Service Quality Analysis on Tracking System and Management of Bus Passenger Study at PT Indo Trans Teknologi

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Abstract. Technological advancement affects a country's social, political, and transportation development. Operating system, facilities, and infrastructure all use modern bus technology. Therefore, valid data about bus passengers is needed to optimize facilities and passenger numbers. This research involves developing an EDR system to collect passenger behavior data. The test was conducted by sending questionnaires to 32 bus passengers who had followed the passenger tracking and management detection system trial procedure. The gap between expectations and reality was −0.24. Physical appearance (tangible), reliability, and assurance are used to measure customer satisfaction. Quadrant A needs better service guarantee standards. Quadrant B attributes are defensive strategies, so their implementation should be maintained because, according to passengers, it's good. In the future, they may become prioritized attributes. Then improve Quadrant C with new strategies. While there are no attributes in quadrant D, indicating no unanticipated or unimportant dimensions or factors, management can allocate existing resources to more urgent and prioritized factors.

Keywords: service quality analysis · importance performance analysis · tracking system · bus passenger management · event data recorder

1 Introduction

In this era of globalization, high business competition will be increasingly felt by service or goods business actors. According to [1], this high competition between business actors creates sharp competition between companies, both because of increasing competition,

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increasing product volume, as well as the rapid development of technology. According to [2], competition occurs because a product that is successfully produced in the market will not be separated from the observations of its competitors who will create the same product so that these business actors must always make improvements to the product or service in order to remain competitive.

One of the efforts made to be able to compete is to improve the quality of service because service is one of the important factors in companies engaged in services [3]. If consumers feel satisfied with the service, they will buy again and will provide recommendations to others to use the same service, therefore a company engaged in services must start thinking about the importance of service quality more maturely [4]. According to [5], the notion of service itself is a series of activities from a process to meet one's needs so that they can be satisfied in the form of products or services that are intangible, quickly lost, more felt and owned by users, actively participate in the process of using services.

In Indonesia, one of the most competitive companies is mass transportation service companies. Mass transportation in Indonesia has covered all land, sea, and air with a variety of facilities and services that compete with each other [6]. With this much competition, these transportation entrepreneurs must be able to compete with their competitors, especially in providing good and oriented services to satisfy their customers. According to [7], service quality is the spearhead for companies engaged in services because it is an indicator of success. Because it can be seen that if the customer is satisfied with the quality of service provided by the company, the customer will compare it with the service quality of other companies. According to [8], Due to the growing population and public interest in land travel, especially bus travel to far and near regions, entrepreneurs began creating autobus companies. Because there are so many bus companies, the owners are thinking of ways to survive and compete with their competitors. One way is to make their customers loyal.

One of the bus companies, namely PT Indo Trans Teknologi, is a bus company that serves inter-city transportation. This bus also serves tourist transportation in large or small quantities. According to [9], the large number of new players serving travel routes caused these bus entrepreneurs to go out of business because they failed to retain their customers. Therefore, to remain competitive, PT Indo Trans Teknologi is committed to continuing to provide the maximum possible service to its customers, this is evidenced by the many facilities provided to its customers. But this is felt to have not provided significant results for the company, because customers still feel some things that make them less comfortable with the services provided by the company.

Transportation is a sector related to various aspects including economic, industrial, social, political and environmental aspects [10]. In the economic aspect, of course this transportation plays a major role in the distribution process of goods and services so that circulation can run quickly and optimally [11]. Likewise, industrial aspects cannot be separated from the role of transportation in terms of distribution of industrial products [12]. In addition, transportation also helps people in terms of mobility, moving from one place to another in a short time. Technological progress has a great influence on the development of a country in various fields such as social, political and transportation [13]. Several applications of modern bus technology have been developed in the operating

system, facilities and infrastructure [14]. Therefore it is necessary to have valid data about the number of passengers who use the bus where later the data is used to evaluate the optimization of facilities and the number of passengers.

One of the transportation that is often used by the people of Indonesia is the bus [15]. Bus transportation in Indonesia provides travel facilities within and outside the city. Even the bus is a vehicle that is widely used in the tourism sector, to take tourists around from one tourist spot to another [16]. Several facilities were also implemented to increase the comfort of bus users. A bus company needs to implement several strategies in terms of competition with other bus companies or to increase the number of passengers and also public interest in using buses as a means of transportation. Several studies suggest that service is an important factor in maintaining public interest in using buses [17]. The decline in service performance can have the effect of decreasing the number of passengers [18].

Several technology solutions are built to create new service features and to meet people's demands. One solution taken by several bus companies is to provide wifi facilities on buses so that passengers can travel comfortably [19]. The government also issued regulations related to technology solutions to support the improvement of services and facilities on buses, namely, asking public transportation vehicle companies to install Global Positioning System (GPS) tracker devices on their fleets to monitor operations and improve efficiency [20].

With this regulation, it can lead to an increase in the demand for transportation logistics, besides that there are still many vehicles that have not installed GPS devices [21]. According to a survey by the Indonesian Telematics Equipment Industry Association, the use of GPS in public transportation vehicles in Indonesia is still less than 10% or less than 2% compared to the total number of vehicles in Indonesia [22].

The construction of an event data recorder (EDR) on the PT Indo Trans Teknologi Company project, the development of transportation telematics related to government regulations leads to an EDR development plan that allows processing of recorded data to produce functions of providing information, monitoring, warning and intelligent systems for monitoring data on facilities transportation. The application of EDR is expected to produce performance index analysis functions of public transportation such as monitoring the behavior of drivers and passengers, accident information, and digital accident reconstruction [23]. This of course will greatly assist the Department of Transportation and the police in collecting public transport information.

This research was conducted as the first step in developing a transportation telematics system at PT Indo Trans Teknologi. The research includes data acquisition on the number of passengers, the number of passengers getting off and boarding at a location and recording events on the bus. The data will be a variable in monitoring passenger behavior and can be used as one of the parameters of the performance index analysis in terms of passenger transportation management in an autobus company [24]. Video data capture during the trip can be used to help validate passenger data, support passenger and driver behavior monitoring, and digitally reconstruct accidents [25].

This research is related to the development of an EDR system to collect data on data that supports passenger behavior. The formulation of the problem in this research is how to make a bus route recording system using GPS sensors and integrate it with the value

of the number of passengers getting on and off at a location leading to efforts to realize the digitization of information such as passenger management related to increasing the number of passengers, as well as improving vehicle order. Especially buses in picking up and dropping off passengers at passenger drop-off locations.

In addition to the alignment of the roadmap, the research was also adapted to some of the equipment provided by the company such as GPS, the research will lead to data collection using image processing methods that can produce data on the number of passengers, pick up and drop off passengers at a bus stop location [26]. Therefore, on this occasion, the researcher tries to analyze the extent to which the service quality has been provided by PT Indo Trans Teknologi by using the dimensions of the modified service quality variable using the importance performance analysis method.

2 Methods

This study uses an Importance Performance Analysis (IPA) approach to analyze passenger satisfaction using a descriptive quantitative research methodology. The Likert Scale was chosen as the tool for measuring the views, attitudes, and consumer perceptions of the issue phenomena, as described by [27]. The phenomena being studied has been carefully identified by the researcher; hence, the ordinal scale used in this study employs a four-point evaluation system in the pursuit of producing a reliable and exact reading [28]. Both quantitative and descriptive methods were used in this investigation. Quantitative analysis is the methodical investigation of components, processes, and relationships [29]. Building and testing hypotheses, theories, and models in mathematics is the objective. Study qualities specified in the research question are the focus of descriptive research designs [30]. This study used both online administration of a questionnaire to obtain data. This study relied on secondary sources such as peer-reviewed journals/scientific publications, previous research, book references, and other published works for data collection.

Probability sampling was used for this study, which means that the sample not picked at random but rather included all possible components of the population. Since all PT Indo Trans Teknologi passengers have been asked to participate in a test of the bus's detecting system in accordance with the criteria and definitions established by [31], this study employs a saturated sample method of data collection. Saturated sampling refers to a sampling strategy in which all members of the population are included in the sample. In contrast to a census, which employs a high percentage of the total population, a saturated sample uses a much smaller percentage [32]. Therefore, 32 respondents is a sufficient sample size to be representative of the community and to ease the distribution of questionnaires by researchers. The GAP between performance and hope is what creates consumer happiness, as defined by [33]. The presence of a negative gap suggests that there is unmet demand for a certain product or service. If the amount of the gap is increasing, then the distance between client expectations and the actual result is also increasing [34]. Researchers use the Importance Performance Analysis (IPA) tool to examine the sevqual dimension in generating passenger happiness [35].

Table 1. Validity Test of Tangible, Reliability, and Assurance Dimensions

Item's Statements	Code	r-Count Value		r-Table
		Importance	Performance	
Design of a simple passenger detection device model (simple)	T1	0,778**	0,707**	0,361
Placement of the number of passenger detection devices in strategic places.	T2	0,750**	0,847**	0,361
The sensor for detecting the number of passengers is functioning properly.	T3	0,647**	0,629**	0,361
The cabling installation of the passenger number detector is neatly arranged.	T4	0,798**	0,764**	0,361
With the management of the number of passengers, the departure time is on time.	R1	0,566**	0,769**	0,361
The passenger capacity on the bus is not overloaded with the help of a passenger number detector.	R2	0,723**	0,886**	0,361
Information about bus routes is correct when monitored using GPS.	R3	0,791**	0,686**	0,361
The suitability of the availability of empty slots on the bus when it stops at the stop pool.	R4	0,718**	0,815**	0,361
The results of recording every incident that occurs on the bus during the trip can be seen clearly.	A1	0,852**	0,783**	0,361
Feel safer because the passenger capacity on the bus is in accordance with the number that should be.	A2	0,770**	0,797**	0,361
With the GPS tracking system, it makes consumers more comfortable in accessing the location.	A3	0,878**	0,690**	0,361
Security on the bus because it is equipped with CCTV cameras.	A4	0,823**	0,829**	0,361

Source: Researcher's Processed with IBM SPSS 25, 2022

3 Result and Findings

Primary data in this research has been collected through online questionnaires which have been distributed to 32 respondents, namely all PT Indo Trans Teknologi passengers have been asked to participate in a test of the bus's detecting system to find out what things should be maintained, then make improvements to the services provided, because the quality of the service is the basis of passenger satisfaction [36].

The data in Table 1 shows that the test of the validity of the tangible, reliability, and assurance dimensions on the service quality variable to 32 respondents is already

Table 2. Reliability Test of Tangible, Reliability, and Assurance Dimensions

	Cronbach's Alpha	**N of Items**
Importance	0,930	12
Performance	0,935	12

Source: Researcher's Processed with IBM SPSS 25, 2022

valid using a two-way test with a significance level of 0.05. All question items, both performance and expectations, have a calculated r value greater than 0.361, so that all statements in the questionnaire circulated to respondents, namely all PT Indo Trans Teknologi passengers have been asked to participate in a test of the bus's detecting system are understandable or acceptable to be the respondent. The reliability test can only be done if the statement items are included in the valid criteria. The prerequisites for a study can be called reliable if the Cronbach's Alpha value is 0.60 [37].

From the results of the questionnaire reliability test shown in Table 2, the Cronbach's Alpha coefficient of the performance and expectations of the service quality variable consisting of a combination of tangible, reliability, and assurance dimensions is greater than 0.60, namely 0.930 and 0.935. Therefore, it can be concluded that all of the research instruments can be trusted or relied on, and it is hoped that from time to time they will be able to provide consistent measurements.

The actual service quality is shown based on the results of respondents' assessment of performance attributes on all dimensions of servqual as a form of passenger satisfaction. Meanwhile, the ideal service quality is shown based on the results of respondents' assessment of the level of expectations of all servqual dimensions. In determining the value of the gap, it can be obtained based on the difference between the performance value and the expectation of service quality. A good level of satisfaction can be indicated by positive results ($Qi > 0$), this shows the performance value of service satisfaction has met the ideal value of service quality expected by passengers. Conversely, if the result is negative ($Qi < 0$), then passenger satisfaction is still at a poor level and has not been able to meet the ideal service quality or passenger expectations [38].

From Table 3, it can be seen that all statements are negative, this indicates that all statement items still have gaps or gaps. This means that currently the satisfaction of all servqual indicators is still below the expectations of all PT Indo Trans Teknologi passengers who have been asked to participate in a test of the bus's detecting system.

Table 3 is the result of processing research data, in the form of the average score of each passenger satisfaction indicator given by PT Indo Trans Teknologi. The expectation score shows the average score of each passenger satisfaction statement expected by the company's passengers and the performance score shows the average score of each passenger satisfaction received by PT Indo Trans Teknologi's passengers.

Then the data in Table 3 will be processed with the help of the IBM SPSS 25 application which produces a Cartesian IPA diagram. This Cartesian diagram divides each service quality attribute into 4 types of quadrants (quadrant A, B, C, and D) by making a boundary line for the average performance value (performance) is the X axis and the value of expectation (importance) is the Y axis (Fig. 1).

Table 3. Gap Calculation Results

Dimension	Code	$\overline{X}_P$	$\overline{X}_I$	GAP
Tangible	T1	3,28	3,50	−0,22
	T2	3,47	3,59	−0,13
	T3	3,13	3,53	−0,41
	T4	3,13	3,53	−0,41
Reliability	R1	3,03	3,47	−0,44
	R2	3,41	3,63	−0,22
	R3	3,44	3,59	−0,16
	R4	3,22	3,47	−0,25
Assurance	A1	3,38	3,53	−0,16
	A2	3,41	3,53	−0,13
	A3	3,47	3,63	−0,16
	A4	3,50	3,69	−0,19
Average		**3.32**	**3.56**	**−0.24**

Source: Researcher's Processed with IBM SPSS 25, 2022

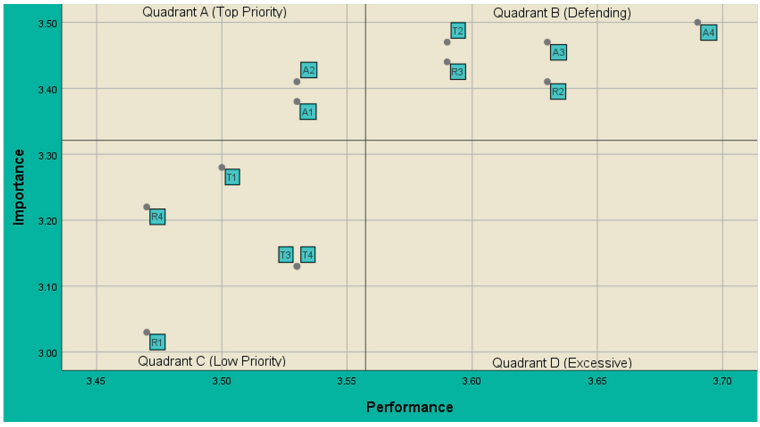

Fig. 1. Cartesian Diagram of Performance and Expectations (IPA Analysis). Source: Researcher's Processed with IBM SPSS 25, 2022

Based on the Cartesian diagram above, it can be seen the location of the attribute elements of the servqual dimension that make up the satisfaction of PT Indo Trans Teknologi passengers. The following is an explanation of the diagram.

1. Quadrant A (Top Priority)

The attributes in quadrant A are considered very important by PT Indo Trans Teknologi bus passengers, but in their application they have not been able to provide satisfaction. So it needs to be a priority for handling or must be addressed further. The attributes belonging to quadrant A:

- A1: The results of recording every incident that occurs on the bus during the trip can be seen clearly.
- A2: Feel safer because the passenger capacity on the bus is in accordance with the number that should be.;

2. Quadrant B (Defensive)

In quadrant B, the attributes or indicators are considered to have been implemented successfully, so they need to be maintained. The attributes belonging to quadrant B include:

- T2: Placement of the number of passenger detection devices in strategic places.
- R2: The passenger capacity on the bus is not overloaded with the help of a passenger number detector.
- R3: Information about bus routes is correct when monitored using GPS.
- A3: With the GPS tracking system, it makes consumers more comfortable in accessing the location.
- A4: Security on the bus because it is equipped with CCTV cameras.

3. Quadrant C (Low Priority)

The attributes contained in quadrant C are less prioritized by the company, because they are considered not too important by customers. The attributes belonging to quadrant C are:

- T1: Design of a simple passenger detection device model (simple)
- T3: The sensor for detecting the number of passengers is functioning properly.
- T4: The cabling installation of the passenger number detector is neatly arranged.
- R1: With the management of the number of passengers, the departure time is on time.
- R4: The suitability of the availability of empty slots on the bus when it stops at the stop pool.

4. Quadrant D (Excessive)
   The attributes belonging to quadrant D are things that customers consider less important, but their application by the company is too excessive. In this research, there are no statement items that belong to quadrant D.

4 Discussions

4.1 Main Findings

The IPA (Importance Performance Analysis) method is usually used to measure the level of customer satisfaction by identifying the level of expectations and perceived performance [39]. So that it can assist the company in fulfilling its satisfaction by formulating suggestions for improvement that must be given and determining what strategies should be maintained [40].

It is emphasized that in this study what is meant by "Bus Passenger Tracking and Management System" is a unit formed from several elements (elements) of service quality for all activities to regulate and coordinate production factors effectively and efficiently, to be able to create add value and the benefits of products (goods or services) produced by all organizational activities, in which the equipment system works properly. So the indicators of this aspect include: dimensions of physical appearance (tangible), reliability, and assurance. The following is a discussion of each of these indicators, and this description represents the gap between maintenance and the realization of its achievements.

In relation to the indicators on the tangible dimension, the information provided by the informants regarding the physical form of the passenger number detector can be stated as follows. That these elements include simple tool design, strategic placement, sensors that function properly, and neatly arranged cable installations. In discussing this indicator, this study shows that the bus fleet has implemented the concept of fleet management in managing its operations. PT Indo Trans Teknologi in controlling buses uses fleet management, not based on corridors, but based on networks. With this system, all buses will be used for. Fleet management is done by zoning routes. They will use GPS (Global Positioning System) on all buses for easy monitoring [41].

If the revenue management is still applying the deposit system so that the number of passengers is chased by vehicle operators without paying attention to passenger comfort, especially during peak hours [42]. This resulted in the low quality of service felt by passengers [43]. In addition, the physical appearance of the bus fleet that is no longer suitable for operation needs to be repaired and/or rejuvenated with a new, better and ideal fleet [44]. Poor service needs to be addressed so as to foster passenger interest in using bus transportation [45]. Bus vehicles must be in good condition, roadworthy, use air conditioning and comfortable seats (priority seats are available for the elderly, women with small children, and pregnant women), provide handrails on the seats or the roof of the vehicle, use a definite schedule that fits time table, and provide safety devices in the vehicle according to standards.

On the reliability aspect of public transportation, it can be seen from the on time departure time, the capacity of passengers that are not overloaded, the correct bus route information according to GPS, and the availability of empty slots when stopping at the pool. The frequency of meeting during peak hours and not meeting during off-peak hours and uneven load factors at every hour are almost found in every public transportation operation due to differences in people's travel times in carrying out daily activities [46]. The service system should prioritize excellent service to the community. This is realized by route services based on user needs [47]. For this reason, in the future it is necessary

to conduct a survey related to the creation of a matrix of the origin of the passenger's travel destination to obtain the area or location that is the origin and destination of the passenger's journey. This is intended to reduce the opportunity for modal shifts to occur during a trip. The exact location of the bus stop and with good and ideal conditions can attract the attention of users [48]. Stops or shelters need to be equipped with travel routes and schedules of public transportation that serves [49]. Determination of a stop or shelter must be based on a survey result by taking into account the location of the generation and attraction of the trip as well as the needs of the user.

Regarding this indicator, informants indicated that public services include all government-provided products and services [50]. In Minister of State Apparatus No. Kep/25/M.Pan/2/2004, General Guidelines for Compiling the Community Satisfaction Index of Government Service Units. Public services are actions performed by public service providers to meet the demands of service users and to execute laws and regulations [51]. Public service activities are general in nature because they cover the lives of many people [52].

It should be emphasized that in this study what is meant by the assurance dimension is related to the following indicators of the need for safety and comfort: the results of recording each incident are recorded clearly, the capacity of the number of passengers is in accordance with the standard it should be because of the management of the number of passengers, the location is easily accessible with GPS tracking, and equipped with CCTV cameras. The required security system must comply with existing standards and user requirements [53]. The security equipment that should be on public transportation at least consists of a fire extinguisher and a glass breaker, but the bus transportation mode owned by PT Indo Trans Teknologi has been equipped with a GPS tracking system and CCTV surveillance cameras. In this regard, the passengers emphasized that the core substance of security and comfort is that buses can ensure the safety and security of customers when enjoying transportation services [54].

Practical Implication due to their availability, flexible scheduling, and many options, buses are a popular form of public transportation [19]. Government and private companies manage city buses. Many private parties are competing to provide comfort and security to attract more customers [55]. One aspect of comfort that is important to note is the number of passengers. This is often overlooked by bus drivers and assistants considering the demands on time and operational costs that must be pursued. Passengers are a measure of the company's services. This parameter is crucial for business planning and operational efficiency [56]. Long-term business planning requires an in-depth analysis of the company's passenger revenue history [57]. Many public transportation systems still manually count passengers based on ticket withdrawals.

Automatic Passenger Counting (APC) is here as an ideal solution to the problems faced by the world of public transportation today [58]. This system was created to assist companies in the process of recording the number of passengers to obtain detailed information about passengers [59]. This APC technology is mostly implemented on buses because of the reliable level of accuracy of the information. The recording system provided became the starting point for tracking payments made by fleet officers [60]. Indirectly, this system is very helpful for the company in reducing the level of losses experienced.

Through the development of artificial intelligence and the Internet, various APC technologies have been developed [61]. Some of them use infrared methods, pressure sensors, or use event data recorders (EDR). Infrared is the most widely used technology, but it is stated that this method has poor accuracy if the number of people passing through the sensor is too many [62]. The number of passengers can also be calculated based on seat status through the placement of pressure sensors placed on each seat. This method also does not guarantee the accuracy of the data provided, because the system will only detect based on weight (it could be that what is placed on the chair is an item and not a person) [63]. In addition, this method also requires a high cost due to the placement of hardware in each seat.

Event data recorder (EDR) provides better calculation accuracy than infrared and pressure sensors [64]. The workings of EDR is to imitate human visuals in interpreting an object. To fulfill this, several criteria must be met, including recognition, object detection, description, 3D inference, and interpreting motion. Various studies have been carried out to perform the process of calculating the number of passengers using EDR [65]. In particular, this research will carry out one of the computer vision methods, namely object detection. A modeling of the passenger count system is provided with a facial and movement recognition scheme using a face detection approach and through GPS signals.

The design of a face detection system on bus passengers as one of the most widely used public transportations by the community, is expected to be able to overcome the main problems often faced by bus, namely the mismatch of the number of passengers transported [66]. A modeling system for calculating the number of bus passengers is made based on the detection of the number of passengers. The model built through this research is written through the design of information systems, device architecture, to the design of a face detection system mechanism to calculate the number of passengers. The use of Raspberry-Pi is expected to be able to accelerate the process of processing and sending data to the server via the Internet, so that the bus management can immediately get information from each fleet in real-time [67].

5 Conclusion and Recommendation

At the level of the gap, between performance and expectations of the service quality variable dimensions consisting of tangible, reliability, and assurance of PT Indo Trans Teknologi, the entire GAP score statement has a negative value. This shows that customers are still not quite satisfied with the performance of the service quality of the passenger tracking and management system that will be implemented at PT Indo Trans Teknologi, so the company must improve all the attributes of each of these dimensions.

Attributes in quadrant A must be prioritized by providing better service guarantee standards, such as improving the quality of CCTV recordings on the bus and adjusting the capacity of the number of passengers according to the bus standards that should be. The attributes in quadrant B are defensive strategies, so the implementation should be maintained because according to the passengers the implementation is good and it is hoped that in the future it can transform into prioritized attributes, so the management must be more reliable, fast, and responsive in dealing with each customer's problems and

needs. Then the attributes in Quadrant C must be improved again with new strategies, such as the detection device model should be designed with a more simple and minimalist form, for the sensor of the tool must also be checked again for the level of responsiveness, in addition to the wiring arrangement of the detector must also be arranged with neat (or expected if possible for wireless), related to the passenger management prediction system, departure times and the availability of empty slots in each stop pool should be the focus of attention. While there are no attributes in quadrant D, thus showing in this study there are no dimensions or factors that are not expected or deemed less important, management can allocate existing resources to other factors that are more urgent and prioritized.

A system design test was conducted to assess the level of suitability of the system built with the company's needs. The test was carried out through making questionnaires which were distributed to 32 respondents (all bus passengers who had followed the trial procedure of the passenger number management detection system) and the result was that the gap between expectations and reality was −0.24. The satisfaction assessment is based on 3 main aspects which include the dimensions of physical appearance (tangible), reliability, and assurance. The continuation of this research is expected to be able to test the accuracy of other similar methods as a comparison to detect the number of passengers and have advantages from the aspect of system speed in sending the results of data processing to the server. It is possible, the test results are then compared with other detection methods to obtain a comparison of the method that best suits the needs in the field with the highest level of accuracy.

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