Easy Ride: A Secure Carpooling Mobile Application for Travellers

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Abstract. The advancement of technology has opened pathways for the rapid development of urban ecosystem. However, the population in urban areas is expected to increase exponentially which may lead to severe mobility problems. Various measures have been implemented by policy makers to mitigate the mobility problems and to provide better transportation facilities to people. Although the efforts are still in infancy stage, they are expected to yield positive results in the long run. In relation to this, the research proposes a mobile application called Easy Ride as an initiative to create an efficient carpooling ecosystem which brings huge advantage to the community in terms of transportation. Connecting people and creating a strong culture of sustainability will be the primary purpose of this application as it serves a path for people to reach out and connect with more travellers. Besides fostering social networks, this application is defined to be cost-effective as it helps the drivers and passengers to share the overall travel expenses. On the other hand, this research describes the agile methodology that has been chosen for the entire development of the application. The system was further tested and validated to determine the efficiency of the overall functionalities and design. The findings indicate that the proposed system has the potential to meet the expectation of the travelers and to enhance their daily lifestyles.

Index Terms. carpooling, transportation, travellers

1. Project Background
Carpool can be elucidated as an arrangement between two or more individuals to make a planned journey in a single car, typically to the same destination where each person takes turn to drive the others. In certain carpool scenarios, there will be only one car owner who drives other passengers to the desired destination [1]. Carpooling is an economically efficient and rational approach. This is because it can significantly reduce a person’s overall travelling cost which includes tolls and fuel expenses. The more the passengers in the carpool, the less the travelling expenses will be. On the other hand, carpooling is also considered to be an environmentally friendly approach as sharing journey mitigates traffic congestion on the roads, greenhouse gas emissions and the need for additional parking bays.

According to [2], air pollution caused by vehicles is severely linked to various health-related issues such as skin allergies, respiratory diseases and asthma. Hence, by practicing carpool, these health
problems can be gradually alleviated. In addition to that, travelling alone causes stress and makes the overall journey boring and tedious. Through carpooling, the travellers can make new acquaintances and turn a loneliness journey into a cheerful one. Despite the fact that carpooling reaps huge benefits to both drivers and passengers, some people are still deeply skeptical and tentative about carpooling.

Past reviews [1,2] have proven that there is a lack of a reliable platform which promotes the concept. Therefore, in order to overcome this problem, a secure carpooling platform for travellers (Easy Ride) will be developed in this project in which travellers who do not possess a car can look for someone nearby who owns a car and travels to the same location. This platform will be designed and developed as a mobile application to bring greater convenience to the users. The target audience of this project are Malaysian especially those who live in urban cities such as Kuala Lumpur and Petaling Jaya where traffic is their daily encountered issues. Since security risks remain a primary concern in carpooling, this project will be carried out by focusing on mitigating the possible vulnerabilities using robust security features. Hence, this project intends to deliver a reliable and efficient carpooling environment in which customers no longer have to worry about their safety.

2. Domain Research
The study deliberately discusses the current transportation problems in Malaysia and other primary factors that contribute for the development of a secure carpooling mobile application.

2.1. Current Transportation Problems in Malaysia
The typical routine in Malaysia is driven by the interaction of traffic, drivers and streets. Traffic flows vary with time and place; mostly throughout the day as it fluctuates with peaks in the morning and in the evening. Many places may have very high volume of traffic due to active economic activities, for example in the main business district of major cities. But other places, including leisure roads, may have to account for heavy traffic only on weekends and holidays. The design and construction of such an installation require proper planning and appropriate engineering judgment, which are not predictable. Congestion occurs when the traffic number is much higher than that of existing road installations (the capacity). The Level of Service (LoS) of such facilities deteriorates when the amount of traffic reaches the capacity of the existing facilities. Because of changes in their convenience, i.e. reduced speed, longer travel time or longer time at road intersections, the users of the affected highway would experience lower LoS. All these made them lose valuable time that could have been used for other useful and more successful enterprises.

Commuting in traffics in the capital of Malaysia has been getting worse from year to year. The traffic rise in the statistics despite the efforts of speed-up lanes and the use of smart toll systems such as Touch and Go and Smart Tag [3]. The government has introduced alternative public transport models such as Rapid commuter bus and train systems to overcome traffic in Kuala Lumpur. On the other hand, a yearly budget is being allocated just for public transportation as an agenda to further ease traffic congestion in the capital state. Adding on, researchers in article [4] have stated that the government has introduced a new electric bus system in Kuala Lumpur and has allocated a budget of 450 million ringgits. Despite these efforts, the problem of traffic around Klang Valley, in general, has been impacting other major cities around Malaysia [5].

Carpooling provides Malaysians with several financial and fiscal incentive as identified in [6]. This is supported by [7] that claimed that carpooling is a cost-effective strategy to alleviate traffic and minimize additional road and public transit capacities, facilitating growth in transportation resources and personal performance. In [7], it was found that casual carpooling can significantly reduce energy consumption for 15 commuters, which means that the same number of passengers can use express bus services at a lower cost.
2.2. Peoples’ Perspective towards Ride Hailing Services

Ride-hailing has been transforming as a major service in most parts of the world. But historically, ride-hailing was implemented during 1640’s. The demand for transportation from point A to B have been officially recorded when in 1635, hackney Carriage Act was the first legislation to be passed to control horse-drawn carriages in England [8]. Due to the advancements in technology and inventions, the ride-hailing platform started to evolve gradually by introduction of cars during 1897 and the first ever known taxi service is called as Daimler Victoria. Adding on, the ride-hailing platform was given a revival by the introduction of yellow taxis or also known as cabs which became the main identity of taxis worldwide. But the fact is evolution of ride-hailing as a service did not stop there. Humans are always capable to perform modifications on almost everything in order to make life easier.

The reputation of taxi services in Malaysia has been marred in general due to not just one but many reasons. Even though, strict regulations have been set up by the government to control taxi drivers all over the places, they still get away with practices like not using the taxi meter given by the company. This creates a scenario that appears to have regulations but without accountability. Customers regularly get cheated on with high fares set by the taxi drivers even before the ride. Only after an agreement of fixed fare, the customers are treated and brought to their destination [9]. Therefore, it peovokes dissatisfaction and distrust between daily travellers; thus, they avoid using taxis by relying more on government provided train systems and also buses. Moreover, many taxi drivers have a record of being rude and unpleasant to customers regardless of locals or foreigners. In 2015, Malaysia was in the top spot as the country with worst taxi drivers followed by Paris and Bangkok. Due to lack of monitoring, the taxi drivers are mostly dishonest and non-presentable adding that they keep their vehicles in a bad shape. So, from here, it is clear now that the reputation of taxi services has been damaged by the drivers that Malaysians nowadays prefer other types of ride-hailing services.

People are more keen on e-hailing rides comprising both taxi and regular citizens as drivers compared to conventional taxi drivers. This inclusively leads to a major drop in taxi services, ending up in a clash between both the services in Malaysia. On the other hand, [10] has stated on his research that most e-hailing ride service users have said that taxi drivers in Malaysia have more bad reputation and are unreliable compared to new e-hailing ride service providers such as grab and uber. His survey has showed that e-hailing ride always provide competitive and at times cheaper compared to taxi rides which tends to fleece money by any means. Moreover, convenience is proven in e-hailing services where the customers can just book rides using a mobile phone and the ride arrives exactly at the spot that they have marked as a meet-up point. Hence, it has become clear that people prefer e-hailing services compared to traditional hailing services due to the convenience and also proper and cheaper pricing. In the near future, technologically advanced transportation network systems might be implemented with the motive of simplifying and economically viable.

2.3. The Future of Transportation

In the future, the transportation ecosystem will evolve into something new that it might include services like carsharing and also shared micro mobility. This is due to the transformative effect is needed and can be achieved by having access to mobility in the future and by converging shared mobility, electrification and also automation. According to [11], this type of evolution will benefit both service provider and customers in terms of overall reduced cost, tend to be more efficient, human driven and convenient. Alternatively, [12] has supported the previous statement by describing the involvement of electronic vehicles (EV) which provides a pollution free solution when it comes to transporting people and goods around the globe. With technological advancements, it might be possible to even integrate secure systems with EV’s, creating a fully automated vehicle without human intervention.
2.4. Limitations in the existing e-hailing services
There are several e-hailing services in the marketplace to provide enhanced travelling experiences to the users such as SOCAR and GrabCar. GrabCar is specialized in providing ride-hailing transports services whereas SOCAR offers a car-sharing platform in which customers can rent a car for a specific duration. However, there are several limitations in both of the applications. Despite providing a wide range of services such as logistics, food delivery and e-wallet, GrabCar still lacks a systematic carpooling platform which allows car owners to share journeys with passengers. GrabCar introduced GrabHitch in 2017 as an attempt to provide carpooling experience to the users but it did not go well due to poor design and implementation [13]. In the proposed application, car owners are not restricted to any regulations and they can cancel a ride anytime without informing the passengers. There has been several occurrences whereby passengers are not informed that an additional passenger would join the ride. Hence, it causes inconvenience and discomfort for the passengers [13]. With all these problems, GrabHitch was eventually removed from GrabCar mobile application. On the other hand, SOCAR only offers car rental services, opting out other significant options such as ride-hailing and carpooling. Due to the unavailability of other services, SOCAR can only capture the attention of a smaller number of audience.

To sum up, there is a need to develop a more user-oriented carpooling mobile application that focusses on usability and user-friendliness.

3. Research Methodology
The research adopts XP Programming methodology because it facilitates the value and outcome of the project based on changing customer requirements. Moreover, this framework comprises an effective programming or coding approach which is usually adopted for complex projects. Besides saving a lot of time, this approach keeps the design of the system as simple as possible so that it is easier to maintain and revise. Another reason the research adopts XP programming is because of its versatility and ease of use. Apart from that, this methodology also encourages multiple feedbacks from customers on how to further refine and improve the system in terms of usability. Although Waterfall and spiral models bring their own advantages, the researcher feels that XP’s benefits highly fit the specification of this overall project. The following diagram briefly illustrates the workflow of XP Programming framework.

![Figure 1. Extreme Programming Methodology](image)

3.1. Release Planning and Iteration Planning
In general, the main purpose of having a release plan is to outline the user stories that will be implemented for each system release. Release plan comprises a set of rules that permits everyone who
is involved in the project to contribute their own ideas and make decisions. Since programmers play a prominent role in the development of Easy Ride, they are privileged to suggest some components which can be implemented. Distinct iterations must be analysed in advance before each iteration begins. The release planning of the proposed system can be categorised into four basic attributes which are resources, quality, scope and time. No one is authorised to govern any of the four attributes. If by any chance someone makes an amendment in one of those attributes, others will be affected too [14].

The objective of having an iterative planning is to create iterative schemes for the project tasks. Customers have the rights to choose the user stories from the sequence of release plans. The chosen user stories are divided into distinct tasks which will be then executed accordingly by the programming team. If a programming task is difficult, the system developers of Easy Ride should estimate and propose a longer time for the respective task. The primary goal of conducting this meeting is to evaluate and stabilize the list of user stories that the developer is going to deliver in the near future [15].

3.2. Designing
An iteration of Extreme Programming begins with designing. Without a functional design, the developers will not be able to understand the mutual relationship between the data and system functionalities. Therefore, relevant logical and physical designs should be presented earlier before the actual implementation takes place. A good design helps the programmers to avoid dependencies which means changing one part of a program will not impact the other parts of the program.

3.3. Implementation
This is where the actual implementation comes in. Programmers start to write code based on the user stories collected from release and iteration planning. A small change in the source code can bring a greater repercussion to the entire system, thus, high level of attention is required during this phase. It is undeniably true that a complete source code defines a complete program. Once the developer completes the coding without any error, a fully functional system can be deployed for the use of customers.

3.4. Unit Testing
Unit testing can be classified as one of the most fundamental phases in Extreme Programming. In unit testing, all the individual components of a system are tested and verified for bugs and runtime errors. Generally, XP programmers practice test-driven development (TDD) which needs an intensive style of unit testing [16]. Developer of Easy Ride should place a greater emphasis on unit testing and verify every single component of the system in order to eliminate unintentional errors.

3.5. User Acceptance Testing
Acceptance Testing can be defined as a testing technique used to decide whether or not the software meets the requirement specifications [17]. In other words, acceptance testing is carried out to test and evaluate each user story during the development phase. A user story can only be considered as complete if it passes acceptance test without any error. End-users of Easy Ride system are accountable to revise the validity of the acceptance tests and highlight the mistakes to the developers for further amendments. For instance, if a particular function of Easy Ride does not align with the end-user needs, the administrative staff should quickly report to the developer before the he or she proceeds with further implementations.
4. Research Methods
A set of questionnaires is designed and created as the main data gathering element to further refine this study. The questionnaire comprises multiple choices questions with less jargons, so that the respondents would not face any difficulties in understanding and answering the questions. Based on the discussion, it was decided that the population for this questionnaire would be young adults who are more enthusiastic towards travelling in Malaysia. In addition to that, the targeted sample size for this questionnaire would be 110 respondents. A total of two weeks would be allocated to distribute the questionnaires. The questionnaires would be created as an online-based survey in which Google Forms would be used to prepare it. Respondents would be asked to answer the prepared questionnaire through smart devices such as Smartphone or iPad given by the researcher rather than attempting to get responds in person. Beforehand, the respondents would be given a brief and concise explanation on the purpose of the questionnaire so that the respondents would have a better understanding on the importance of this data gathering, in hope that they would respond the questions with upmost honesty. Upon completion of data gathering, the results gained will be analysed using the Google Form tool where further evaluations will be done later. The following table briefly demonstrates the research questions and the objectives.

Table 1. Survey Questions and Objectives

| No | Questions                                      | Objectives                                                                 |
|----|------------------------------------------------|---------------------------------------------------------------------------|
| 1  | Gender                                        | To determine the gender of the respondents.                                |
| 2  | Age                                           | To determine the age of the respondents.                                  |
| 3  | Employment Status                             | To determine the profession or position of the respondents.               |
| 4  | Mobile Operating System                       | To determine the type of mobile operating system that is mostly used by the respondents. |
| 5  | What is your primary mode of transportation?  | To find out how the respondents travel to other places in Malaysia.       |
| 6  | What are the factor(s) you would consider in travelling? | To find out what are the factors that are being emphasized by respondents when travelling. |
| 7  | What are your average travel expenses per week to office or other places? | To find out the weekly costs that are spent by respondents for travelling purposes. |
| 8  | Have you ever felt bored when travelling alone? | To investigate the perception of respondents towards travelling alone.   |
| 9  | How often do you                              | To find out how                                                           |
encounter traffic congestion when travelling? | frequently the respondents experience traffic congestion when travelling to other places.

10 Please rate how strongly you agree or disagree each of the following factors that lead to traffic congestion? | To gather some information on how strongly the respondents agree or disagree on the mentioned factors that contribute to traffic congestion.

Respondents’ Carpooling Experience

11 Have you ever involved in carpooling? | To determine whether the respondents have travelled via carpooling before.

12 If you answered ‘yes’ for the previous question, how would you rate your carpooling experience? | To find out the level of respondents’ interest towards carpooling.

13 Would you be interested to offer a ride to someone if he or she is willing to share the transportation costs? | To identify the respondents’ perspective on offering ride to strangers with the agreement of sharing transportation costs.

14 On a scale of 1 to 5, how much do you agree or disagree that the practice of carpooling can reduce traffic congestion? | To gain some insights on the perception of respondents whether traffic congestion can be mitigated with the practice of carpooling.

15 On a scale of 1 to 5, how much do you agree or disagree that the practice of carpooling can reduce environmental pollution? | To gain some insights on the perception of respondents whether environmental pollution can be mitigated with the practice of carpooling.

Introduction to the Application

16 Do you think a seamless carpooling application to travel would be beneficial to you? | To find out whether the respondents are interested towards a digitalized carpooling mobile application.

Personal Safety
From a security perspective, do you think that the car owners must be thoroughly verified before they can offer a ride to a passenger via the mobile application?

To find out whether the respondents would like to see a verification process in the proposed mobile application.

If you answered yes for the previous question, what type of verification method should be implemented in the application?

To determine the respondents’ preferred verification method in the proposed mobile application.

What do you think the most suitable pricing system for a shared journey via the mobile application?

To determine the users’ perception on how the overall travelling costs must be calculated within the application.

What is your preferred payment method for the carpooling?

To find out what type of payment method that the respondents would like to see in the proposed application.

Kindly suggest other recommendations that can be implemented in the proposed carpooling mobile application in order to serve the community better.

To understand and analyse the suggestions that are recommended by the respondents which can be considered for implementation.

5. Results and Discussions
The results show positive feedback from most of the respondents, supporting the fact that such mobile application benefits the travellers in the future. Almost 80% of the respondents have said “Yes” when they are asked whether they have ever involved in carpooling. Hence, it can be deduced that most people are aware of the carpooling concept and a proper solution would be needed to further enhance it. Other than that, 37 respondents have given a rating of 4 out of 5 on their overall carpooling experience. This shows that the respondents have enthralling experiences on carpooling which would definitely need to be emphasized in order to boost up their overall satisfaction. Moreover, majority of the respondents agree that the practice of carpooling could reduce environmental pollution. Since environmental pollution has caused huge problems in a country like Malaysia, it is wise to come up
with a solution which could contribute towards preventing or reducing environmental pollution which was mainly caused by the usage of motorized vehicles. About 30% of respondents have said that they would hesitate to use a carpooling mobile application to travel. This could be due to their past unpleasant experience towards carpooling which might need to be improvised to serve the community better. However, 70% of the respondents claimed that they would be interested to use a carpooling mobile application. Hence, it could be said that developing this application will meet the demand of the consumers that are interested in carpooling. Based on the collected responses, it can be seen that most of the respondents would require the car owners to be verified before they could offer a ride to the passenger via the mobile application. Therefore, safety countermeasures are highly required to be implemented in the development of the mobile application in order to gain more trust from the consumers towards using the mobile application.

6. Evidence of Outcome
The section briefly highlights some of the user interfaces of the mobile application along with a brief explanation.

![Figure 2. Show Available Rides Activity (Passenger)](image)

Once the passenger clicks the start button after inputting his or her desired pickup location, drop off location and time, he or she will be presented with the screen shown above. A polyline is created between the passenger’s pickup point and drop off point to indicate the route. All the available driver rides that meet the requirements of the passenger are displayed on the map with a ‘Click Me’ option. When the user clicks the option, an alert dialog appears with the information of the driver’s name and overall travelling cost. If the user is interested to join the ride, he or she simply needs to click the pop-up option.
Figure 3. Manage Journeys Activity (Passenger)

This page comes with three different fragments in order to help the passengers to manage their journeys in a more systematic and organised manner. The functions of each fragment has been deliberately discussed in the list below.

- **Upcoming** – This fragment contains all the newly booked journeys which need to be approved or declined by the drivers.
- **Current** – This fragment contains all the journeys that are taking place at the moment.
- **Past** – This fragment contains all the journeys that are either successfully completed or rejected by the driver.

Figure 1. Create Waypoints / Pickup Points Activity (Driver)

The driver has the privilege to select the waypoints from where they would like to pick up the passengers during the journey. They can choose the waypoints simply by clicking on the map and the waypoints are added dynamically in the form of text fields as shown in the image above. If the driver accidentally selects a waypoint, he or she can simply remove it by clicking the ‘cancel’ icon beside the waypoint. The drivers are restricted from adding more than five waypoints throughout the journey. The new journey will be added to the recycler view as soon as the driver clicks the ‘Add Path’ button.

A total of 5 respondents participated in the Usability Testing to evaluate the acceptance of Easy Ride mobile application developed by the researcher. Majority of respondents are satisfied with the overall implementation of Graphical User Interface (GUI). This proves that the user interface is attractive and perceptive enough for the users. Thus, there were no major issues found by the testers while experiencing the user interface. Majority of the respondents are satisfied with how the
interaction works in the system. This is an evidence that the navigational structure of the system is well implemented and can achieve high usability. The vital security technologies such as JWT token, fingerprint authentication and also Bcrypt hashing are included in the system in order to enhance the security features of the proposed application.

7. Conclusions
Various researches have been done with careful deliberation in order to gather some comprehensive information that are associated with the proposed carpooling mobile application. The results of the studies have mentioned that a fully integrated carpooling application is highly sought by Malaysian travellers who currently rely on public transportation. From researcher’s perspective, the proposed mobile application will also be beneficial for car owners as the overall transportation costs can be shared with the passengers. If developed and implemented well, this proposed system has the potential to help thousands of travellers to communicate with each other and share journeys. All travellers need a medium to travel, but not everyone owns a motorized vehicle. Therefore, this mobile-based carpooling application is intended to close the transportation gap and provides a robust medium for travellers to share journey and fulfil their own travelling needs. If the proposed mobile application reaps huge profits and receives great acclamation from the end-users, there is a huge potential for the application to be expanded to different regions and countries.

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