification of a user account's role			
Fit Criteria	Outstanding	Target	Minimum
	0.5s	1s	1.5s

3.4 Design Constraints

Portability, modifiability are important aspects of the design constraint.

Upgrade Constraints			
Overview: Time that the system can be down during upgrades.			
Fit Criteria	Outstanding	Target	Minimum
		Zero-downtime upgrades	

Supported Platform

Overview: Platforms with which the system must be compatible.			
Fit Criteria	Outstanding	Target	Minimum
		iOS 7.0++ Android 3.0++	

Cost of the System			
Overview: Expected cost, in Vietnam Dong, to develop the system.			
Fit Criteria	Outstanding	Target	Minimum
	$0	$1500	$3000

Information Transmission			
Overview: Information transmission in the software			
Fit Criteria	Outstanding	Target	Minimum
		Information transmission should be securely transmitted to server without any changes in information	

Security Constraints			
Overview: Time that the system can be down during upgrades.			
Fit Criteria	Outstanding	Target	Minimum
		Zero-downtime upgrades	

Delivery Timeline

Overview: Time required to develop the software.			
Fit Criteria	Outstanding	Target	Minimum
	1 month	3 months	6 months

Documentation			
Overview: Required documentation for drivers, passengers and administrators.			
Fit Criteria	Outstanding	Target	Minimum
		- Manual for administrators - Manual for user - Full system design document - Preconditions and postconditions for all functions	

External Dependency			
Overview: The restrictions placed on the system's dependency on external sources (i.e. libraries)			
Fit Criteria	Outstanding	Target	Minimum
		Only have dependency on open source libraries.	

3.5 Quality Attributes

The critical quality measures are user usability, maintainability, and security.

Maximum Group Existence Time			
Overview: Maximum existence time of a group supported by the system.			
Fit Criteria	Outstanding	Target	Minimum
	4 years	60 days	1 days

Successfully Match Percentage

The percentage of rides that can choose the suitable group.			
Fit Criteria	Outstanding	Target	Minimum
		80%	

Support Pages			
Overview: Support pages per UI screen.			
Fit Criteria	Outstanding	Target	Minimum
		1	

Support Quality			
Overview: Percentage of feedback resolved through admin help.			
Fit Criteria	Outstanding	Target	Minimum
	100%	60%	50%

Time to Verify User Accounts			
Overview: Time required to verify user accounts (send code).			
Fit Criteria	Outstanding	Target	Minimum
		30s	2 minutes

System Availability			
Overview: The required uptime of the system.			
Fit Criteria	Outstanding	Target	Minimum
	100%	99.9%	99%

Bugs Per Lines

Overview: Number of bugs per line of code written.			
Fit Criteria	Outstanding	Target	Minimum
		1 bug/200 lines	

Fault Tolerance			
Overview: The percentage of faults handled by the system			
Fit Criteria	Outstanding	Target	Minimum
		The system must tolerate 100% of all non-critical faults.	

User ID Registration			
Overview: Users account hence proper login mechanism should be used to avoid hacking			
Fit Criteria	Outstanding	Target	Minimum
		100% email verified.	

C. System Modelling

1. Goal Model

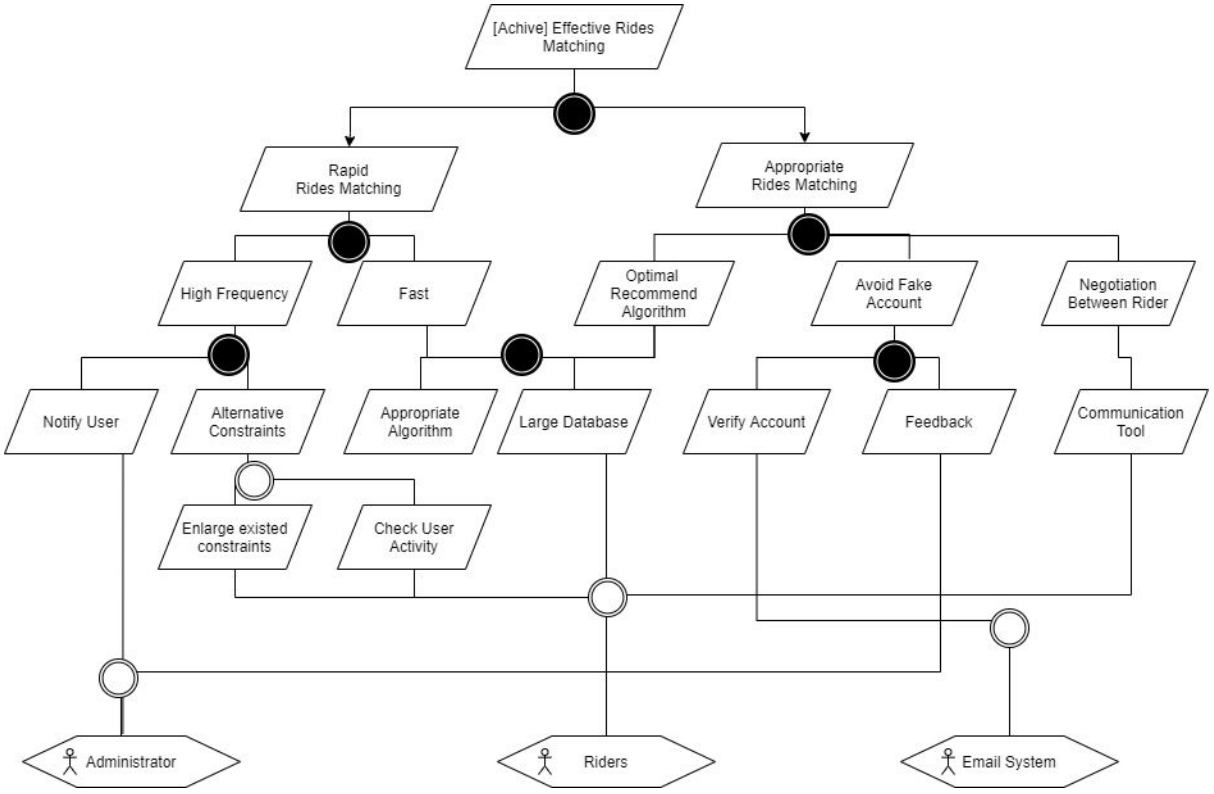


Figure 1: Goal Model

1.1. Subdivide goals (1st floor):

To reach the system goal: “Effective Rides Matching”, two subgoal need to satisfied:

- Appropriate Rides Matching: The nomination of participants must be reasonable

- Rapid Rides Matching: Teaming performance must be fast

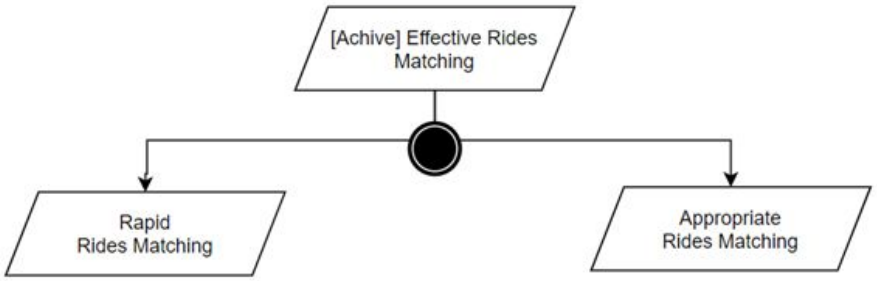


Figure 1.1: Subgoal Model (1)

1.2. Subdivide the goal (floor 2,3)

1.2.1 Streamline nomination group

Level 2: In order for the method to nominate participants, it is necessary to ensure that the user's information is not false as well as users can communicate with each other to increase success in grouping and ensuring that the algorithm for recommending a companion is optimal

Level 3: In order for the method of ensuring users' information without forgery, it is necessary to have these following: the system ensures user identity via VNU email system (confirmation mail system attached); function / receiver of user reports (Admin); users can communicate with each other to increase success in grouping, they need user communication mechanism (related to actor rider) and ensure that the algorithm for recommending a companion is optimal, which include choose appropriate algorithm and secure large amount of data for experimentation (related to actor rider)

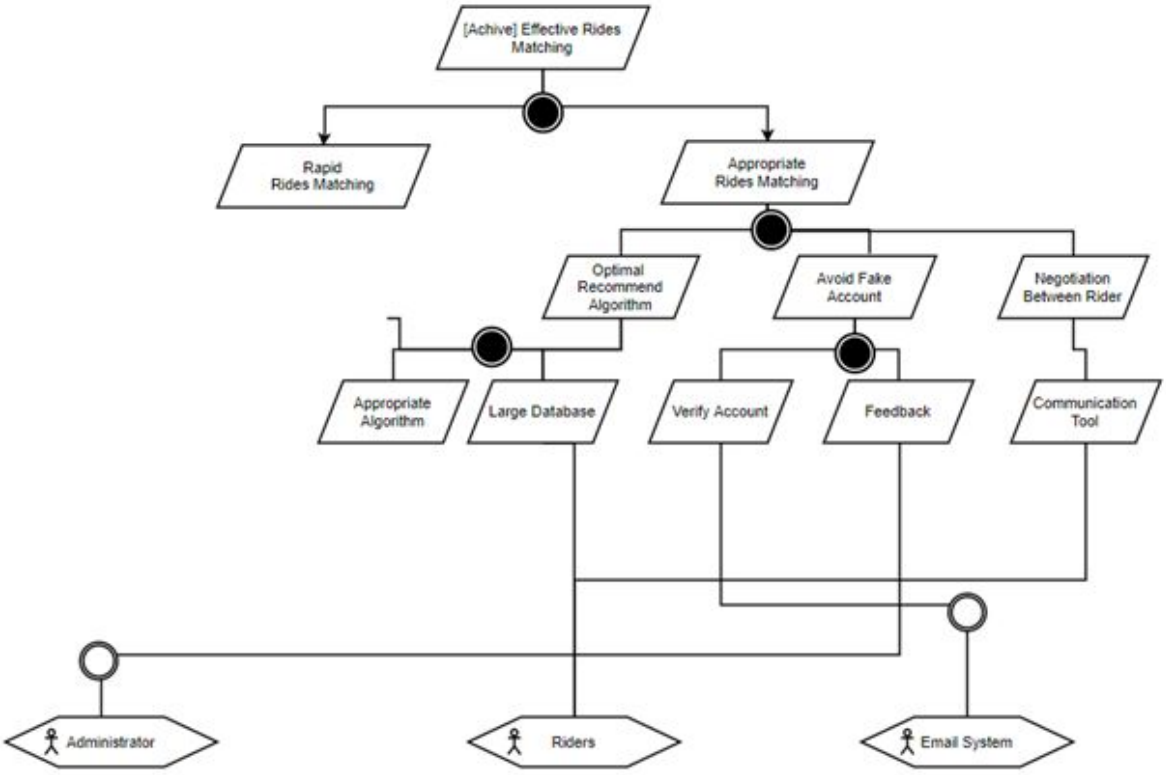


Figure 1.2: Subgoal Model (2)

1.2.2 High performance grouping

Level 2: In order for the method to nominate participants, it is necessary to maximum transplant group frequency and ensures each grouping time reaches high speed

Level 3: For the method of maximum transplant group frequency, there must be notify user successful transplant or rider actor go with expand the scope of searching, raise user request (rider actor). For each high speed grouping, it is necessary to have reasonable algorithms and high quality processing machine

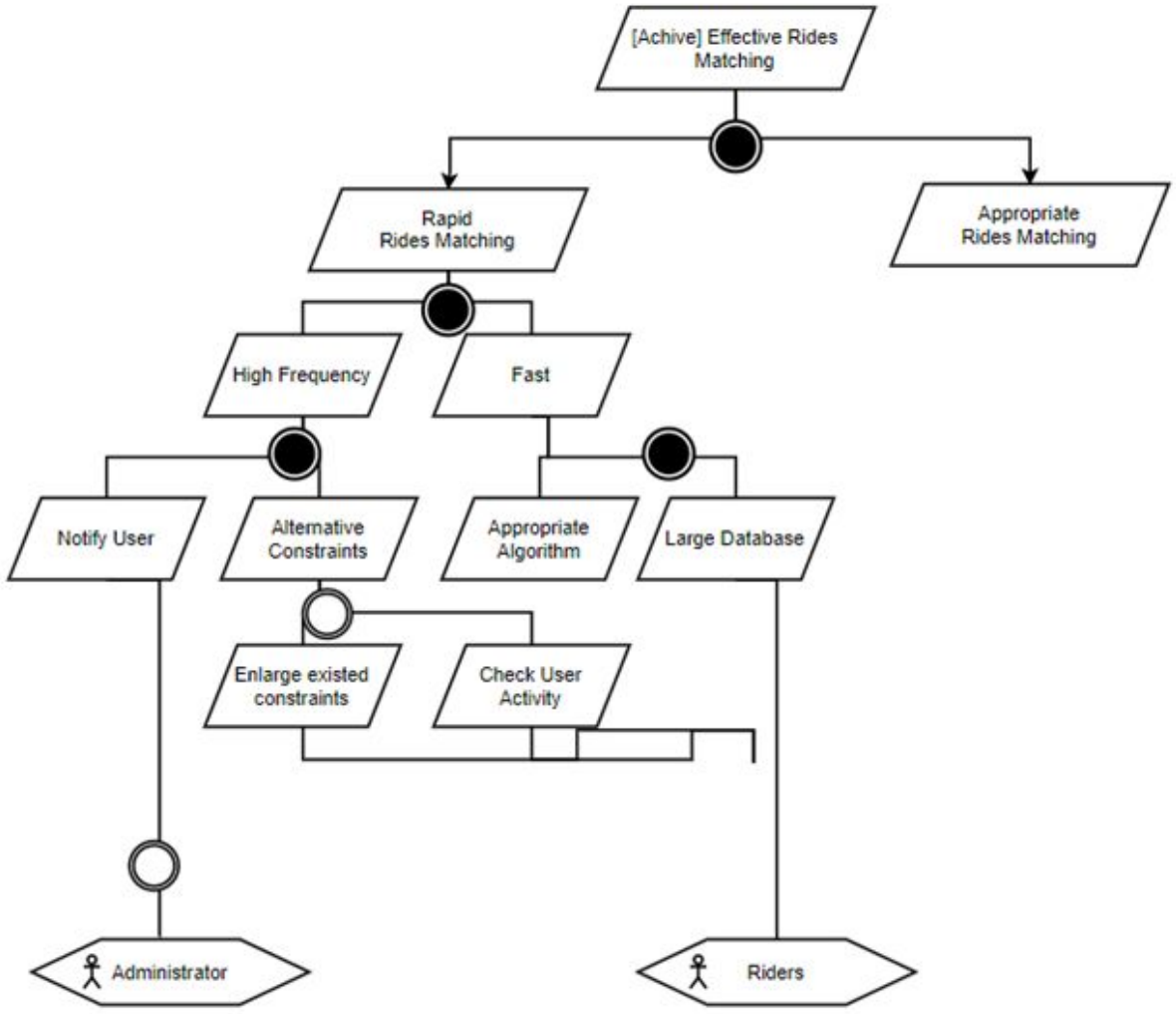


Figure 1.3: Subgoal Model (3)

2. Conceptual Objects Model

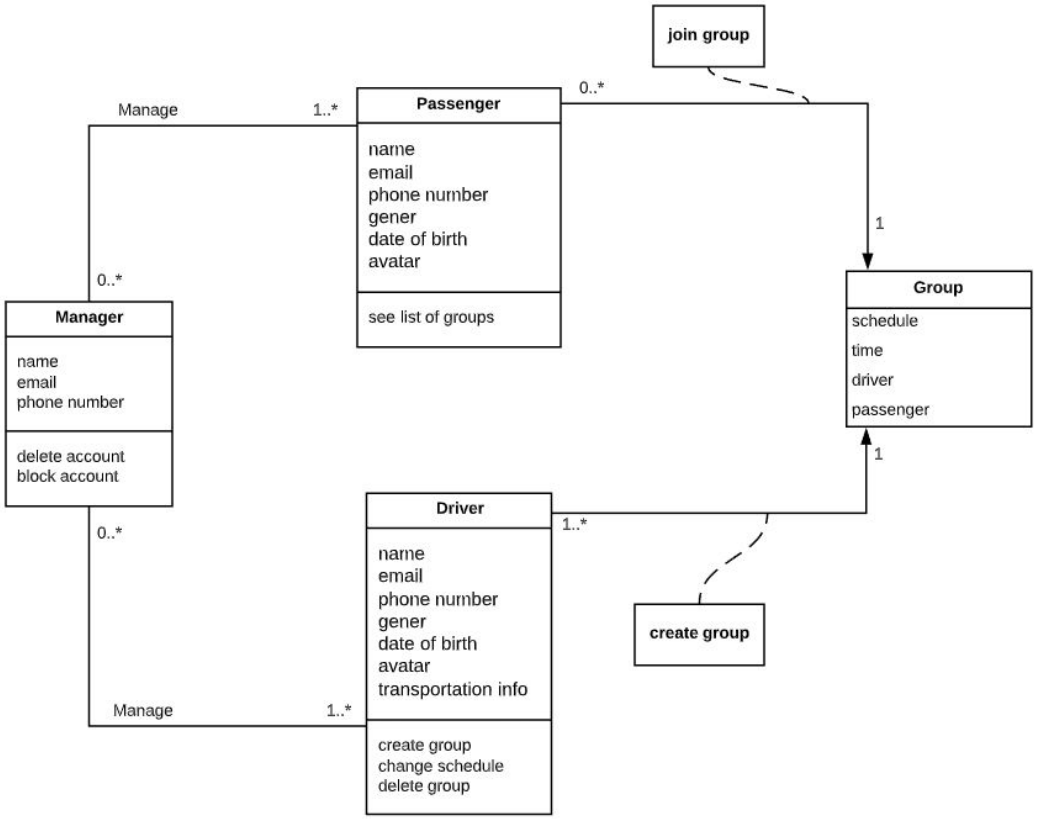


Figure 2: Conceptual Objects Model

3. Agents Model

Three main agents are derived from goal specification: Driver, Passenger and Administrator. Group and Request are the two object attributes that are only influenced by Driver and Passenger: Group could only be created by a Driver and set the Request/Message value via the Send methods by both the Driver and the Passenger. Both agents could send a Feedback to each other after the Group attribute has been terminated. All responsibilities of Driver and Passenger is to maintain that group matching be proceeding smoothly with minimum chance of failure happening. Alternatively, the main responsibility for the Administrator is to ensure privacy within the system, therefore it's main tasks are to manage reports sent by the Driver/Passenger and enforce the appropriate consequences.

Administrator is the only agent that does not satisfy any of the main goals within the system; but is the only agent that could enforce any actions to proceed reports or to manage privacy problems within the system.

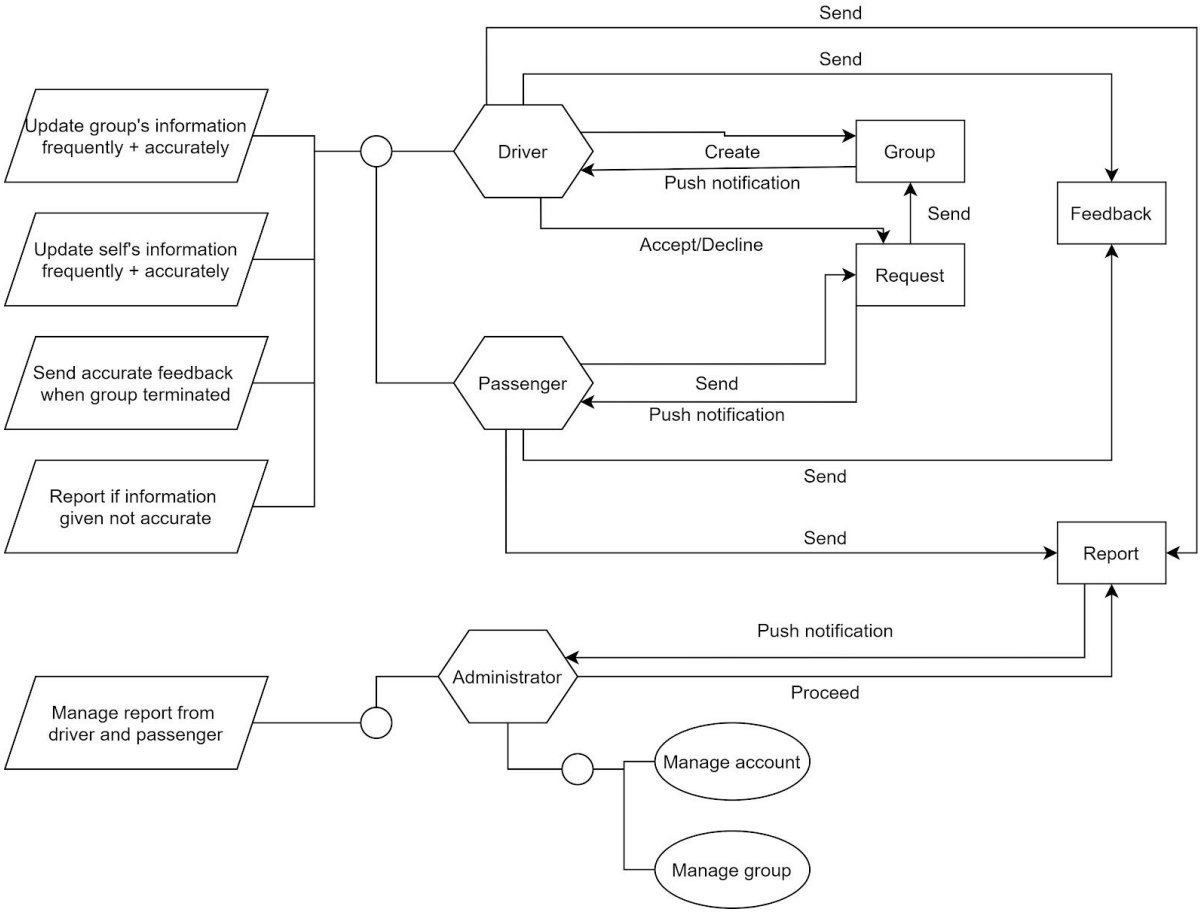


Figure 3: Agents Model

4. Scenario Diagram

4.1 Sign Up

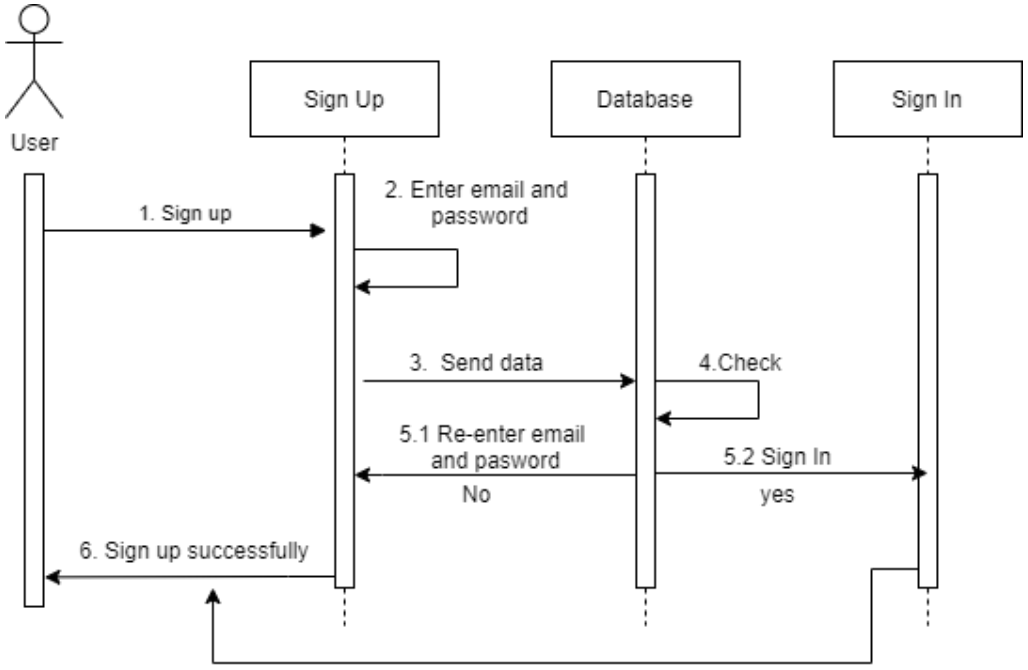


Figure 4.1: Signup Scenario Diagram

4.2 Sign In

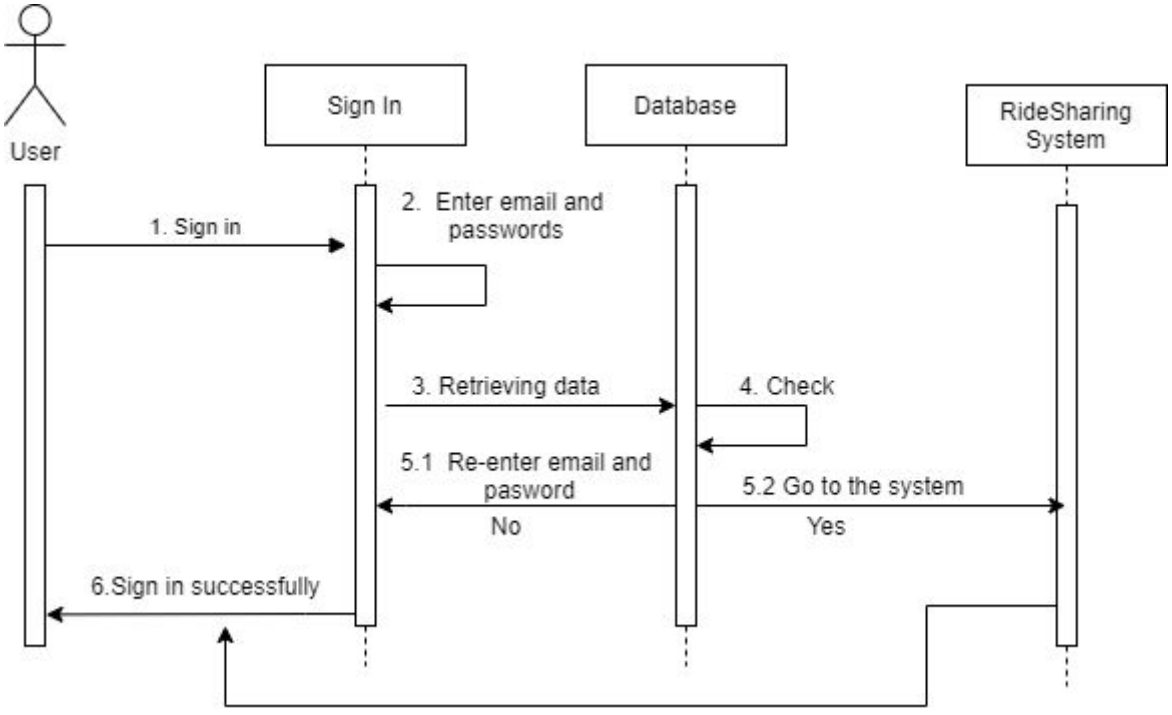


Figure 4.2: Sign In Scenario Diagram

4.3 Create Group

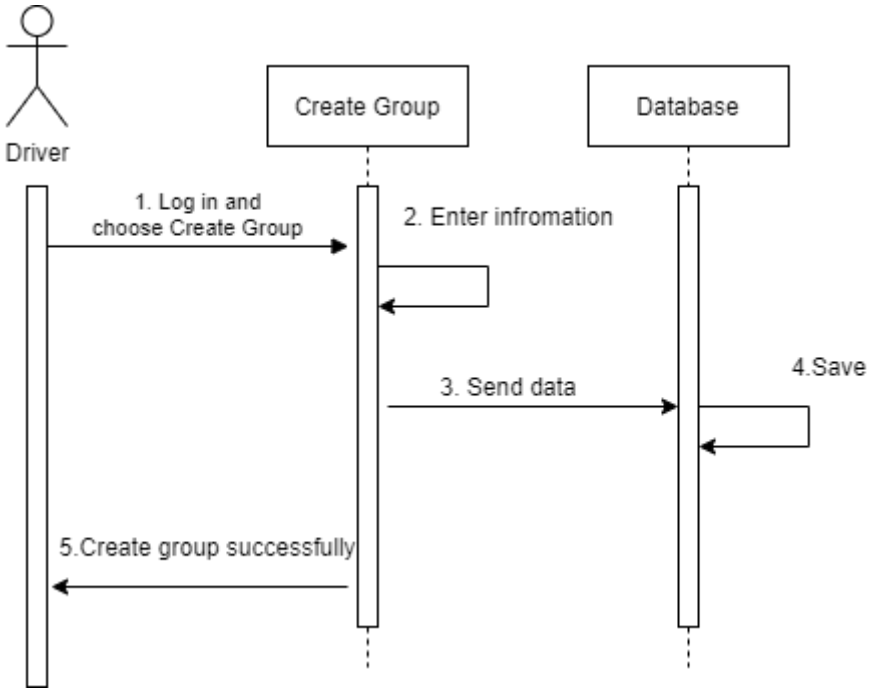


Figure 4.3: Create Group Scenario Diagram

4.4 Delete Group

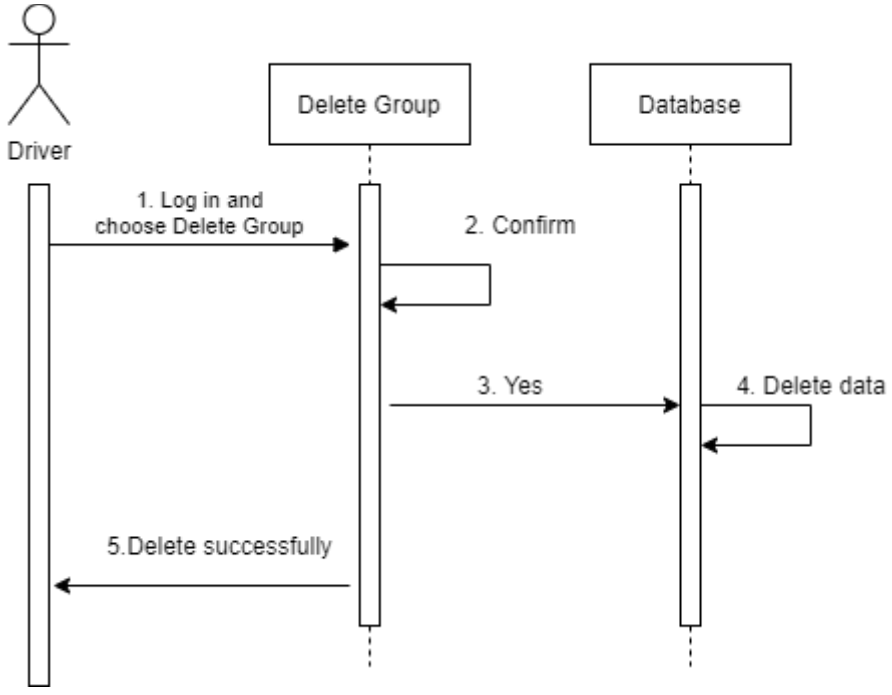


Figure 4.4: Delete Group Scenario Diagram

4.5 Send feedback

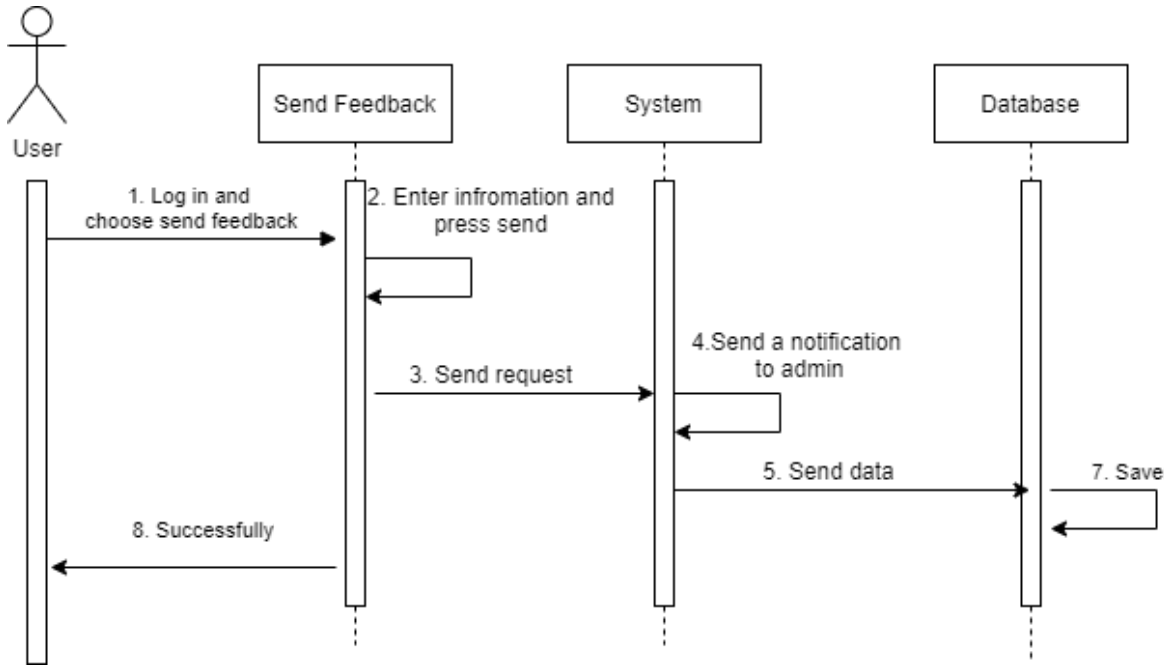


Figure 4.5: Send Feedback Scenario Diagram

4.6 Choose rider

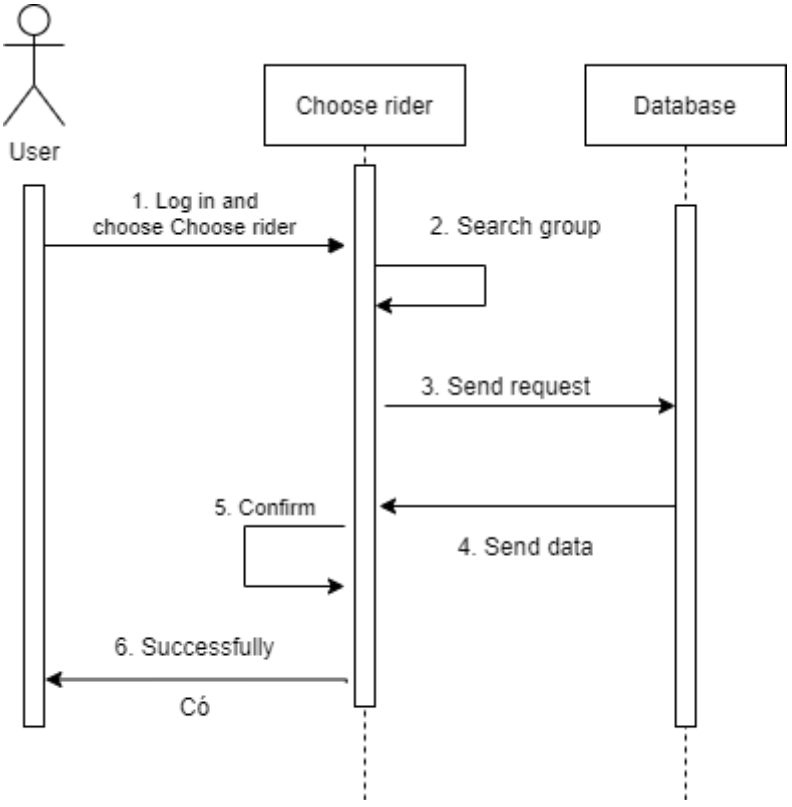


Figure 4.6: Choose Rider Scenario Diagram

4.7 Communication between rider

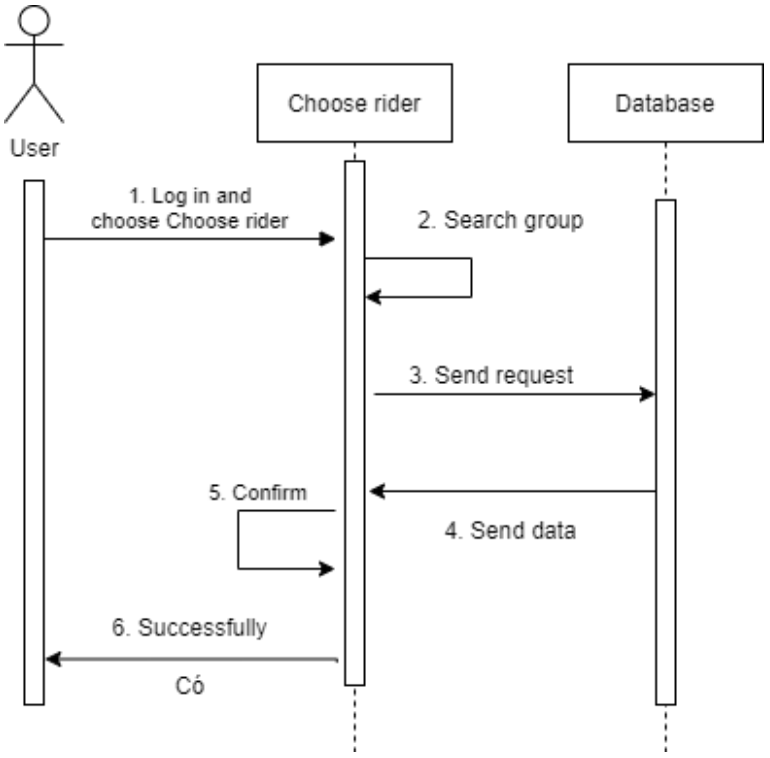


Figure 4.6: Choose Rider Scenario Diagram

4.8 Manage account

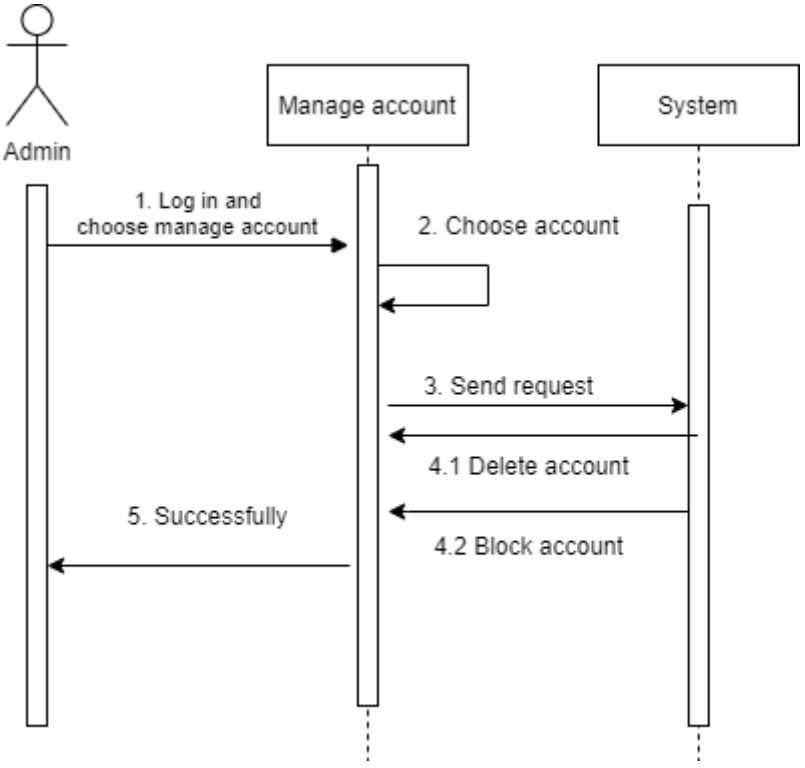


Figure 4.8: Manage Account Scenario Diagram

4.9 Manage group

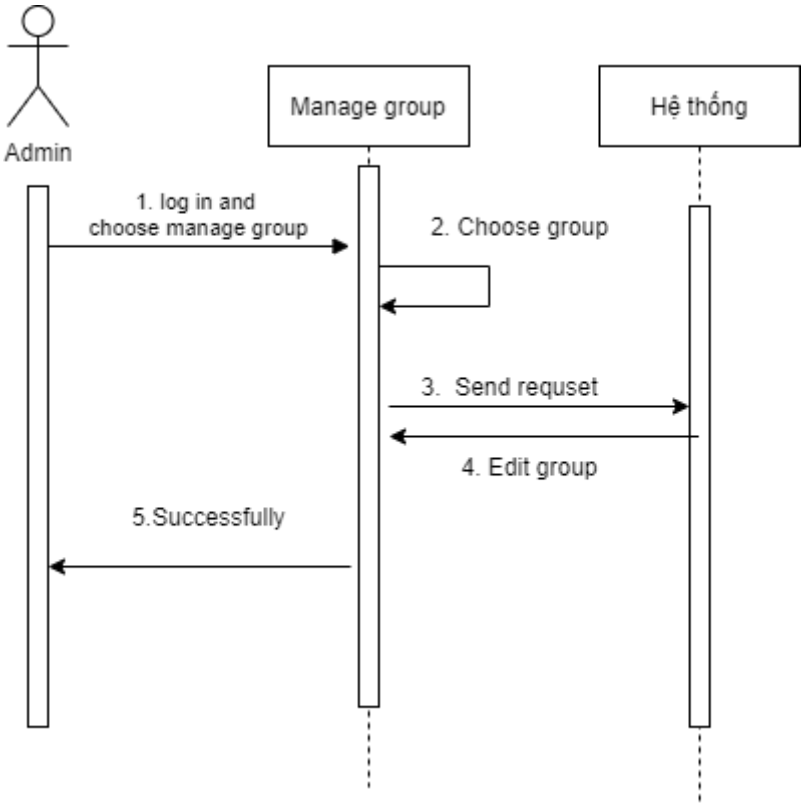


Figure 4.9: Manage Group Scenario Diagram

5. Operation Model

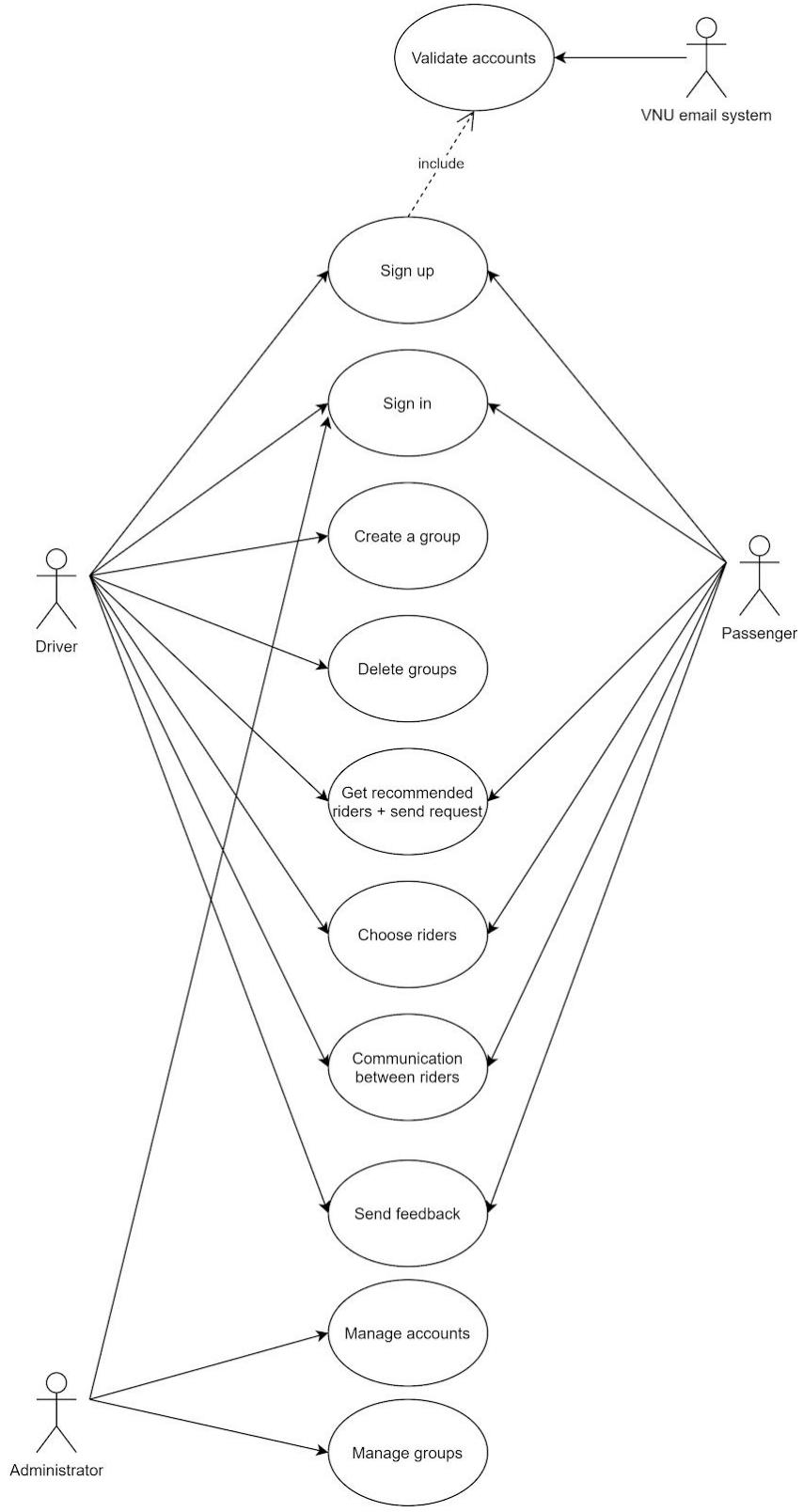


Figure 5: Use Case Model

6. State Diagram

6.1 Registration

When the user signs in to the system, they can have two states as their role in the system: manager and rider.

6.2 Manager

A user in manager state only if they sign in as manager. As a manager, they can use their power to manage the system.

6.3 Idle

This state can be reached if an user signs in but doesn't make any change to the system.

6.4 Find Group

The very first state when a user signs in as a rider. They started to find groups or wait for rideshare invitations from another group. They may send requests, communicate & receive system response notifications.

6.5 Wait

This state can be reached if a user is waiting for system response (reject, accept,...). After that, user states change into Idle, Find Group or receive roles as Driver, Passenger.

6.6 Driver

When the user sends a group-create request and receives accepts from the system, this user joins the group as Driver. State changes when the user leaves the group or group deleted.

6.7 Passenger

When the user sends group invitations to a group and receives acceptance from the system join group as Passenger. State changes when this user leaves group or group deleted.

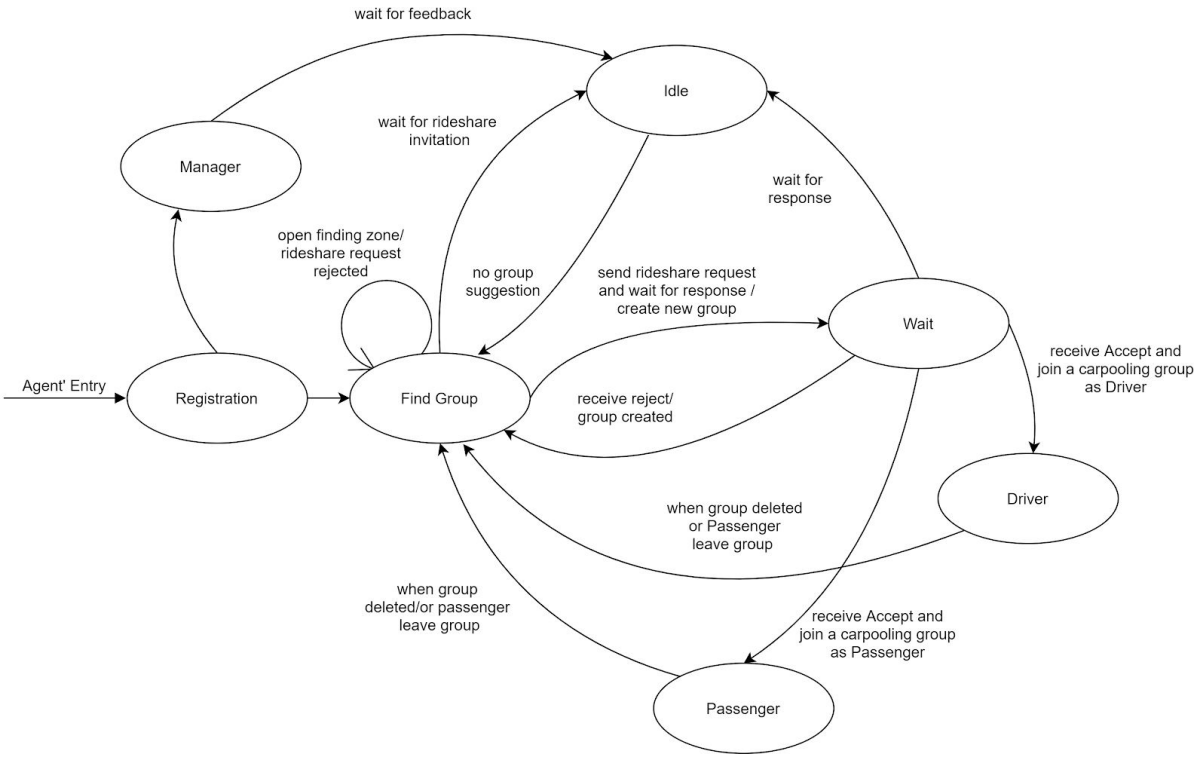


Figure 6: State Diagram