Design and Development of JuzShareIt- Car Sharing System: A Mobile App for Rent and Rent Out Car

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Abstract: Car Sharing System is a platform that allows car owners to rent their vehicle to other people when their car is not in use. It can also allow people who do not own a vehicle to rent it for a short period, where the payment is made according to the time rented. By using Car Sharing System, the vehicle owner can generate extra income by renting out his less frequently used vehicle, and the customer can easily rent a car based on his needs. There is a lack of car-sharing platforms in Malaysia. This study aims to identify car sharing system requirements and develop a mobile application prototype to implement a car sharing platform. The main users of this car sharing system are administrators, car owners and customers. The administrator has the most privilege to edit, view, add or delete data, car owners who can rent out vehicles and customers who will rent the vehicles. The system prototyping method is followed to design and implement the system. The mobile app is developed using Android Studio IDE and Java programming language, and data will be kept in the JomHosting web host. Usability testing is conducted to evaluate the developed system by 43 potential users. The results showed that the system is usable, easy to use and satisfies their requirements.

1. Introduction

A car is a type of transportation that allows people to travel long distances. A car can usually fit up to 5 people in one trip, making it one of the most preferred vehicles. In addition, by having a car, people can easily travel a long distance with family or friends. Car Sharing is an act of an owner of the car renting out their car to other people. The owner can rent out his/her car when it is not in use. On the other hand, people with no car or transportation can rent a car by paying the owner on a time basis. By sharing the car, the owner can earn some extra income while the customer can use the car for their own purpose.

In Malaysia, there is a similar app called SOCAR. By renting a car using SOCAR, the customers do not have to worry about car maintenance, insurance, and loans. The hourly rate for renting a car with the SOCAR application. Everything is managed through the app, and it is a fully keyless system [1, 2]. The customers can unlock/lock the car using the apps. However, SOCAR is used to rent cars but not to rent out the cars by owners. In addition, the customers need to return the car at least 50% fuel tank to the original place. SOCAR also may provide door-to-door services with extra charge for those customers who cannot pick up the car. Furthermore, smoking and vaping are not allowed in the car. Customers who smoke or vape in the car are fined RM500.

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This study aims at developing a mobile app as a car sharing platform so that car owners can rent out their less frequently used cars and customers can rent a car based on their requirements.

2. Background

Any innovation requires early adopters to take the first leap of faith and embrace new technology or a new service. In 1994, Meijikamp and Theunissen researched car sharing in the Netherlands. First, they studied a group of individuals who chose to be members of the Huur-op-Maat program in Leiden. Then, they organized a group meeting with 10 car-sharing organization members (CSO). They concluded that it is fundamental to have guidelines to encourage car sharing and make the model more popular to undertake car sharing as a style of transportation [3].

In 1999, Katzev analyzed the adoption method of the latest Car Sharing Portland (CSP) members. He discovered that early adopters of car sharing in Portland had been a notably knowledgeable, tremendously affluent organization of people. He additionally mentioned that members have been conscious of environmental problems, but this is not their primary reason for joining the CSO [4]. These findings confirmed the similar trends described in advanced European research, a survey of 262 PillyCarShare early adopters in 2003 and trends somewhere else in the United Stated [5]. The PhillyCarShare study hooked up that income becomes no longer a determinant in being a car-sharing user. However, low-income groups were likely less represented because joining CSO requires a large amount of deposit and credit checks. Convenience and affordability were mentioned as the main reasons for members to join. The decline of car-sharing members will be affected by a high percentage of failure in reserving a car.

One major impact of car sharing is its effect on car ownership. Car sharing is used to decrease the number of cars on the road or replace personal vehicles with shared with other people. In Philadelphia, Lane determined that each PhillyCarShare vehicle contributed to the removal of 22 cars on average from roads. Millard-Ball compiled car owner information from previous studies and estimated that car sharing removes 14 cars from the road [6]. The main point of car sharing is to reduce the number of vehicles.

Car sharing should be promoted in conjunction with different sustainable delivery modes to reduce the number of vehicles on the road. Increasing car usage and membership will make a car-sharing company achieves success. However, reducing the availability of vehicles for users to reserve will also affect the quality of the car-sharing system. Understanding those elements will help in proposing changes to the existing work to make certain better levels of availability and usage.

Table 1 shows the existing car-sharing system that is available in the market. Although the application is available for Android and iOS users, the application is still complicated for first-time user. So, the JuzShareIt- Car Sharing System can provide a user-friendly application for users, and they only need to pay the payment when they want to book a car.

Table 1. The existing car-sharing systems in the market

Grab [7]	-	assign the closest taxi to the customer to reduce the waiting time.
	-	can know the fare upfront before committing to a booking.
EzCab [8]	-	offers swift booking service for Taxis, Cars, and Luxury vehicles, connecting riders to drivers in one app.
SOCAR [2]	-	can book a SOCAR car at any preferred zone and pick up the car once a booking is confirmed.
	-	discover flexible connectivity by renting a car hourly, daily, weekly or even monthly.

3. Methodology of the study

This project is conducted by adapting System Prototyping [9]. There are four main processes in system prototyping as illustrated in Figure 1.
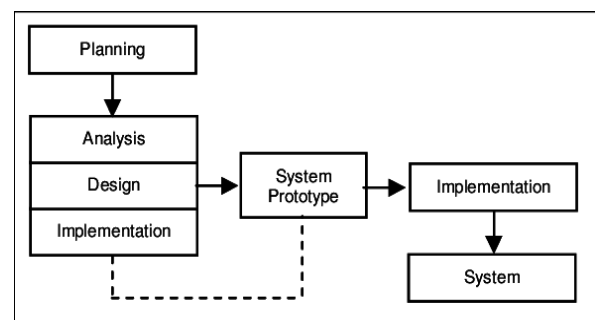

Figure 1. The System Prototyping Methodology

i. *Planning Phase*

In this phase, a problem is identified, and a plan is proposed to develop a system that can provide a platform for the owner to rent out their less frequently used car, and the user can have a platform to look for a car to rent. A project proposal is drafted explaining the problems, objective, significance, scope and schedule of the project.

ii. *Analysis Phase*

In the analysis phase, the requirements of this car-sharing system are analyzed by having a process of requirements analysis. There are two types of requirements which are functional and non-functional requirements. The requirements are gathered by analyzing similar apps such as SOCAR and questionnaires used to gather user data. In this phase, a use case diagram is used to model the functional requirements.

iii. *Design Phase*

In the designing phase, a class diagram is developed to show the relationships between essential concepts in the problem domain. Sequence diagrams are used in this phase to illustrate how objects interact by passing messages to implement the functionality of each use case. It can show the details of how the operations are carried out. For example, a

sequence diagram can depict the chronologically structured event flow through a use case. Android Studio and Java also are used to design and implement the system.

iv.   Implementation Phase

A low fidelity prototype is developed at the implementation phase, the prototype is tested, and the feedback is used to refine the requirements and improve the design to enhance the functionality and acceptance of the system. This process is iterated till the high-fidelity prototype is developed and ready for usability testing.

4. Design and Development of Car Sharing System

This section contains the list of all functional and non-functional requirements of the Car Sharing System, the use case(s) model, analysis object model, and dynamic model. An initial interface prototype is also included at the end of this section. The functional requirements are shown in Table 2, while non-functional requirements are shown in Table 3.

Table 2. Functional requirements of Car Sharing System

No.	Requirement ID	Requirement Description	Priority
	CSS_01	**Register**	
1	CSS_01_01	Users are needed to insert e-mail, password, name, IC number, phone number and upload license photo to complete the registration.	M*
2	CSS_01_02	System will show out a successfully register message.	M
3	CSS_01_03	System will display error message if user did not fill in details on fields that are mandatory.	M
	CSS_02	**Login Car Owner and Customer**	
4	CSS_02_01	Car owner/ customer are required to fill in their email and password to log into the system.	M
5	CSS_02_02	Car owner/ customer can request for a password reset if they forget their password.	M
6	CSS_02_03	System will display error message if the user inputs a wrong e-mail/ password combination.	M
	CSS_03	**Forgot Password**	
7	CSS_03_01	Car owner/ customer can request for a password reset if they forget their password.	M
8	CSS_03_02	System will send the password to the user email address.	M
	CSS_04	**Logout**	
9	CSS_04_01	Users can logout from the application by clicking "Logout" button.	M
10	CSS_04_02	System will bring user to login interface.	M
	CSS_05	**Edit Information**	
11	CSS_05_01	Users can change their information such as name, password and telephone number using the system.	M
12	CSS_05_02	System will display error message if user did not fill in details on fields that are	M

No.	Requirement ID	Requirement Description	Priority
		mandatory.	
13	CSS_05_03	Users can cancel changing their information at any time by clicking the 'Cancel' button.	O*
	CSS_06	**Rent Car**	
14	CSS_06_01	Customers can select the car from the application.	M
15	CSS_06_02	Customers can book the car from the application.	M
16	CSS_06_03	Customers can cancel the booking at any time by clicking the 'Cancel' button.	O
	CSS_07	**View Booking**	
17	CSS_07_01	Customers can view their booking by clicking "My Booking" button.	M
18	CSS_07_02	Customers can cancel booking at any time by clicking the 'Cancel Booking' button.	O
	CSS_08	**Make Payment**	
19	CSS_08_01	Customers can make payment through online.	M
20	CSS_08_02	System will display error message 'Bank Account Not Available' when the customer inserted wrong information.	M
21	CSS_08_03	Customers can cancel make payment at any time by clicking the 'Back' button.	O
	CSS_09	**Rent Out Car**	
22	CSS_09_01	Car owners are needed to upload car photo, plate number, type of car, start date and end date, start time and end time and renting price.	M
23	CSS_09_02	System will display error message if customer did not fill in details on fields that are mandatory.	M
24	CSS_09_03	Car owners can cancel rent out the car at any time by clicking the 'Delete' button.	O
	CSS_10	**Manage Car Details**	
25	CSS_10_01	Car owners can change their car information such as type of car, start date and end date, start time and end time, renting price, phone number and location using the system.	M
26	CSS_10_02	Car owners could delete their car information if they wished to.	M
	CSS_11	**View Customer Details**	
27	CSS_11_01	Car owners can see the customer details who booked his/her car.	M
	CSS_12	**Manage User Details**	
28	CSS_12_01	Admin can manage user details such as add, view, edit and delete	M
	CSS_13	**Manage Car Details**	
29	CSS_13_01	Admin can manage car details such as add, view, edit and delete	M

M represents that the system must do
O represents that the system preferably does.

Table 3. The non-functional requirement of the Car Sharing System

No.	Requirement ID	Requirement Description	Priority
	CSS_14	**Security**	
30	CSS _14_01	System uses strong authentication such as strong passwords and two-factor	M

31		authentication to help secure users' accounts.	
31	CSS _14_02	All information regarding the user is private and confidential.	M
	CSS _15	**Usability**	
32	CSS _15_01	Provides a user-friendly interface for the users.	M
33	CSS _15_02	Users should be able to learn on how to use the application with a simple guide.	M
	CSS _16	**Reliability**	
34	CSS _16_01	Users' data are always being updated and backup to prevent any data loss from happening.	M
35	CSS _16_02	The system should crash no more than 10 times in 24 hours.	M

The functional requirement presented in Table 2 included register, login, forgot password, logout, edit information, rent car, view booking, make payment, rent out car, manage car details, view customer details, manage user details and manage car details. While the non-functional requirement presented in Table 3 included security, usability and

reliability.

The next process is visualizing and modelling the application's requirements using the appropriate modelling method and tools. In this work, the Unified Modelling Language (UML) is used to visualize and model the requirements. The models used in this work are Use Case Diagram, Activity Diagram and Class Diagram. The diagrams were drawn using StarUML. Figure 2 illustrates the use case diagram showing the use cases and the actors' relationships with car-sharing system. On the other hand, Figure 3 presents the activity diagram showing the maiuser's main n business process and different roles. Figure 4 models the relationships between the classes identified based on the objects interacting to implement the functional requirements represented in the use case diagram.

Figure 2. Use Case Diagram for Car Sharing System

Figure 3. Activity Diagram of Car Sharing System

Figure 4. Class Diagram for Car Sharing System

5. The Car Sharing System Prototype Development

A prototype of the Car Sharing System was developed. Software prototyping is a standard way of demonstrating the software requirements so that further comments and suggestions can be obtained from the users based on their experience in interacting with the prototype [2]. Android Studio was used as the main integrated development environment (IDE) tool to build the prototype. Further, the JomHosting web host was used as the database for data storage. Figures 5-21 show screenshots of the interfaces for Car Sharing System (JuzShareIt).

Figure 9. Rent Out Car Screen Figure 10. Rent Car Screen
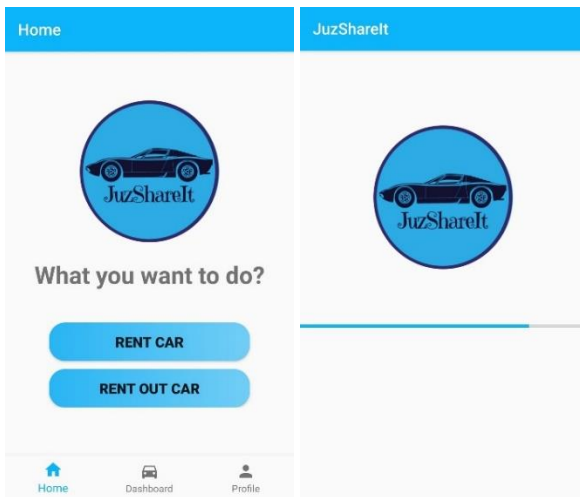
Figure 5. Splash Screen   Figure 6. Main Screen
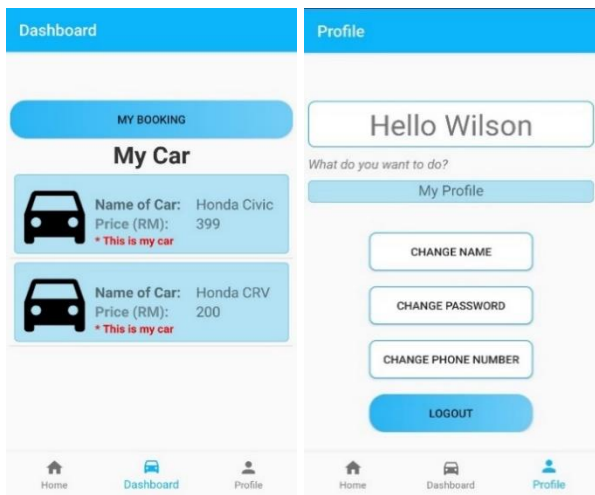
Figure 7. Dashboard Screen   Figure 8. Profile Screen

Figure 15. Change Name Screen

Figure 16. Change Password Screen
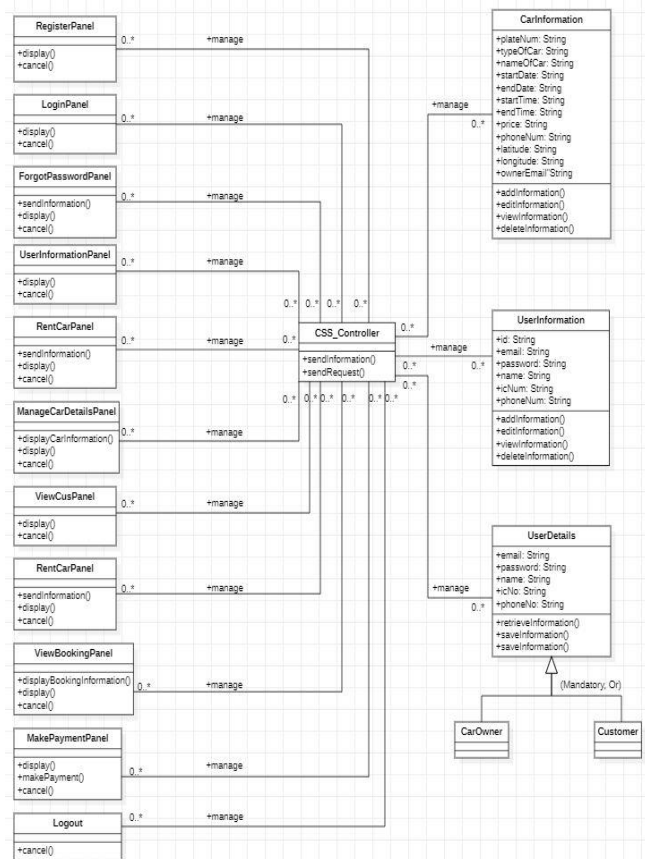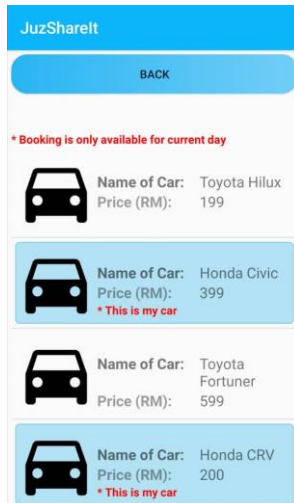
Figure 11. Rent Car List Screen
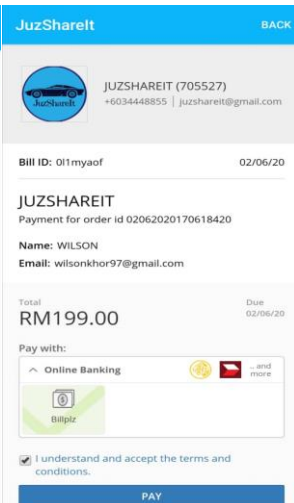
Figure 12. Payment Gateway Screen
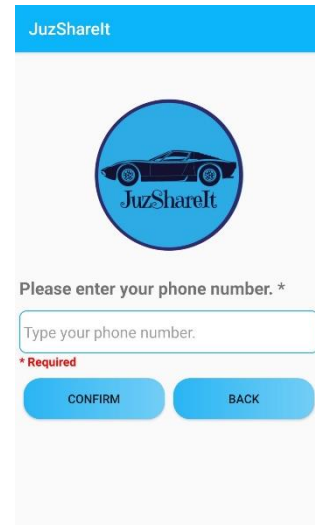
Figure 17. Change Phone Number Screen

Figure 13. Payment Gateway Screen

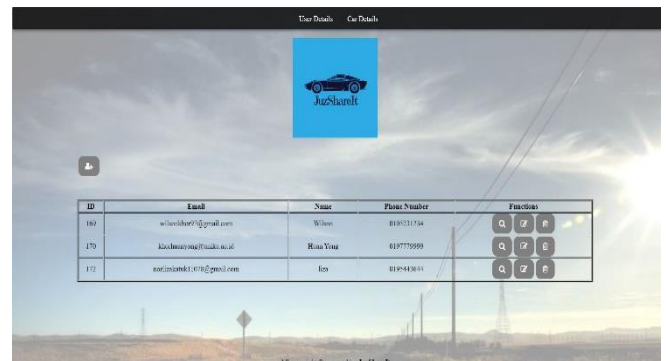Figure 14. Receipt Screen
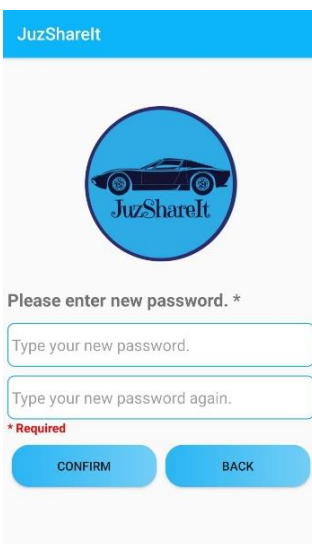

Figure 18. Admin Website (User Details)
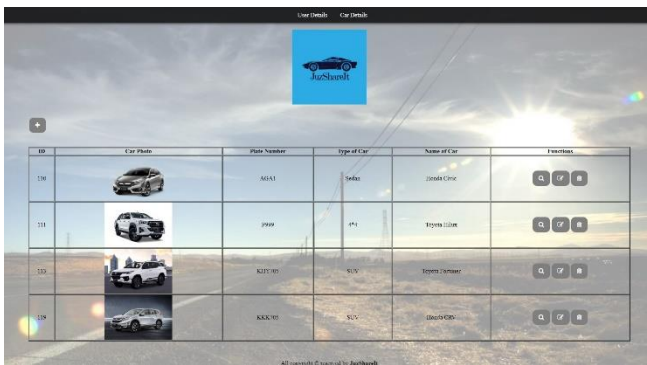

Figure 19. Admin Website (Add User)
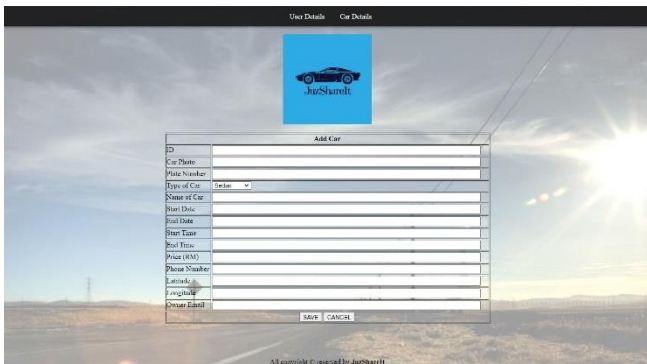
Figure 20. Admin Website (Car Details)

Figure 21. Admin Website (Add Car)

6. Evaluation of Car Sharing System

The type of evaluation used is Usability Evaluation that, concerned with gathering data about the usability of a design or product by a specific group of users for a particular activity within a specified environment or work context. The system is evaluated in terms of its usability, efficiency, effectiveness, and satisfaction in a specific context of use [10]. The objective of the evaluation is to (1)find errors and bugs in the application and web, (2)ensure the application and web meet the requirement, (3)compare the actual output with the expected output, and (4) know user acceptance for the application and web.

Forty-three respondents were recruited to participate in this application evaluation. 18 male respondents and 25 female respondents participated in this application evaluation. The respondents were randomly picked among friends and family. Most of them are between 21 and 30, and a small number are 41 and above. All participants consented to participate in the evaluation.

The stacked bar graph shown in Figure 22 represents the usefulness of the car-sharing system. Most of the respondents, more than half the total, agree and strongly agree with this section, and there is no respondent in the strongly disagree part. There are only 1 or 2 respondents who disagree with this section.

Figure 22. The usefulness of Car Sharing System

The stacked bar graph (Figure 23) shows that most of the
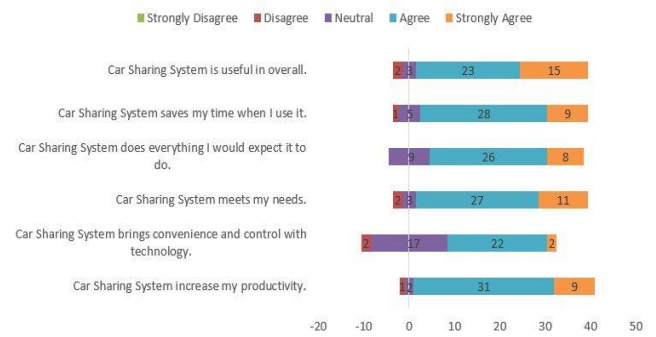
respondents agreed on this ease of use section. The least respondents are in disagree part, two respondents who cannot easily remember how to use the application and one who thinks that this application is not user-friendly. Even though there are more than half respondent agree and strongly agree with the ease of use of the application, but there are respondents neutral and disagree. It may indicate that the application is not user-friendly.
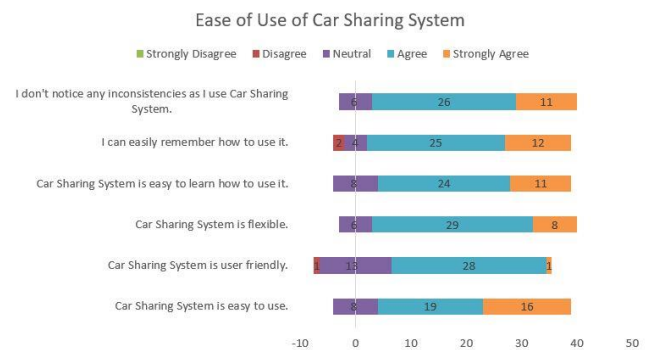

Figure 23. Ease of Use of Car Sharing System

The stacked bar graph (see Figure 24) shows that most respondents agree on this satisfaction section. There are 1 or 2 respondents who disagree that this system is wonderful and pleasant to use, and they would recommend it to their friends, but it does not affect the satisfaction of the system. It proves that this application can solve their problems and does not exceed their expectations.
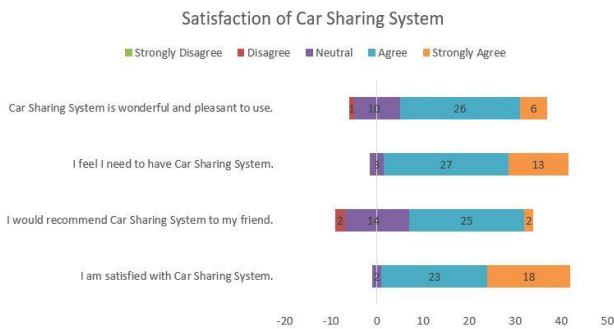
Figure 24. Satisfaction of Car Sharing System

The stacked bar graph shown in Figure 25 represents the functionalities of the car-sharing system. Most of the respondents agree and strongly agree about the system's functionalities. For example, only one respondent cannot use the payment gateway to make payment, update thier profile and get his/her profile information correctly. Other than that, most of the respondents agree with these functionalities of the car-sharing system.
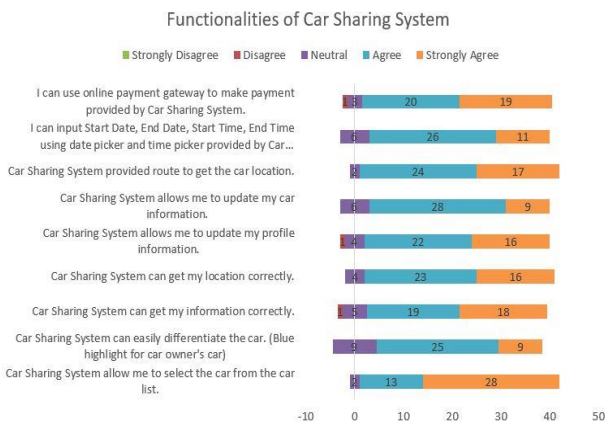

Figure 25: Functionalities of Car Sharing System

7. Conclusion

This paper describes the design and development of Car Sharing System for car owners and customers. The study is expected to provide a platform for the car owners to rent out their less frequently used cars, and the customers can also rent the car they want in the car list. However, there are still many aspects that can be studied. In future work, the developer plans to expand the Car Sharing System's functionality, and some functions can be improved to be better than what had been done. The limitation of this application is that the users need to have internet access to this application. The evaluation results show that the overall system is usable and that most respondents are satisfied with all aspects of usability measurements. The interface and design of the application can also be enhanced to ensure that the application is more user-friendly. In future development, it is recommended that photo recognition can be used in this application.

Acknowledgements

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