

Implementation of Android-Based Parking Management Applications

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Abstract— Parking problems are one of the problems faced in every city, especially in big cities. The availability of limited parking spaces and the unavailability of a parking system that can support the ease of parking management are essential things that must be found as the best solution. The parking application developed can provide information easily. In addition, parking users also get convenience in placing orders, extending time, or canceling. The parking system can provide comfort for parking management to manage parking areas with an efficient system, not only in terms of information but also in terms of payment, by utilizing digital payment methods. The parking application developed based on Android is an alternative that provides user-friendly solutions and parking management. The application has worked well based on trials with various scenarios, both normal scenarios (without cancellation or without extension) and testing with abnormal conditions. From the usability test of 40 respondents with ten questions from the SUS method, an average score of 76 was obtained.

Keywords— Parking Management, Real-Time; Parking Order, Rapid Application Development, System Usability Scale.

I. INTRODUCTION

In Indonesia, the number of private vehicles is still high due to adequate public transportation services' unavailability. Data from the Surabaya Central Statistics Agency recorded that in 2015 the number of motorized vehicles was 2,126,168 units, an increase of 114,656 units or around 5.7% from 2014. Two-wheeled vehicles contributed to the largest 1,655,891 units, or 77.8%, followed by private vehicles. Four-wheeled vehicles as many as 348,115 units or about 16.3%, goods car vehicles as many as 119,049 units with a percentage of 5.6%, and Bus vehicles as many as 2,936 units or around 0.13% .

The above situation has an impact on the availability and management of parking. Parking users have difficulty in getting information on the availability of parking spaces, reservations, payments, cancellations, and parking extensions. Therefore we need a system that can make it easier for vehicle users to find available parking spaces in real-time, so users can directly place orders and make payments simultaneously. The parking system developed is intended for paid parking lots, such as parking areas in Malls .

The developed Android-based parking system can provide information on parking availability in slots and rates for and duration that the user can adjust. Users place an order by selecting an available parking location. Then it is completed by payment via the GoPay e-wallet from the Gojek application. A successful payment will provide a booking code used to enter and exit the parking location using a QR-Code [.

II. RESEARCH METHODOLOGY

The development stage of the Parking System application "Parking" uses the RAD (Rapid Application Development) development model, an object-oriented approach to system development that includes one development method and

software tools. Changes rapidly, three phases in RAD involve analysts and users in the assessment, design, and implementation stages. The three phases in RAD are requirement planning, design workshop, and Implementation.

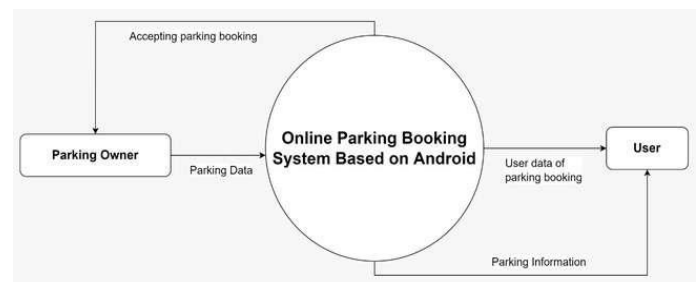


Figure 1. Context diagram

This application has the basic concept of connecting parking locations with prospective parking users. The manager registers the parking location to the applicator, and the system provides parking information and booking services. Figure 1 describes the process of interaction between entities.

A. Parking Order and Payment

The parking reservation process starts with the user searching for a parking location based on the current location. After selecting a parking location, the user inputs the order, then makes a payment and gets a booking code to enter the parking location. This process is described in Figure 2, where there are four, namely users, systems, managers, and payment APIs.

B. Parking Entry Process

After the user completes a parking reservation by making a payment, the user will be given the order code information and order details. To do a parking check-in, the user scans the

QR Code for ordering on the scanner. The system carries out verification, and when verified, the user will be invited to enter the parking location. Figure 3 shows the process of entering the parking lot.

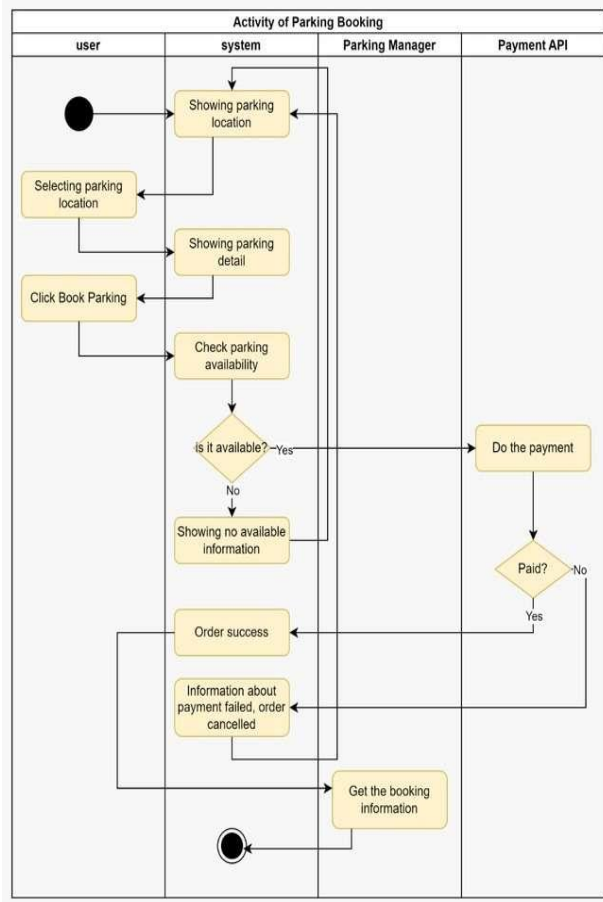


Figure 2. Order Activity Diagram.

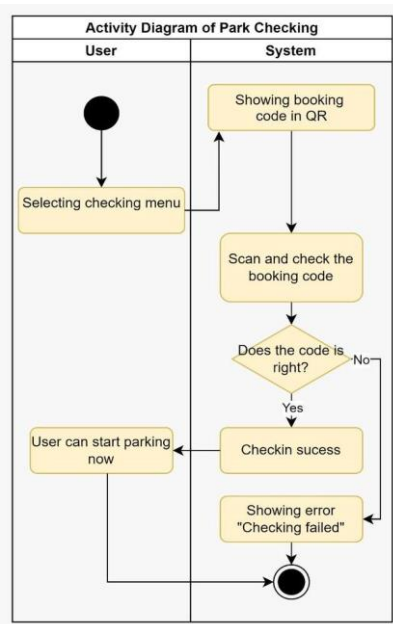


Figure 3. Parking Entry Chart

C. Parking Exit Process Design

Users will get a notification that the parking will end in 30 minutes and 15 minutes with the option to extend the parking duration or exit the parking immediately. If the user renews, the duration will be increased, and a fee will be charged according to the added duration. Suppose the user does not check out until the parking deadline. In that case, it will be automatically extended by the system, and fees according to the duration will be subject to additional fines.

The parking exit process is described in Figure 4, starting with the user showing the order code on the scanner, then the system will check whether you still have unpaid bills. Besides that, the officer will also check the vehicle. After all the checks are complete, the user can leave the parking location.

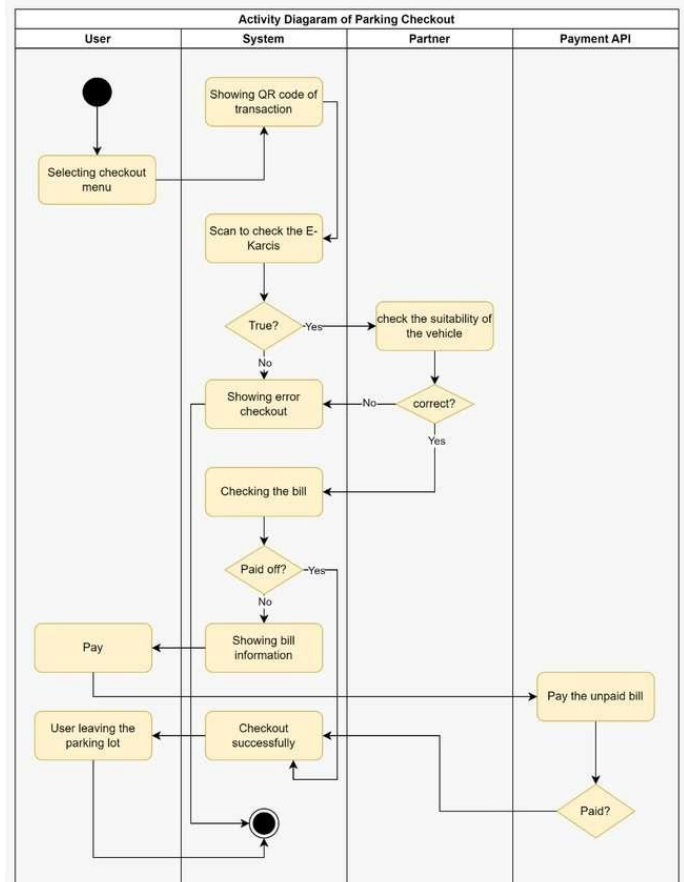


Figure 4. Parking Exit Chart

D. Database Design

Database system for the description of data requirements through database design and relationships between tables using a MySQL database. The tables created include the user table, parking table, parking slot table, parking reservation table, parking order details table, settlement table, tariff table, and payment table. Figure 5 shows Conceptual and relationships between tables.

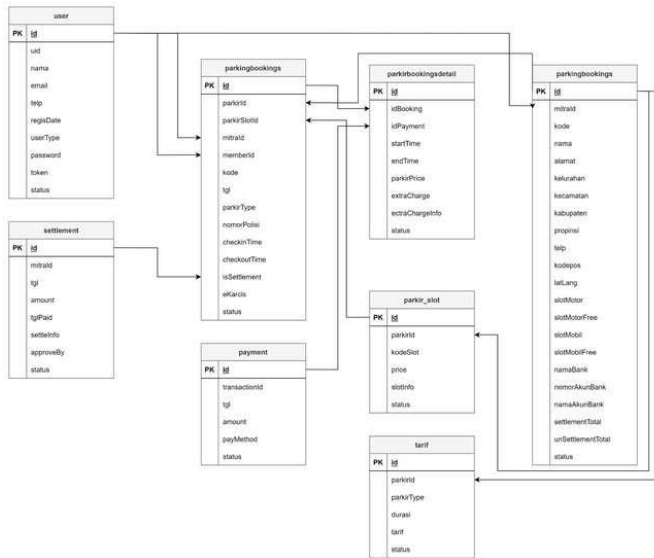


Figure 5. Database Design

III. RESULT AND DISCUSSION

The application design test will create several scenarios to test how the user uses the application under normal or abnormal conditions

A. Order Testing Normally

This test aims to determine whether this application can make parking reservations. The test results are proven by the display of successfully ordering in the user application and parking slot data on the backend of the parking manager. Figure 6(a) shows the condition before ordering the slot is still empty. Figure 6(b) shows the results of a successful booking display. The user gets a booking code, and detailed parking information ordered. Figure 6(c) shows a previously empty slot that has now been used.

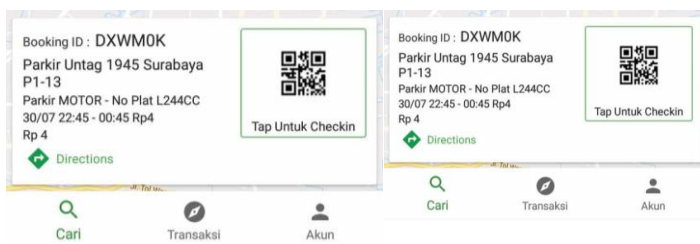
Data Parkir

Home > Dashboard

+ Tambah Slot Parkir

No	Kode Slot	Jenis Parkir	Keterangan	Status
1	P1-13	Motor	Slot Motor	Kosong
2	P1-14	Motor	Slot Motor	Kosong

(a) Empty Slot Condition



(b) Order Successful

(c) Used Slot Condition

Figure 6. Scenario for Order Testing Normally

B. Parking Payment Test

Parking payment is made after the user has checked out the parking order. It will be given 5 minutes. If it exceeds the 5-minute limit, the order will be canceled. Figure 7(a) shows the initial conditions before payment, Figure 7(b) shows the results of the successful payment process.

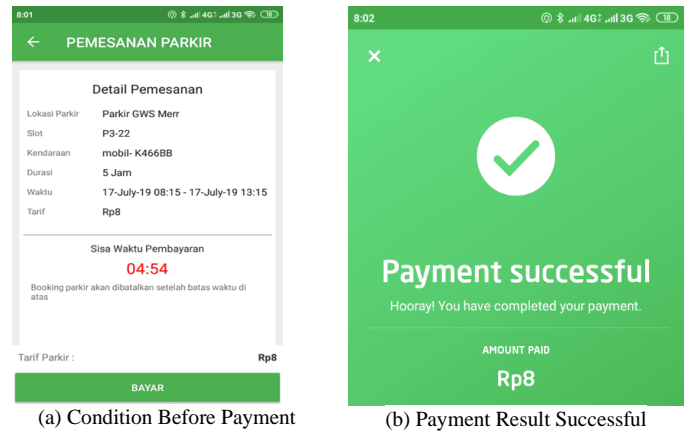


Figure 7. Parking Payment Procedure

C. Testing Entrance to parking under normal conditions

Parking payment

The normal condition is that the user enters the parking lot according to the booked hour. Figure 8 shows the car's condition before check-in parking reservation status to wait for check-in. Figure 9 shows the successful check-in process displayed on the user's application. Figure 10 shows the parking status changed to the current parking.

Transaksi Terbaru

BookingID	Jenis Parkir	Waktu Parkir	Checkin	Checkout	Status
RDPVWT	MOTOR P1-16 - S2333	30/07/2019 23:15 - 31/07/2019 02:15			Dipesan. Menunggu Checkin
E3RX6I	MOBIL P1-21 - K3777	30/07/2019 23:00 - 31/07/2019 01:00			Dipesan. Menunggu Checkin
DXWM0K	MOTOR P1-13 - L244CC	30/07/2019 22:45 - 31/07/2019 00:45			Dipesan. Menunggu Checkin

Figure 8. Condition Before Check-in



Figure 9. Successful Checking Condition

Transaksi Terbaru					
BookingID	Jenis Parkir	Waktu Parkir	Checkin	Checkout	Status
RDPVWT	MOTOR P1-16 - S2333	30/07/2019 23:15 - 31/07/2019 02:15	30/07/2019 23:57		Checked In. Sedang parkir
E3RX6I	MOBIL P1-21 - K3777	30/07/2019 23:00 - 31/07/2019 01:00			Dipesan. Menunggu Checkin

Figure 10. Condition Before Check-in

D. Testing Exit parking under normal conditions

The normal parking exit test is a condition when the user parks out before the parking time expires. The initial condition described above in Figure 10 is that the parking status is currently being parked/used. In Figure 11 the reserved parking status has now been checkout.

Transaksi Terbaru					
BookingID	Jenis Parkir	Waktu Parkir	Checkin	Checkout	Status
RDPVWT	MOTOR P1-16 - S2333	30/07/2019 23:15 - 31/07/2019 02:15	30/07/2019 23:57	31/07/2019 00:02	Checked Out. Parkir Selesai

Figure 11. Condition After Checkout Parking

E. Parking entry test before reserved time (Not Normal)

Testing this condition is to understand the situation where the user enters the parking lot before the reserved parking time. This condition will give rise to three possibilities. First, users park with the same slot, and the time changes according to the time of entry. Both users park with different slots and times according to parking entry times. Third, the user could not enter because there were no available slots and times. Figure 12 shows the initial conditions. The user orders parking at 4.30, then at 4.6, the user has arrived and will check-in parking. So in Figure 13, the results show the user has successfully checked in with the time adjusting.

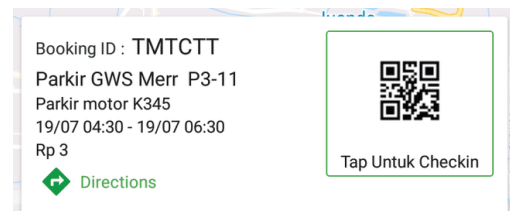


Figure 12. Initial condition

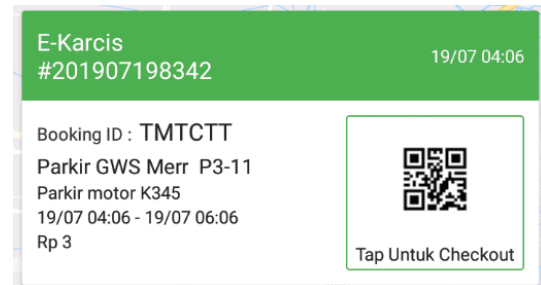


Figure 13. After check-in

In Figure 14, the user orders parking at 4.25 with slot P3-11 when the user enters. The test results in Figure 15 show the user successfully enters the parking lot with the slot being P3-12, and the time adjusts the parking entry time.

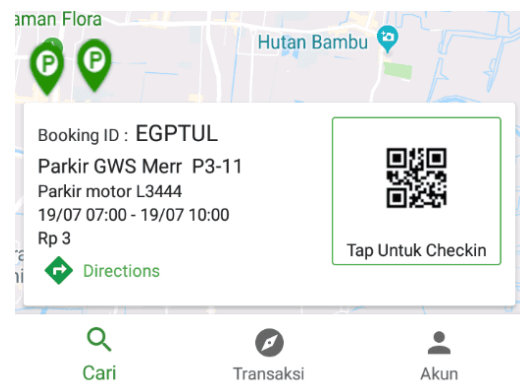


Figure 14. Initial Condition

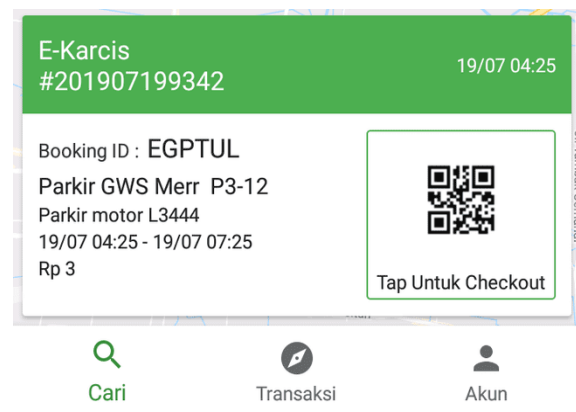


Figure 15. After Checking with New Slot

F. The user test does not leave the parking lot until the time limit has passed.

In this test, the system will notify users 30 minutes before parking ends and 15 minutes before the end time. Users can extend parking or checkout immediately. In this test, if the user does not immediately check out the parking lot, the system will automatically renew, and the user will be subject to an additional fine. Figure 16 shows a 30-minute notification, and Figure 17 shows a 15-minute notification. In Figure 18, the user has been charged with a fine, and the parking duration is automatically extended by one hour.

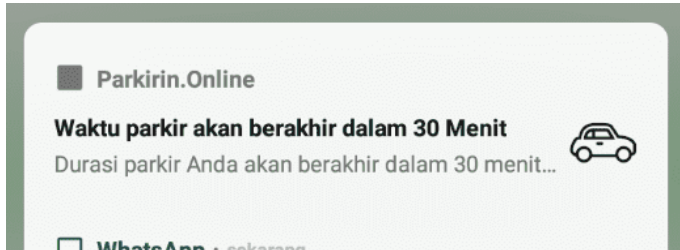


Figure 16. Notification 30 Minutes Before Ending

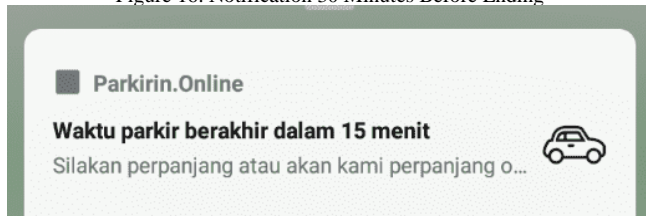


Figure 17. Notification 15 Minutes Before Ending

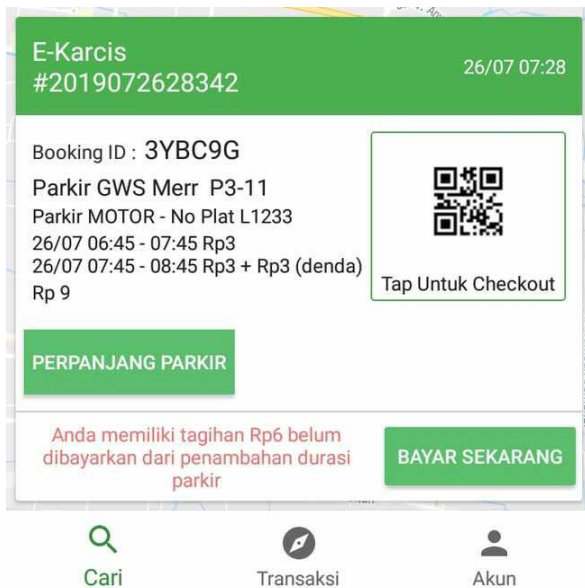


Figure 18. Parking is restricted for an additional hour and is subject to a fine

G. Parking time extension test

The parking extension is carried out by the user himself to avoid being subject to late checkout penalties. Users can extend with the condition that the slot is still available and the time is available. Otherwise, the user must immediately exit

the parking lot. Figure 19 shows the process of increasing the parking duration, and Figure 20 shows that the duration was successfully increased without being penalized.

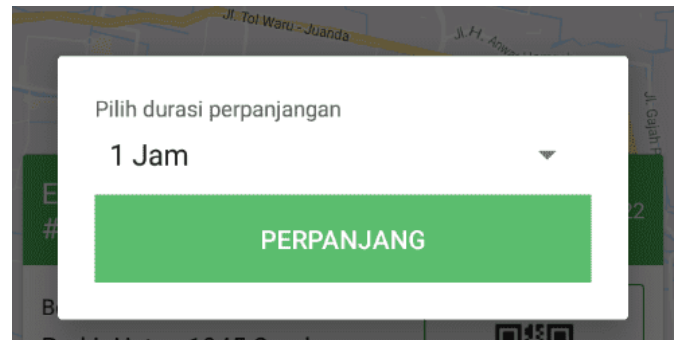


Figure 19. The Process of Adding Duration

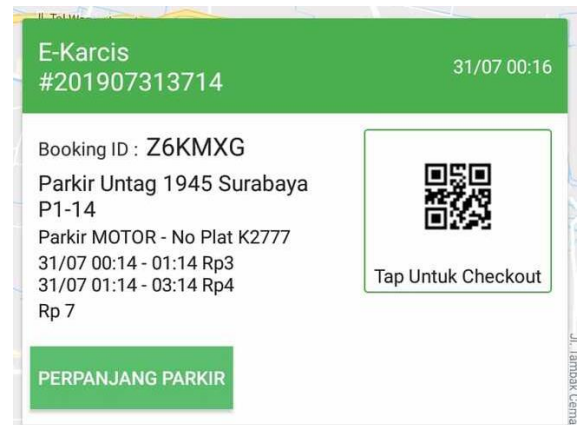


Figure 20. Result Of Duration Extension

H. Testing of additional parking payments

In this test, parking users will make payments for additional parking, either in parking fees or parking fines. Payments are made like normal payments via GoPay. Figure 21 shows the user has an unpaid bill. In Figure 22, the billing notification has disappeared because it has finished making payments.



Figure 21. Payment Bill

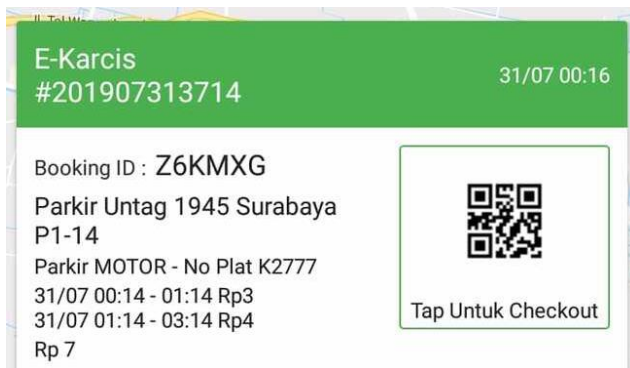


Figure 22. Bill Has Been Paid

I. Parking Exit Testing while Still Having Unfinished Payments

This test prevents users from getting out of the parking lot before completing the bill payment. Checks are carried out when the user is about to leave. The check results are shown in Figure 23 that cannot exit the parking lot and are asked to make payment.

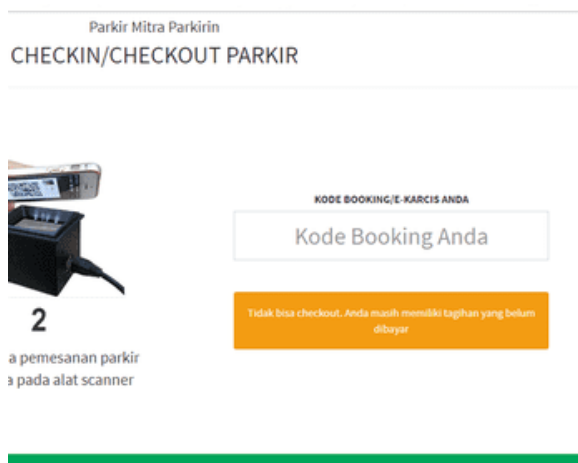


Figure 23. Preventing Someone From Leaving The Parking Lot Before It Has Been Paid Off.

J. Discussion

It is possible to discuss these tests based on the results of the tests with different scenarios described above, both normally and abnormally. When it comes to system design and its application, the conversation addresses whether it is acceptable and whether anything needs to be addressed due to the application's recommendation. The discussion is described in Table I.

TABLE I
SCENARIO TEST

Test	Results
Parking reservation test. The test was carried out by	In

Test	Results
simulating the Parking land with several trials. After testing the initial conditions of parking that were previously still available, the reserved parking slots have been used.	accordance
Parking payment test. Tests have been carried out by users who have reserved parking. The user successfully made a payment with GoPay	In accordance
They were testing the parking check-in process under normal circumstances. Several trials were carried out with different accounts. The results showed that the three parking users parked successfully.	In accordance
Parking checkout test under normal conditions. Testing is done several times with different accounts to checkout. From the test results, the three users successfully checkout, and the condition of the previously used parking slot is now empty.	In accordance
Abnormal testing, parking check-in earlier than reserved parking time. There are three possibilities of testing this early check-in; among them :	
• Users can check-in early with the reserved slot, and the parking time adjusts to the check-in time. This condition requires that the reserved space can be used at that time	In accordance
• Users can check-in early with other available slots by adjusting the parking time according to the check-in time. This condition is if the reserved slot cannot be occupied at that time and there are other similar slots available	In accordance
• The user cannot check because the slot booked at that time is not available, and there are no other similar slots available	Not in Accordance
Testing for users not to checkout beyond the parking time limit. In this case, the user will be given a notification within 30 minutes and 15 minutes before the end. If the user does not extend the parking time, the system will automatically renew. There are two possibilities of this case, including:	
• It can be automatically renewed if a parking slot is available at that time	In accordance
• It cannot be extended because the slot at that time is not available	Not in Accordance
Parking extension testing by users. The user will do an extension after checking in parking for some reason, the addition of the duration is done hourly and check the availability of time	In accordance
User testing makes parking payments from parking renewal bills. Users who have bills make payments with GoPay after adding parking duration.	In accordance
Checkout testing is performed when there are still unfinished payments. This test is to prevent parking users have not paid the payment bill.	In accordance

In the usability test using the SUS method to 40 users, the average score was 76. Twenty-five people strongly agree about the easy use of the application. Eleven people are still thinking about the ease of application. A total of 27 options Strongly Agree on the ease of application navigation, and 3 of them Disagree. A total of 29 people Agree that the application runs well. A total of 25 people Strongly agree, and five people are neutral about the application's appearance.

IV. CONCLUSION

Based on the results of research and testing of this application. Applications can search, order, and pay online. Android ordering applications can facilitate the needs of vehicle users to find parking locations. Provides convenience in conducting parking transactions because it uses digital money payments, which will be the main choice in the future. Make it easy for parking location owners to manage and get parking tenants. As for the hope of developing this application in the future, it is a handler when users check-in parking early and/or an extension of parking with no parking conditions available. In addition, the application can be implemented on iOS devices.

V. REFERENCES