JURNAL ECOTIPE
Electronic, Control, Telecommunication, Information, and Power Engineering

Volume 10, Issue 2, Oktober 2023, pp. 225-236
ISSN 2355-5068 ; e-ISSN 2622-4852
DOI: 10.33019/jurnalecotipe.v10i2.4477

Quality of Service Analysis on EaTrain Application at A Restaurant on A Train

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ARTICLE INFO

Article historys:

Received : 27/08/2023
Revised : 01/10/2023
Accepted : 04/10/2023

Keywords:

Android Application; E-Wallet Payments; Restaurant; Train; QoS

ABSTRACT

One of the services on the train is a dining car that sells food and drinks. However, the current system has problems such as the unclear position and operating hours of the dining car, the lack of menu information, and the difficulty of officers in giving change. The purpose of this research is to make it easier for passengers to order food and drinks, increase the officer's efficiency in managing menu, and determine the network quality while using the EaTrain application on the train. The EaTrain application was built using android studio with cloud firestore as a database for storing data, and integrated with midtrans payment gateway in making payments. Wireshark software is used to measure the network quality of EaTrain application in train restaurant. The test results show that the EaTrain application can run well on Android 7.0 devices and above. The value of delay, throughput, and packet loss in Quality of Service (QoS) testing while making payments is determined by network quality of each provider. Provider A has average delay of 123ms, packet loss is 10.72%, and throughput is 3974 bps. While provider B has average delay at 1343ms, packet loss is 50.88%, and throughput is 33628 bps.

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1. INTRODUCTION

Transportation is one of the most important things in supporting the daily lives of Indonesian people. With transportation, a person can carry out activities more quickly and efficiently. One of the most popular means of public transportation is the train [1]. Trains are the most popular mode of transportation for the people of Indonesia because they provide an alternative mode of transportation when traveling long distances to avoid city congestion [2], and it also includes modes of public transportation, the cost of which is currently quite affordable by all levels of society with varying income [3]. Every year, the number of train passengers grows [4]. According to the central statistics bureau, there will be a 272,419 rise in railroad passengers on the island of Java in 2022 [5].

Convenience is an important factor that influences the passenger experience in transportation. Service is one of the factors that influence passenger experience in transportation. Passengers will be inconvenienced if their transportation does not give great service. The form of service provided by the train itself is like the existence of a dining car that is useful as a restaurant to serve eating and drinking passengers while traveling [6]. The service system at the train restaurant currently still uses a conventional ordering process, which is in the form of direct sales to passengers. There are issues that train passengers frequently encounter throughout the traditional ordering and payment process.. To prove the problems that occur in the train ordering process, preliminary research was conducted by distributing questionnaires using the pieces method [7] through google form to find out the various problems contained in the train restaurant facility. From the questionnaires that have been distributed to

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train users as many as 51 samples taken randomly, the results show that 35.3% of people often experience difficulties when buying food or drinks at train restaurants, and 21.6% of people often experience difficulties when buying food or drinks at train restaurants. The difficulties experienced by passengers in ordering food and drinks at train restaurants include the lack of information about the location of restoration wagons, erratic operating hours of dining trains, and not knowing the available food and beverage data information in real time.

There are several previous studies that have similarities and can be used as references in conducting this research. In research [8, 9] an android application has been designed, but has not been applied in ordering food or drinks by delivery. In research [10, 11] an android-based application for online food ordering has been designed, but it has not been implemented on trains and payments are still made conventionally. In research [12, 13, 14] has used midtrans payment gateway as a payment system. In research [15] designing an application using firebase firestore as an application database that can update data in realtime and can be used offline. Then in research [16, 17] designed a food and beverage ordering application using a mobile application (android) applied to trains.

Based on previous research, there have been those who have implemented food and beverage ordering applications in restaurants. However, from some of these previous studies there are still shortcomings and problems, namely the absence of application development in mobile restaurants such as restaurants on train transportation equipped with digital payment methods. Based on these shortcomings and problems, this research was conducted to develop a service system at a train restaurant in the process of ordering food and drinks, namely "Service Quality Analysis on the EaTrain Application at Railway Restaurants". The EaTrain application made in the process of ordering food and drinks has been equipped with an order status notification feature and order countdown so that passengers can monitor orders ordered. In order to accept payments, the EaTrain application has been connected with the Midtrans payment gateway, as well as the use of firebase cloud firestore as a database to store admin and user data. Furthermore, this research will examine network quality of service (QoS) testing of latency, packet loss, and throughput values to establish the network's quality when utilizing the EaTrain application on the train. Thus, users can find out whether the network used when using the EaTrain application in the train has good quality or not.

2. RESEARCH METHOD

The type of research to be carried out is a type of research using quantitative research methods to find out the problems contained in the train restaurant. Data collection is done through questionnaires given to respondents to fill in the answers to the questions asked. In addition, this research is a type of Science and Technology (IPTEK) development research which is a development of pre-existing research on android-based food and beverage ordering applications. This research will discuss the research design in the form of system and application design, system design, system implementation to build the software system to be created. In this research, the EaTrain application was created using Android Studio with Kotlin programming language integrated with Midtrans as a payment gateway in making payments, and Firebase as a system database. The stages in the application design and development process are described in the sub-chapters below.

2.1. Research Stages

In conducting this research, there are stages of research as shown in Figure 1. The stages of this research are in the form of detailed stages in making software so that the results obtained are in accordance with the design.

The first stage in conducting this research is to conduct a literature study on dining trains on trains and making applications, the need for tools and materials used in making system planning, including the number of software uses, how to use software, and software characteristics. The second stage is system software and database planning, in this planning includes application design, application output system, estimated location of the required application, and planning the database to be used. The third stage is the creation of applications and firebase as a database, at this stage designing the system structure and applications to be built. In addition, at this stage, database design is also carried out on firebase which

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will later be implemented in the application made. The fourth stage is to test the application that has been made. If during the trial the application is not as expected, then return to the system design stage in the application. The fifth stage is testing the application based on Quality of Service (QoS) parameters. The sixth stage is to analyze the results of the application that has been made, and whether the application has tested its success against the Quality of Service (QoS) that has been carried out. The last stage is to make conclusions and suggestions.

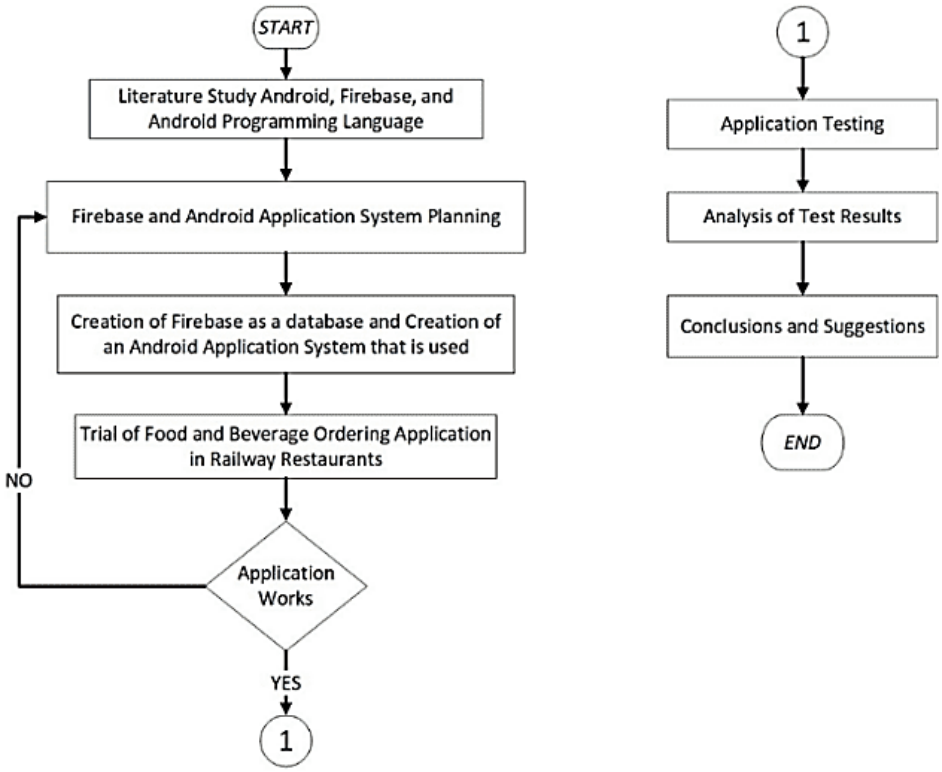

Figure 1. Flowchart of research stages

2.2. Block Diagram

The system block diagram used in the research is shown in Figure 2 below. There are 2 access rights in the application made, namely user (passenger) access rights and admin (manager) access rights. User access rights are for train passengers who want to order food and drinks from train restaurants. Admin access rights are for train restaurant managers who are tasked with managing menu data, orders, and payments. The user application will connect to the firebase database that stores menu, order, and payment data, via the internet. Users can access the menu page to see a list of food and drinks provided by the train restaurant along with name, price, and menu description information. The user can select the desired order and put it in the cart. Furthermore, to make payments, users can use one type of E-Wallet available on the application. The admin application will be connected to the firebase database via the internet. Admin can send information related to data updates and product stock through the product data update and product stock update buttons. This information will be displayed on the user menu page. Admins can also view incoming orders through the order list history page. If the order has been shipped, it will be removed from the list. After the train restaurant admin receives the order, the user can monitor the order status on the order history page. The order status can change from "Preparation" to "Shipping" and then to "Completed" according to the order shipping process. The admin can send the order status to the user's smartphone by pressing the "Preparation", "Shipping", or "Completed" button.

Admin provides Midtrans payment service for online payment process and provides e-wallet options that will be used by users in the application. Admins can also view transaction details on the Midtrans dashboard. While in the user application, digital payments can be made through the Midtrans payment gateway provided by the admin through the available e-wallets.

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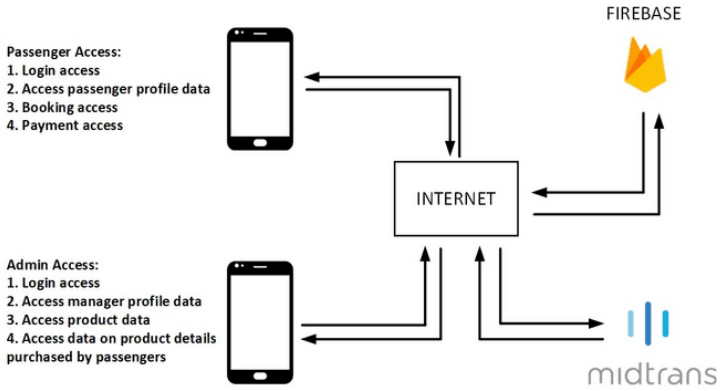

Figure 2. System Block Diagram

2.3. Data Flow Diagram

Figure 3 shows a level 1 data flow diagram that describes the flow of application users, namely passengers and managers to the system related to access rights to access content in the system.

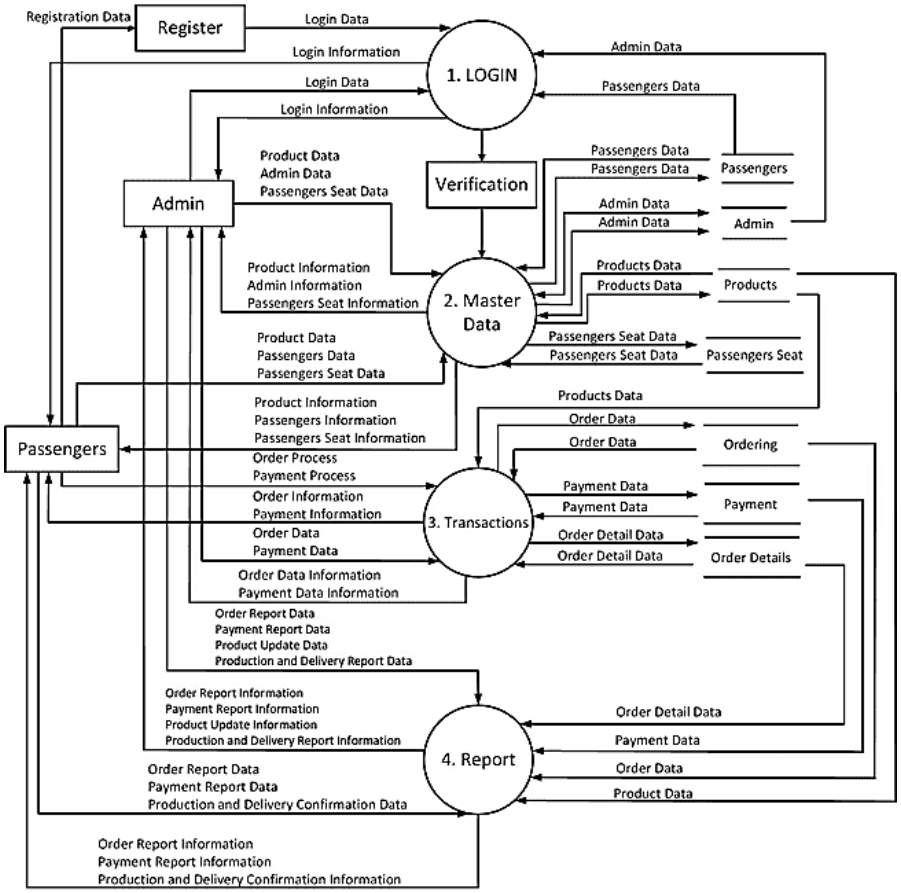

Figure 3. Data Flow Diagram Level 1

2.4. Database Design

Figure 4 is a picture of database planning by compiling rational database tables in the form of relations. Each table has a primary key column. A primary key in a database table is a column or combination of columns that uniquely identifies each row or entity in the table. The relation schema can be seen in the Figure 4

The database used from this application is Firebase Firestore, where all data sent from both users and admins will be managed in the firestore in firebase. Firebase serves as a repository for information sharing between users and administrators. On the manager or admin side, firebase plays a role in

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receiving input from applications such as menu updates, product stock, and prices. As for the user, firebase plays a role in storing account information in the application (when registering) and purchasing data for the food or beverage menu.

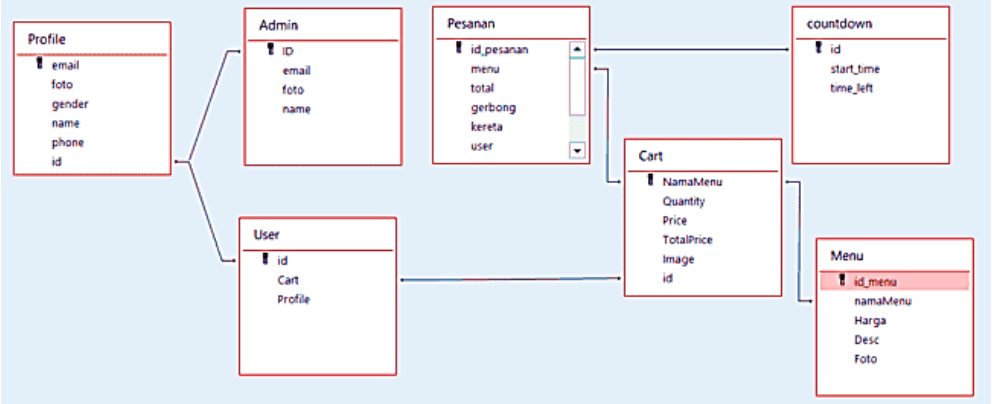

Figure 4. System Database Design

2.5. Flowchart

1. Flowchart of User Application System

Figure 5 shows the application system flow diagram for users. There are three main pages in the user application, namely the splash screen page, the passenger main page, and the purchase history page.

- The splash screen page displays the title and logo of the application for a few seconds. Users must register and login with email and password to access the application.
- The passenger main page has three buttons, namely the user profile button, the home button (list menu), and the purchase history page button.
  a) The user profile button displays user profile data, such as name, profile photo, email, gender, and phone number. Users can also update their profile data with the profile update button.
  b) The home button (menu list) displays a list of food and beverage menus available at the train restaurant. The user can select the desired menu and put it in the cart. The user can also delete or change the number of menus in the cart. To order, the user has to fill in the order form with the train name, carriage number, and seat number. Users can then pay with e-wallets available in the app. If the payment is successful, the user will be directed to the purchase history page. If the payment fails, the user will return to the home page (list menu).
  c) The purchase history page button displays information about user purchases such as booking name, booking ID, train name, carriage number, seat number, and booking status.

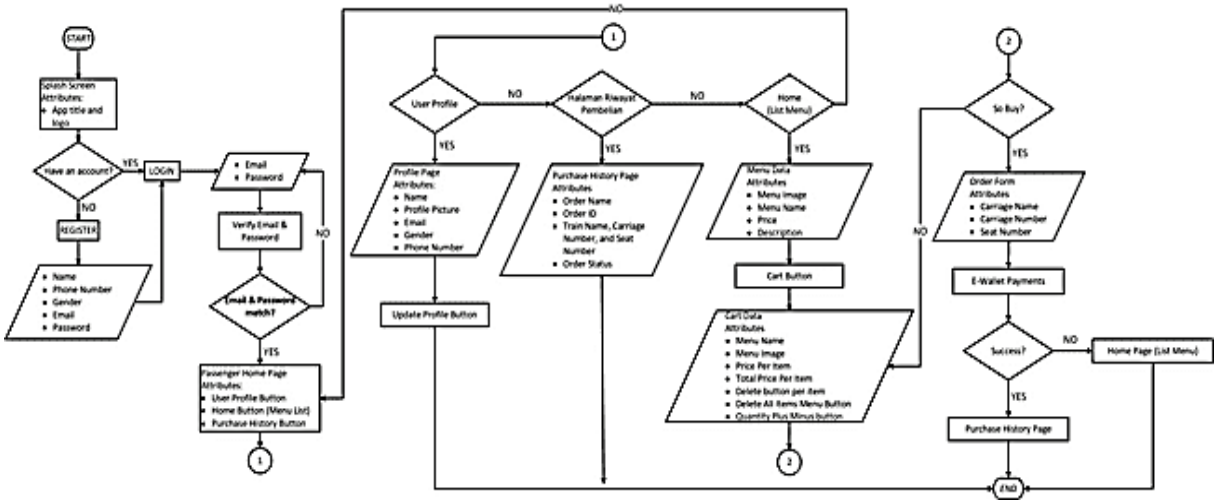

Figure 5. Flowchart of User Application System

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2. Flowchart of Admin Application System

Figure 6 shows the flow chart of the application system for the admin. There are three main pages in the admin application, namely the splash screen page, the manager's main page, and the order list page.

- The splash screen page displays the title and logo of the application for a few seconds. Admins must login with their email and password to access the application.
- The admin main page has three buttons, namely the manager profile button, home button (menu list), and order list button.
  a) The admin profile button displays admin profile data, such as name, email, gender, and phone number.
  b) The home button (menu list) displays a list of food and beverage menus available at the train restaurant. Admins can add, change, or delete menus with the upload, edit, or delete buttons. Admins can also view product details by pressing the holder of each menu.
  c) The order list button displays a list of purchases containing details of purchases made by users, such as the orderer's name, order ID, train name, carriage number, seat number, and order status. Admin can change the status of the order by pressing the prepare, send, or finish button.

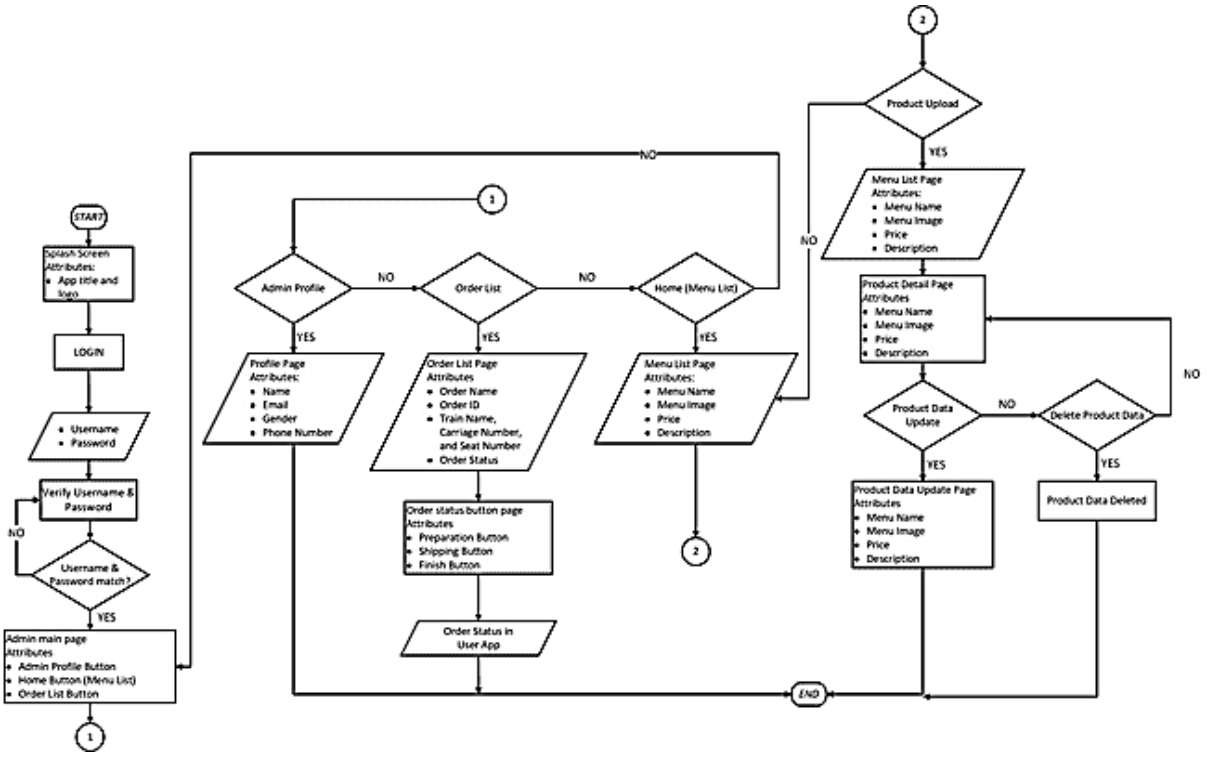

Figure 6. Flowchart of Admin Application System

2.6. Quality of Service (QoS)

QoS (Quality of Service) is a way for measuring the quality of a network and attempting to describe the characteristics and properties of a service. [18].

The QOS parameters are as follows:

1) Throughput: Throughput is the effective data transfer rate measured in bits per second. Furthermore, throughput can be defined as the total of successful packet arrivals within a certain time interval divided by the duration of the specific time interval [18]. This throughput defines the state of data speed in a network. The higher the throughput value, the better the routing protocol's performance [19].

$$Throughput = \frac{Total\ of\ packets\ sent}{Packet\ sending\ time} \quad (1)$$

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Througput standards according to TIPHON are as follows:

Table 1. Throughput Standart According to TIPHON [20]

Throughput Category	Throughput (bps)	Index
Excellent	> 100	4
Good	75	3
Medium	50	2
Bad	< 25	1

2) Packet Loss: Packet loss is calculated as the percentage of packets lost in comparison to packets transmitted between the source and destination nodes. When one or more data packets flowing across the network fail to reach their destination, this is referred to as packet loss [19].

$$Packet\ Loss = \frac{(data\ packets\ sent - received\ data\ packets)}{data\ packets\ sent}\ x\ 100\% \quad (2)$$

Packet Loss standards according to TIPHON are as follows:

Table 2. Packet Loss Standart According to TIPHON [20]

Packet Loss Category	Packet Loss (%)	Index
Excellent	0 %	4
Good	3 %	3
Medium	15 %	2
Bad	25 %	1

3) Delay: Delay is the time it takes for data to travel from origin to destination [21].

$$Delay = \frac{Timespan(s)}{Total\ of\ packets} \quad (3)$$

Delay standards according to TIPHON are as follows:

Table 3. Delay Standart According to TIPHON [22]

Delay Category	Delay (ms)	Index
Excellent	< 150 ms	4
Good	150 – 300 ms	3
Medium	300 – 450 ms	2
Bad	> 450 ms	1

3. RESULTS AND DISCUSSION

Electrical Engineering covers many sub-fields, one of which is Telecommunications. EaTrain application can contribute to this field by performing Quality of Service (QoS) analysis in its data communication. QoS is an important parameter in telecommunication networks that determines the level of service provided to users. By performing QoS analysis, the quality of the network can be known and ensure optimal user experience.

In addition, this application can also contribute to the field of Internet of Things (IoT). IoT refers to a network of interconnected devices, and this app can be considered part of that ecosystem. Analysing the QoS of this app can help understand the performance of IoT devices under different network conditions.

Thus, this EaTrain application not only contributes to the field of Telecommunications in Electrical Engineering, but also to the field of IoT. This analysis is very important to ensure that the technology created can function properly under various conditions to provide the best service to users.

3.1. Location of Test

The locations of the train travel routes used in conducting QoS testing are as follows:

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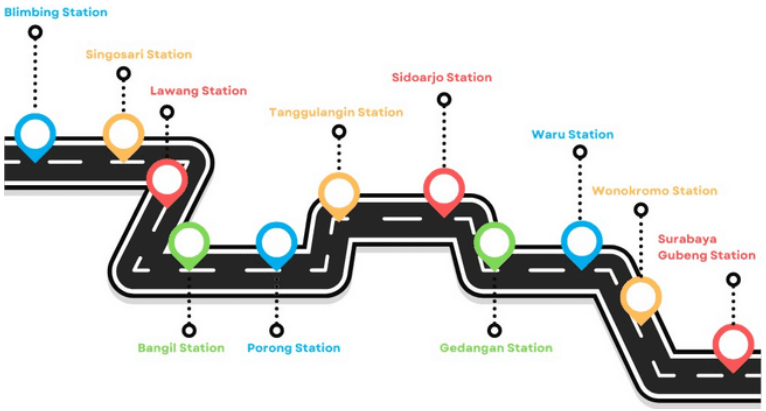

Figure 7. Location of Test

3.2. Results

This sub-chapter will cover the outcomes of the application development process that has been completed.

1. Application Interface Admin

Figure 8. Home

Figure 9. Upload Product

Figure 10. Update Product

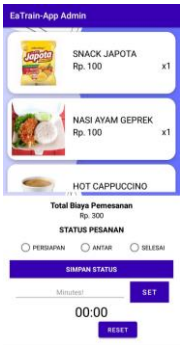

Figure 11. Order list details and order status

Figure 8 displays a list of menus that have been uploaded by the admin using the + button on the home page. Figure 9 displays details of each menu which allows the admin to delete or edit the menu. Figure 10 shows the menu edit page, with the "SAVE" button to save the menu changes made by the admin. Figure 11 displays passenger orders, order status, and time required to complete the order.

2. Application Interface User

Figure 12. Home (Menu List)

Figure 13. Cart List

Figure 14. Order Form

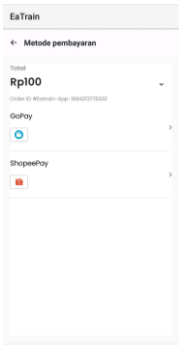

Figure 15. E-Wallet Payment (Midtrans)

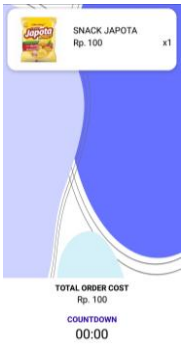

Figure 16. Order History Detail

Figure 12 displays a complete list of menus available in train restaurants. Figure 13 shows the menus that have been added to the cart. In this menu, users can change the number or delete the menu.

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Figure 14 displays an order form to make it easier for restaurant staff when delivering orders. Figure 15 is a passenger payment page using Midtrans as a payment gateway. Meanwhile, Figure 16 shows details of each menu ordered. This page also displays a timer to provide an estimate of the time required to prepare the order.

3.3. Testing and Discussion

1. Application Installation Testing

Application installation testing is carried out to ensure that the installation and functions in the application can run according to their duties on several different brands of smartphones and android versions. From the experiments that have been carried out, from 6 different brands of smartphones and android versions, the passenger app successfully installed and works well on at least Android version 7.0 (Nougat).

Table 4. Application Installation Testing

No	Name User	Merk Smartphone	Android Version	Functional
1.	Chanda Arief	Samsung Galaxy A3 (720 x 1280)	5.0.2	Failed
2.	Destanuari	Vivo Y83 (720 x 1520)	8.1.0	Succes
3.	Risma Wulan	Samsung J6 Pro (720 x 1480)	10.0	Succes
4.	Nur Hanafi	Poco X3 Pro (1080 x 2400)	11.0	Succes
5.	Nella Abda	Oppo Reno F4 (1080 x 2400)	12.0	Succes
6.	Aprilia Orrin	Vivo Y53S (1080 x 2408)	13.0	Succes

2. Quality of Service (QoS) Testing

a. Delay Testing

Figure 17 depicts a graph of the results of delay testing conducted on trains with the route Blimbing Station - Gubeng Station Surabaya in the time range 13.30 - 16.00 WIB involving two different providers. At 13.30 - 13.59, provider A has a 540 ms delay, whereas provider B has a 1343 ms delay. Then, between 14.00 and 14.29, there was a delay increase of 668 ms for provider A and 1387 ms for provider B. At 14.30 - 14.59, provider A's delay value decreased to 474 ms, however provider B's delay increased significantly to 1735 ms. At 15.00 - 15.29, provider A saw another delay rise to 578 ms, while provider B experienced a delay decrease to 1393 ms. Then, between 15.30 and 16.00, the delay value for provider A dropped significantly to 123 ms, whereas provider B's delay grew to 1639 ms. According to these statistics, provider A has the greatest performance during 15.30 - 16.00 with a delay of 123 ms, whereas provider B has the best performance at 13.30 - 13.59 with a delay of 1343 ms.

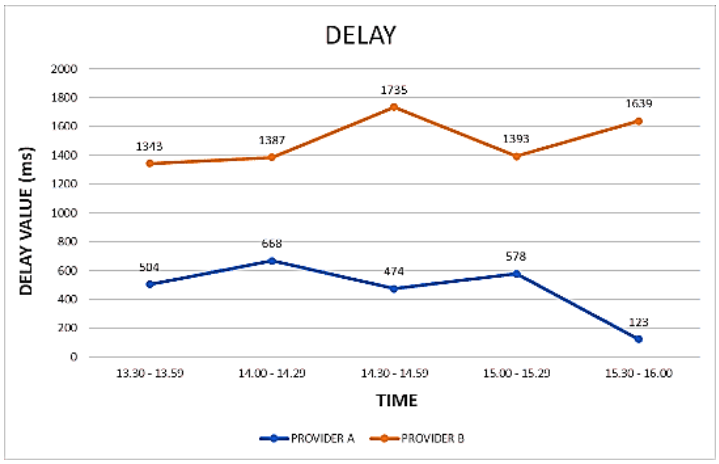

Figure 17. Delay Testing Results Chart of Provider A and B

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b. Packet Loss Testing

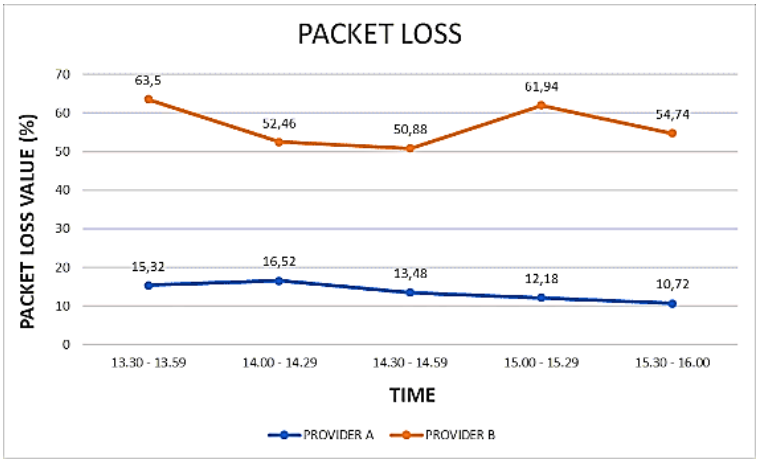

Figure 18. Packet Loss Testing Results Chart of Provider A and B

Figure 18 shows a graph of the results of packet loss testing conducted on trains with the route Blimbing Station - Gubeng Station Surabaya in the time range 13.30 - 16.00 WIB involving 2 different providers, provider A has a packet loss of 15.32% between 13.30 and 13.59, whereas provider B has a packet loss of 63.5%. Between 14.00 and 14.29, provider A's packet loss increased to 16.52%, whereas provider B's fell to 52.46%. Between 14.30 and 14.59, packet loss in provider A fell to 13.48% and 50.88% in provider B. Between 15.00 and 15.29, provider A had a drop in packet loss to 12.18%, while provider B saw an increase to 61.94%. Then, between 15.30 and 16.00, packet loss on providers A and B dropped to 10.72% and 54.74%, respectively. According to these statistics, provider A has the greatest performance at 15.30 - 16.00 with a packet loss of 10.72%, whereas provider B has the best performance at 14.30 - 14.59 with a packet loss of 50.88%.

c. Throughput Testing

Figure 19 shows the graph of the throughput test results conducted on the train with the route Blimbing Station - Gubeng Station Surabaya in the time span of 13.30 - 16.00 WIB involving 2 different providers, provider A has a throughput of 589 bps between 13.30 and 13.59, whereas provider B has a throughput of 33628 bps. Between 14.00 and 14.29, both providers' throughput dropped to 392 bps on provider A and 2096 bps on provider B. Another fall in throughput occurred between 14.30 and 14.59, with provider A dropping to 223 bps and provider B dropping to 1841 bps. Between 15.00 and 15.29, provider A suffered a 128-bps fall in throughput, whereas provider B witnessed a 9011-bps rise. Then, between 15.30 and 16.00, both provider A and provider B had an increase in throughput, with provider A having 3974 bps and provider B having 6639 bps. According to these statistics, provider A has the greatest performance at 15.30 - 16.00 with a throughput of 3974 bps, whereas provider B has the best performance at 13.30 - 14.59 with a throughput of 33628 bps.

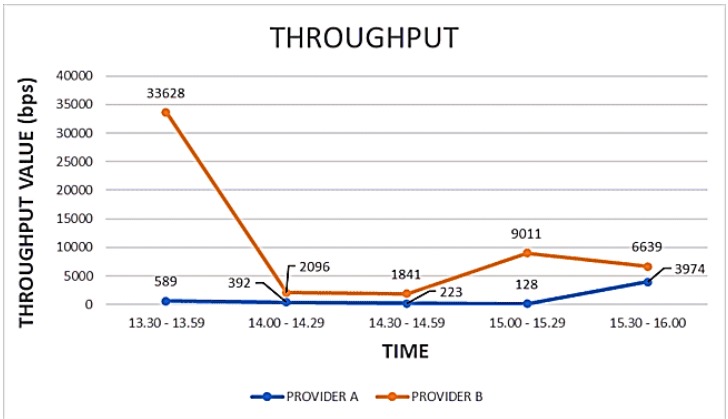

Figure 19. Throughput Testing Results Chart of Provider A and B

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4. CONCLUSION

Food and beverage ordering applications in train restaurants using e-wallet payments are built on an android basis. The results of the functionality test of each menu and application feature both from the admin and passenger (user) side can run well as planned and successfully installed on smartphones with the type and version of android at least 7.0 (Nougat). The QoS (Quality of Service) test results reveal that the network quality of each provider utilized in the application's payment process influences the level of delay, throughput, and packet loss. The QoS measurement results show that the best delay and packet loss are on provider A at 15.30 - 16.00 WIB with a delay value of 123 ms and packet loss of 10.72%. While the best throughput value is on provider B at 13.30 - 13.59 WIB with a throughput of 33628 bps. 4. Researchers hope that this research can be developed in the future by adding a signal booster that is placed on each train car so that the network in the train is more optimal. In addition, this research can be developed by adding a proof of booking feature such as E-Bill sent via WhatsApp or Telegram.

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