

# Mobile Application System, Location Tracking and Trip Estimation for Uk Petra Shuttle Bus Application Using Flutter and Google Maps

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## ABSTRACT

Petra Christian University (UK Petra) is a campus that has grown rapidly into one of the leading universities in Indonesia by having thousands of students from within the country and abroad which is currently located on Siwalankerto Street, precisely at number 121-131, Surabaya. Petra Christian University plans to organize a Shuttle Bus with the route of West Surabaya - Petra Christian University to facilitate many students from West Surabaya to reach UK Petra and vice versa.

However, in using this Shuttle Bus, a management system is also needed to manage the use of this Shuttle Bus by students. This management system is divided into several major features, namely registration, reservation, identification, tracking, and related features such as rating along with notification.

The results show that after the design of this "Petra Shuttle Bus" application, most of the passengers feel benefited because they can make reservations in advance along with accessing other important features such as viewing bus locations and rating related schedules for service improvement. In addition, the driver also feels benefited because with the current check-in system, it is very easy for the driver in the process of validating passengers who have made reservations. Please note that this application is far from perfect and requires further improvement based on user suggestions.

**Keywords:** Flutter, Shuttle Bus, Reservation, Mobile Application, Location Tracking

## ABSTRACT

*Petra Christian University (PCU) is a campus that is already growing rapidly becoming one of the popular universities in Indonesia with thousands of students from Indonesia and outside Indonesia which is now located in Jalan Siwalankerto, exactly in number 121-131, Surabaya. Petra Christian University planned to launch Shuttle Bus with west Surabaya - Petra Christian University route to facilitate many of the students from west Surabaya to reach Petra Christian University and vice versa.*

*But, this Shuttlebus needs a control system to manage the usage of this shuttle bus by students. This control system is divided in a few big features, which are registration, reservation, identification, tracking, and features related to rating and notification system. The research results showed that after the "Petra Shuttle Bus" application was designed, most of the passengers benefited from being able to make a reservation in advance along with accessing other important features such as viewing bus locations and ratings.*

*related schedules for service improvement. In addition, the driver also feels benefited because with the current check-in system, this greatly facilitates the driver in the process of checking passengers' attendance who have made the reservations. Please note that this application is far from perfect and requires further improvement according to users' feedback.*

**Keywords:** Flutter, Shuttle Bus, Reservation, Mobile Application, Location Tracking.

## 1. INTRODUCTION

Petra Christian University (UK Petra) is a campus that has grown rapidly into one of the leading universities in Indonesia by having thousands of students from within the country and abroad which is currently located on Siwalankerto Street, precisely at number 121-131, Surabaya [6]. Of the many students studying at UK Petra, around 500 of them are spread in the west Surabaya area. PPPK Petra students are one of the UK Petra markets with the largest number of students, so it is necessary to organize a Shuttle Bus whose route is from west Surabaya (especially Pakuwon Mall) to UK Petra and vice versa.

This Shuttle Bus is currently in the procurement process which is planned to be operated in the even semester 2021/2022. However, in using this Shuttle Bus, a management system is also needed to manage the use of this Shuttle Bus by students. This management system is divided into several major features, namely registration, reservation, identification, tracking, as well as related features such as a feature to rate passenger trips, and a notification system.

This management system is needed because there are various problems that arise, such as the limited number of slots in the bus, how to find out that passengers who board the bus are UK Petra academics, difficulty in knowing the position of the bus boarded by students on the schedule they are riding.

Regarding the bus ticket reservation system on mobile, in 2015, there was a similar research on the Android-based bus ticket booking application program "Damri Mobile Ticketing" [5]. The advantage of this research is that the booking and payment system is integrated and comprehensive because it is integrated with the admin page. However, the disadvantage of this research is the appearance that is not maximally designed because it only focuses on functionality. In addition, the application is not available on the iOS platform.

Then in 2017, there was research on a platform integrated with mobile devices called OneRide with

three main features, namely mobile payment, route planning, and social networking that utilize QR Code technology, GPS, and wireless technology [4]. The advantage of this research is that the system has been tested in a live field application, and many residents of Porto, Portugal, consider that this application is really useful for them. However, the drawback of this research is that the tracking feature on the vehicle in certain cases does not show real-time arrival time and only displays the arrival schedule, so it needs to be further improved.

In 2021, there was research on a platform for making online reservations on computerized buses with various features such as schedule reservations, viewing details of the bus, viewing passenger details, seat availability, and payment [3]. The advantage of this research is that there is a mechanism to pay easily and practically with the *prepay* feature, as well as a reliable reservation system because slots will only be used by passengers who make *bookings* and do not *cancel*. However, the drawback is that when the application is used when there is no internet connection at all, the application cannot run at all, so it is very dependent on the internet connection.

## 2. THEORETICAL FOUNDATION

### 2.1 Global Positioning System

Global Positioning System (GPS) is a satellite-based navigation mechanism or system used to obtain the position of an object on the earth's surface developed and operated by DoD since 1972. Initially used for the needs of the United States military, GPS is now commonly used in the public in various applications [7][9]. In this research, GPS will be used to *pinpoint* and track the location of the UK Petra shuttle bus that is in operation.

### 2.2 Mobile Application

*Mobile* applications are computer programs that run on mobile devices and are an important part of our lives with each person spending an average of 30 hours per month using *their mobile* device [10]. This Mobile Application is the main component of the UK Petra Shuttle Bus application.

### 2.3 Flutter

Flutter is a tool developed by Google to make it easier for developers to build beautiful applications for various platforms, such as mobile, web, desktop, using only one codebase. Flutter has various advantages, such as fast application development speed because it is supported by the *hot reload* feature, stunning and expressive user experience display, and performance equivalent to native [1][8]. Not only that, Flutter is also updated regularly. In the UK Petra Shuttle Bus application, Flutter will be the main *framework* that will be used to build the application from scratch.

### 2.4 Google Maps API

Google Maps API is a platform developed by Google to enable *developers* to integrate the realtime experience of maps, routes, and place features contained in Google Maps to be implemented in the application developed by the developer [11]. This Google Maps API uses a Google account as a medium for using the Google Maps API and its management in Google Maps.

Google Maps Platform, part of Google Cloud Platform. In the UK Petra Shuttle Bus application, the Google Maps API will be utilized for *tracking* and estimating the journey of the UK Petra Shuttle Bus that is in operation.

## 2.5 Business Logic Component (BLoC)

BLoC or *Business Logic Component* is a *design pattern* that helps in separating UI with business logic so that the components of the project are divided into UI, BLoC and data provider. The result is a function structure and programming writing that is easier to understand and *reusable* by subsequent application developers. This BLoC allows developers to focus on converting events into state and when an implementation is changed, there is no need to make many changes to other code [2]. This BLoC architecture is also used as the architecture of the Petra Shuttle Bus application to make it easier for *developers* to make improvements and updates to the application.

## 3. SYSTEM DESIGN

The system design of the system in the Petra Shuttle Bus application is divided into *use case diagram*, *activity diagram*, as well as ERD and user flow.

### 3.1 Use Case Diagram

Use case diagrams are used to explain user interactions with the system in the UK Petra Shuttle Bus application. Each user has several functions that can be performed such as reserving bus schedules, canceling reservations, filtering according to dates and routes, *scanning QR codes*, viewing bus locations, and displaying reserved schedules. The use case diagram of the Petra Shuttle Bus application created in this research can be seen in Figure 1.

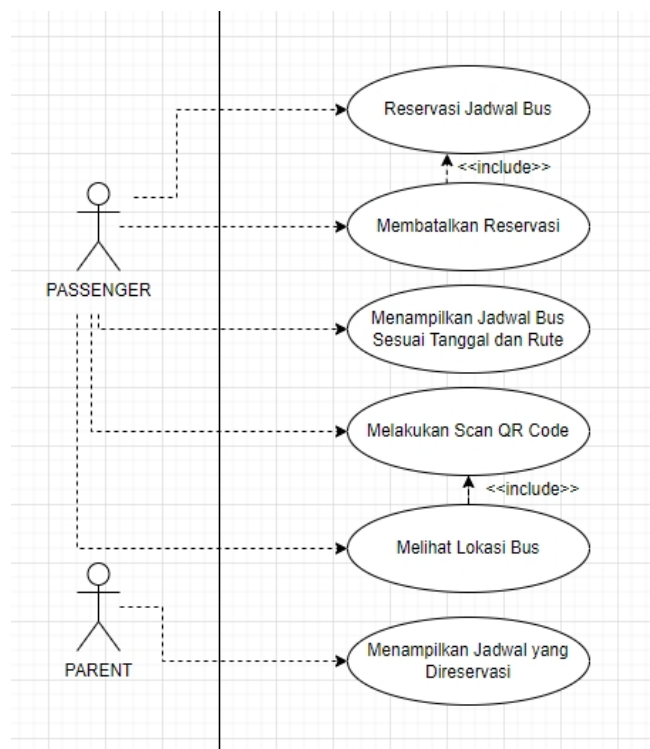
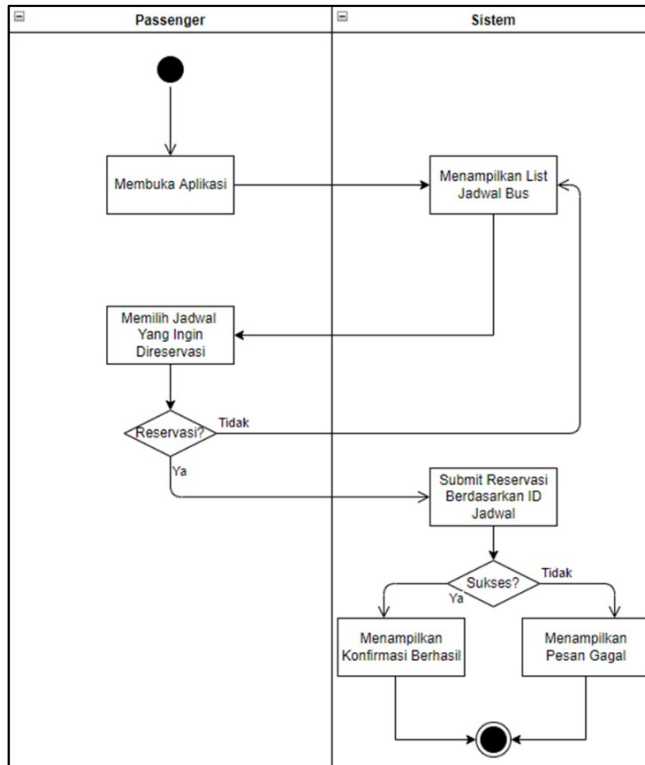


Figure 1. Use Case Diagram

### 3.2 Activity Diagram

Activity diagrams are used to explain the details of activities that occur between users and the system. The activity diagram is based on the use case diagram of the user and driver to explain the details of the use case. Activity diagram of the main features of Petra Shuttle Bus, especially from the reservation side, can be seen in Figure 2.



Reservation Activity Diagram

### 3.3 User Flow Design

User Flow Design is used to explain how the Petra Shuttle Bus application works when it is to be used from the side of the UK Petra Shuttle Bus passengers. The intended users are all academicians from Petra Christian University. The following is the user flow of the Shuttle Bus application:

1. Academic staff or passengers log into the Shuttle Bus application using john/peter email registered in SIM Petra.
2. After login, passengers can view the available schedules and can make a reservation on the desired schedule. Passengers can also cancel the shuttle bus schedule reservation if they wish.
3. After making a reservation and the passenger arrives on the D-day scheduled to board the bus, the passenger will scan the QR Code on the bus that has been generated by the bus driver.
4. After scanning the QR Code, if the scan fails because the passenger has not made a reservation or the QR Code of that schedule is no longer valid, then the passenger cannot board the bus. On the other hand, if the scan is successful, it means that the passenger has made a reservation for the previous bus schedule and can board the bus.

5. After scanning the QR Code successfully, the user can access the page to see the location of the bus he is currently riding along with the estimated trip.

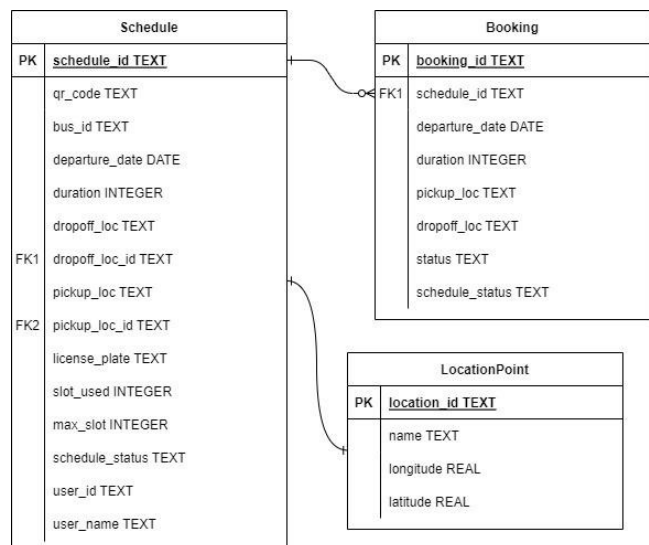
6. After the passenger arrives at the destination location, the reservation will be moved to the history page so that passengers can see the schedules that have been boarded by previous passengers.

7. Passengers can also perform other functions such as parent management, along with logout. In addition, there is also a manual system (offline mode) that allows the application to be used *offline* if the server crashes, in order to minimize the dependence of shuttlebus operations on the system.

This is the explanation for the user flow design of the Petra Shuttle Bus application.

### 3.4 Entity Relationship Diagram (ERD)

*Entity Relationship Diagram* is used to explain the relationship between entities in the *offline* database in the UK Petra Shuttle Bus application. In the *offline* system in the database, data will be retrieved from the API *fetch* results every time the user connects to the internet (maximum for the next 5 days, always updated every time the user connects to the internet and opens the application). But if suddenly the server crashes temporarily, users can still access the data that has previously been stored by the system automatically. The ERD of the Petra Shuttle Bus *offline* system can be seen in Figure 3.

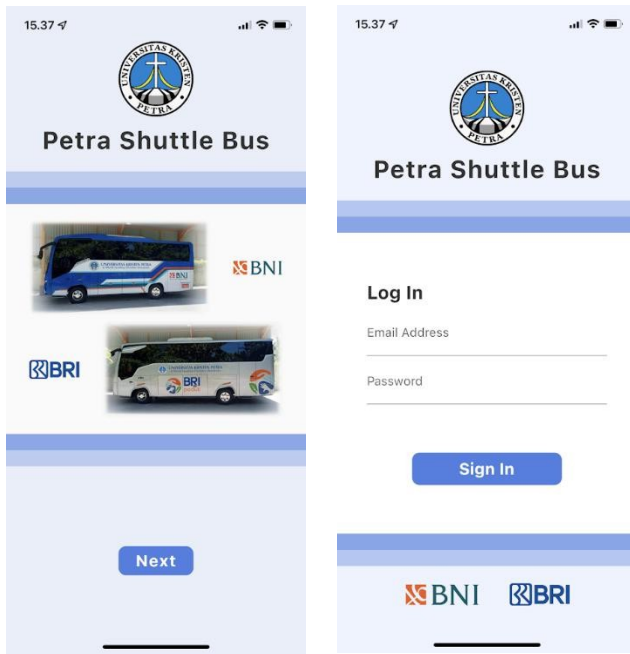


Entity Relationship Diagram

## 4. TESTING

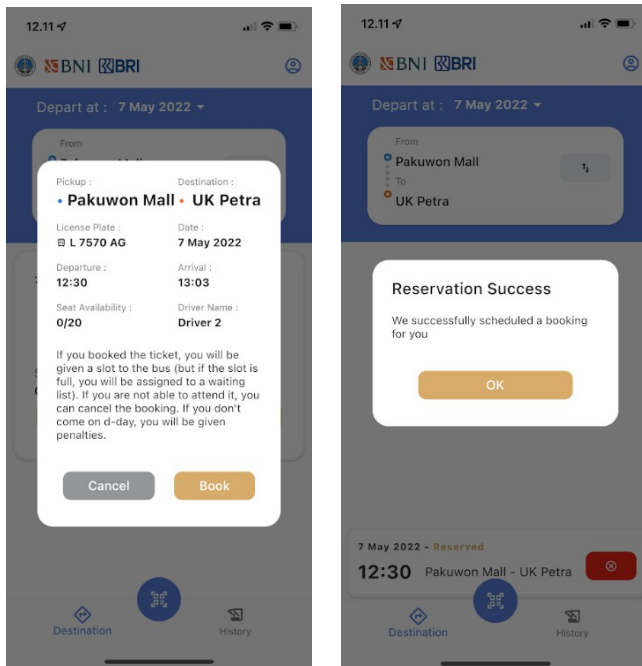
### 4.1 Application Testing

When the user opens the Petra Shuttle Bus application for the first time, they are presented with the start page, and when the *next* button is selected, the user will be redirected to the login page. In the login page, Users can try to login by using the john account provided by the University, where the account is registered in Petra SIM as shown in Figure 4.



**Figure 4. Registration (Login) Feature**

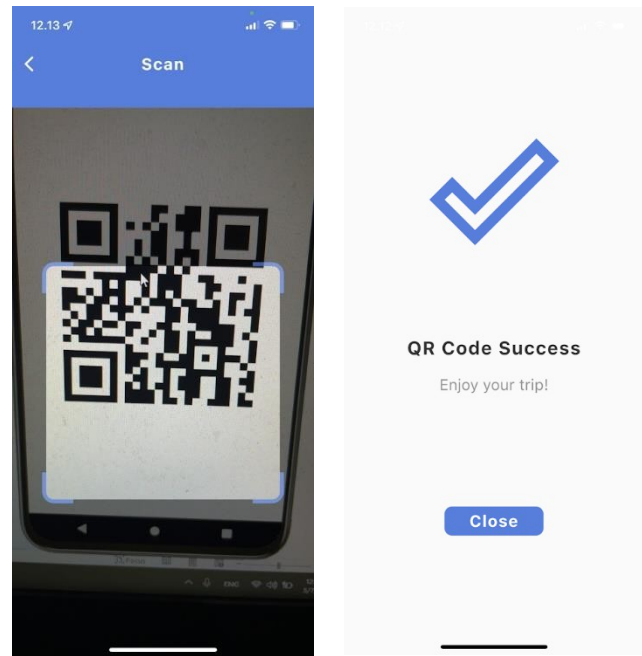
Then after the user selects the *pickup*, *dropoff* location, along with the departure date in the filter section. After filtering, the application will display schedules that match the filter. Then the user makes a reservation on a schedule by pressing the "Book a seat" button, then the user gets a confirmation dialog, and successfully makes a reservation on the schedule as shown in Figure 5.



**Bus Schedule Reservation Page**

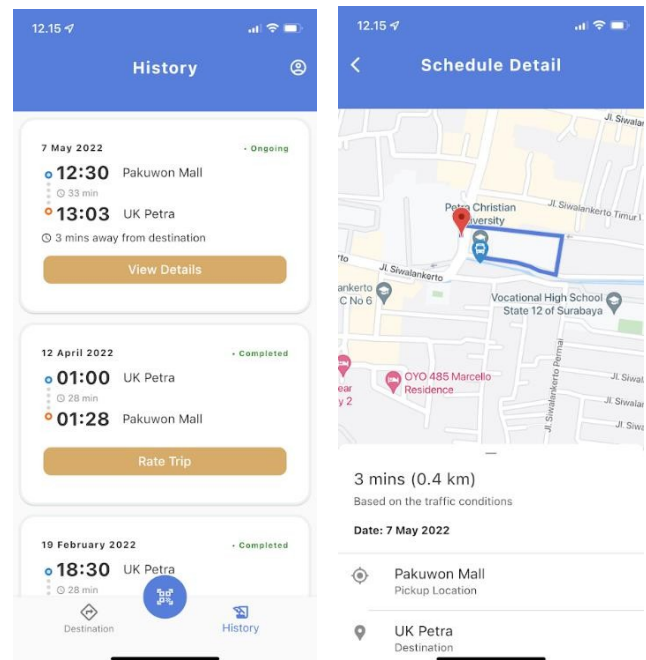
When the bus has arrived, the user needs to open the QR Code scan page to check-in, by scanning the QR code on the driver's tablet. After scanning the QR code on the driver's tablet, the user gets a confirmation on *his* smartphone that his scan

successful, and the user can get into the bus for the trip to the destination as shown in Figure 6.



**Figure 6: Identification page**

When the user sees the details of the schedule that is being actively ridden at that time, the location and estimated trip of the bus he is riding can be seen. Users can see the *pinpoint of the* starting location, destination location, bus location at that time, along with the travel route and estimation (in meters and minutes) to arrive at the destination as shown in Figure 7.



**Figure 7. Trip Tracking & Estimation Page**

## 4.2 User Testing

One of the ways to test the quality of the UK Petra Shuttle Bus service, especially from the application side, is *user testing*, where the research method that will be used in this case to obtain maximum results is a combination of survey methods (questionnaires) and *usability studies* (research to measure the ease of using a product). In addition, to obtain opinions from *drivers*, data collection is also carried out by the on-site interview method after the researcher rides in the shuttlebus.

The testing method to obtain student opinions was carried out by distributing surveys that had been prepared in such a way to several samples of Petra Shuttle Bus application users who had made reservations and had gone through the process of arriving at the destination location on the schedule they had reserved using the *shuttle bus* facility, as participants in this *user testing*. The results of *user testing* on UK Petra Shuttle Bus passengers can be seen in Table 1.

**Table 1. Petra Shuttle Bus Application Questionnaire Results**

No.	Question	Average
1	Easy login process	4.83
2	The login process runs well	4.79
3	Simple and easy reservation process	4.64
4	The reservation process can be used well	4.52
5	Reservation process addresses needs	4.56
6	QR code check-in process easy to do	4.42
7	The bus trip tracking and estimation feature works well and can Reliable	3.99
8	The waiting list system is running well	4.12
9	Rating and review feature running well	3.94
10	The violation system is running well	4.04
11	Notification feature works well	4.14
12	Information provided in application is easy to understand	4.42
13	Layout of information and buttons in application makes it easy to use the application	4.4
14	Overall application value	4.26

Rating scale description:

- Score 1: Strongly Disagree
- Score 2: Disagree
- Score 3: Neutral
- Score 4: Agree
- Score 5: Strongly Agree

According to the results of the questionnaire obtained from passengers of the "Petra Shuttle Bus" application, it can be seen that this application gets a score with most aspects of the feature having an average of above 4 with an overall application score of 4.26. It can also be seen that the question "The login process is easy" gets the highest score (with an average of 4.83) and the question "The rating and review feature works well" gets the lowest score (with an average of 3.94), and the overall application gets an average of 4.26. "The rating and review feature works well" gets the lowest score because there are some users who say that the rating feature does not work on their device (Which is filled in the column of the question "The most frequent difficulty experienced when using the application", possibly because users can submit ratings many times, so users have the idea that this feature does not work well). So it needs to be improved further in the future (both in UX and features).

Users also provided various *feedback* in the "Feedback and suggestions for this application" question column, such as the need to separate the *list* page for schedule reservations from the *list* for active *booking pages* only, the feature to provide info through the application, and clarify information for each feature (where researchers also update the application regularly to reduce *pain points* from users).

Then for *user testing* regarding the UK Petra Shuttle Bus application that has been carried out to the driver in the form of interviews. The interview was conducted to two drivers on duty, namely Mr. Sugeng and Mr. Sigit. For the results of *user testing*, related to the feature that displays the QR Code that will be scanned by students, initially the two drivers experienced difficulties because they were only briefed by BAKA and immediately practiced in the field following instructions. However, according to Mr. Sugeng, it is still easy to use because it is possible to learn by yourself. Meanwhile, according to Mr. Sigit, when this application was first released, this QR Code was a bit difficult to use because it used to experience errors, but after various improvements and updates until now, finally this QR Code feature is more reliable for drivers because in addition to not experiencing errors anymore, it also now appears on the screen, making it easier for drivers again because there is visual and sound assistance every time a student scans the QR Code.

Regarding the feature to view the passenger list on the driver's side, Mr. Sugeng is very confident that this system is easy to use, for navigation and how to see it is also easy to understand. The same thing was also said by Mr. Sigit, even Mr. Sigit gave advice that in the future, the feature to see the passenger list should not be eliminated, because this feature really helps the driver if something happens with the QR Code system.

Regarding the process to notify the system that the bus will depart and arrive, Mr. Sugeng felt that the system was easy to use, although recently there was an error so he asked BAKA. Meanwhile, according to Mr. Sigit, this feature is good, but it would be nice if this slider button feature



can be replaced with something more compact, such as a button that can simply be pressed to notify the system that the bus is leaving or the bus is arriving at the destination.

Pak Sugeng rated this application as very good, because the appearance is organized, although perhaps if at any time there are new features such as waiting lists, it needs to be further socialized so that drivers know about this. Mr. Sigit gave a score of 8 out of 10 for the overall application.

## 5. CONCLUSIONS AND SUGGESTIONS

The following are conclusions and suggestions obtained from the results of testing the "Petra Shuttle Bus" application.

### 5.1 Conclusion

From the results of system testing that has been carried out, the following conclusions can be drawn.

- This application answers the problem formulation with a location tracking feature that runs well and is integrated in the "Petra Shuttle Bus" mobile application. In addition, scenario testing shows that this application can run in accordance with the following  
The expected use-case corresponds to the use-case that each user will usually go through, including all the main features such as registration, reservation, identification, and location tracking along with trip estimation.
- From the results of user testing regarding the UK Petra Shuttle Bus application that has been carried out to passengers, it can be seen and concluded that the main features in the application can be said to be good (with an average score above 4), with an overall application value of 4.26 based on the assessment of 76 respondents,  
so this application answers the needs. However, some users experience problems when using this application, so this application needs to be further improved and carried out regular updates to improve services and further meet the needs of users of the "Petra Shuttle Bus" application.
- From the results of user testing regarding the UK Petra Shuttle Bus application that has been conducted to the driver, the driver also said that this application helps them a lot in shuttle bus operations, especially in the check-in section, where the feature utilizes a QR Code, making it easier for the driver to sign in passengers.

### 5.2 Advice

From the results of the analysis and conclusions regarding the "Petra Shuttle Bus" application, suggestions that can be given to improve and develop this application further include the following.

- Further improve the UX and layout of information and copywriting in the application based on feedback obtained by user testing to make it easier for first-time users.
- It is recommended that the active *booking* section of students be equipped with the full name and photo of the driver like similar booking applications, so that if something goes wrong in the operation, it is easier for users to convey details about their travel experience. In addition, it can also  
The location of the bus is added before it arrives, so that passengers do not have to wait too long for their bus.

- An information panel can be added in the application so that BAKA can convey information directly in the application (so that application users do not need to check IG BAKA regarding *shuttle bus* information).

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