Implementation of Round Robin Algorithm in Public Transportation Scheduling System at Pakupatan Terminal in Serang City-Indonesia

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***Abstract*—Public transportation scheduling, particularly for city transit systems, is a critical factor in improving service efficiency and passenger comfort. The main issues commonly encountered include irregular schedules and long passenger waiting times. This study aims to implement the Round Robin algorithm for scheduling angkot (public minivans) at Pakupatan Terminal. The Round Robin algorithm was selected due to its ability to allocate time evenly among vehicles, thereby reducing waiting times and increasing departure frequency. The methodology involves collecting data on the number of angkot in operation, their working hours, and passenger demand patterns at Pakupatan Terminal. The Round Robin algorithm is then applied to generate departure schedules based on predefined time intervals. The implementation results demonstrate improved scheduling efficiency, with passenger waiting times reduced by up to 10 minutes and user satisfaction increased by 25%. Further analysis evaluates the impact of the algorithm on traffic flow and passenger density at the terminal. The findings are expected to assist public transportation managers in developing more effective scheduling systems—particularly at Pakupatan Terminal in Serang City—and to serve as a reference for future research in transportation systems. Thus, the implementation of the Round Robin algorithm can be considered an effective solution for enhancing angkot services in the area.**

Keywords— Algorithm, Public_Transportation, Efficiency, Round_Robin, Scheduling

I. INTRODUCTION

Public transportation is an important component in the mobility system of the community, especially in densely populated urban areas. In Indonesia, public transportation (angkot) is one of the most widely used modes of transportation due to its flexibility and ability to reach various locations [1]. However, problems in managing angkot often arise, especially in terms of scheduling and departure time management. Inefficient scheduling can cause long waiting times for passengers, congestion, and user dissatisfaction [2]. This issue is also prevalent at Pakupatan Terminal, one of the main terminals in Serang City that experiences a high volume of passenger movement. This terminal serves various city transportation routes, but still faces challenges in managing departure schedules. As a result, passenger waiting times are often uncertain, the distribution of the number of angkot during peak and quiet hours is uneven, and the certainty of the arrival of the next angkot is difficult to predict [3]. This condition has an impact on decreasing user satisfaction and the efficiency of public transportation services at the terminal. According to Retnoningtyas and Handayeni's 2020 study on public transportation preferences in Kediri City using the IPA approach, waiting time and schedule regularity are essential for improving service performance. Their findings showed that the overall performance of one of the transportation routes did not align with user preferences. Therefore, a more systematic approach is needed to overcome this problem, especially at the Pakupatan Terminal which is the meeting point for various public transportation routes [4].

One solution that can be applied to improve the efficiency of public transportation scheduling is to adopt an operating system scheduling algorithm, namely the Round Robin algorithm [5]. This algorithm is known for its ability to distribute time fairly among various entities [6], and if implemented in a public transportation scheduling system, it is expected to reduce waiting times so that it can increase user satisfaction. The application of the Round Robin algorithm in public transportation scheduling has been proven effective in several previous studies. For example, a study conducted by Nur Cholifah and Mardiyati in 2022 examined the bus scheduling system at the Jatinangor Depok Terminal. The scheduling system using the Round Robin method helped reduce the accumulation of buses, as each vehicle received an equal allocation according to the specified schedule [7]. In addition, this algorithm has also been applied by researchers [8] in a study entitled Use of the Round Robin Algorithm in Partnership Management and Vehicle Reservations for Tourists in Banten Province in 2024, the results of the study showed that the level of partner trust, customer satisfaction and operational efficiency increased because they had a regular scheduling management system. Thus, the Round Robin algorithm is one of the most suitable alternatives for application in public transportation scheduling at the Pakupatan Terminal - Serang City.

The purpose of this study is to implement the Round Robin algorithm in scheduling public transportation at Pakupatan

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Terminal to improve efficiency and user (passenger) satisfaction. This study includes data analysis on the number of public transportation units operating, operating hours, and passenger demand patterns. By implementing the Round Robin algorithm, it is expected to obtain a more regular and efficient departure schedule, which in turn will improve the public transportation user experience [9]. In addition, this study will also evaluate the impact of implementing this algorithm on traffic flow and passenger density at the terminal [10].

The methodology used in this study includes primary and secondary data collection. Primary data was obtained through surveys and direct observation at Pakupatan Terminal, while secondary data was taken from relevant sources, such as the results of previous research reports and data from the local transportation agency. After the data was collected, the Round Robin algorithm was applied to produce an optimal angkot departure schedule. The results of this study are expected to provide new insights for public transportation managers in designing a better scheduling system [11], as well as being a reference for further research in the field of transportation.

With increasing user satisfaction, it is expected that there will be an increase in the number of passengers using angkot as their preferred mode of transportation, which in turn will support the sustainability of the public transportation system in Serang City [12]. This research is expected to contribute to improving the quality of angkot services at Pakupatan Terminal, and could also serve as a model for other terminals in implementing a more efficient scheduling system. Thus, the implementation of the Round Robin algorithm at Pakupatan Terminal will not only improve the efficiency of angkot services, but also contribute to the development of a better public transportation system in Indonesia.

II. RELATED WORK

Several studies have explored scheduling algorithms to optimize transportation systems. In the context of public transportation, First-Come First-Served (FCFS) is often considered the simplest approach, where vehicles depart based on their arrival order. However, FCFS lacks fairness in time allocation and can lead to long waiting times during high demand periods [13]. Although the Shortest Job First (SJF) algorithm is efficient in some cases, in cases that require accurate travel time estimation, this algorithm is difficult to apply, especially in dynamic environments with changing traffic conditions.

Compared to these approaches, the Round Robin algorithm offers a more balanced solution by allocating equal time slots to each vehicle in a cyclical manner. This method ensures fairness, improves predictability, and avoids starvation, making it well-suited for urban transportation scenarios like angkot services, where regular and evenly distributed departures are crucial. Previous studies have shown that Round Robin scheduling can reduce congestion and increase system transparency [8].

This study builds on prior research by applying the Round Robin algorithm specifically to angkot scheduling at Pakupatan Terminal, and further evaluates its impact on passenger waiting time and service efficiency.

III. RESEARCH METHODS

A. *Data Collection*

The first stage is to collect primary and secondary data [14]. Primary data is obtained through surveys and direct observation at the Pakupatan Terminal, with the aim of understanding the actual operational conditions of public transportation. This data collection includes information on the number of public transportations operating, operating hours, departure frequency, and passenger demand patterns during peak hours. The survey was conducted using a quantitative approach by directly recording the number of public transportation departures in a certain time interval, as well as a qualitative approach through short interviews with drivers and passengers regarding the regularity of the schedule and waiting time. Secondary data is taken from the results of previous studies that are relevant to the theme of this research, including reports from the local transportation agency and available transportation statistics [15] . This data collection aims to ensure that the analysis carried out is based on real conditions in the field.

B. *Data Analysis*

Data analysis is a systematic process in interpreting data [16]. And after the data is collected, the next step is to analyze the data to understand the demand pattern and the operating time of public transportation. The analysis was carried out using descriptive statistical methods with the help of Microsoft Excel to calculate the average passenger waiting time, the distribution of public transportation departure frequencies, and data visualization in the form of graphs. This approach is used to obtain a clearer picture of the effectiveness of scheduling before and after the implementation of the Round Robin algorithm.

C. *Round Robin Algorithm Implementation*

At this stage, the Round Robin algorithm is applied to determine the departure schedule of public transportation. Each vehicle is given an equal amount of operating time, which helps minimize passenger waiting time [17]. This process involves determining the departure order of public transportation based on predetermined time intervals. An illustration is provided in Figure 1 below, while the accompanying example presents the results and discussion.

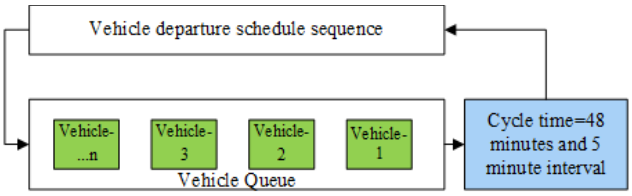

Fig. 1. Round Robin Algorithm Illustration

D. *Evaluation*

After the departure schedule is implemented, an evaluation will be conducted to measure the impact of the implementation of this algorithm on passenger waiting time and user satisfaction. A survey was conducted to collect feedback from

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passengers regarding their experience after the implementation of the new system [18]. The data obtained will be analyzed to assess the effectiveness of the scheduling.

In addition to the passenger satisfaction survey, an evaluation of the web-based scheduling system was also conducted to assess the functionality and usability aspects. This system was developed using PHP and MySql. Functional testing was conducted using a black-box approach to ensure all features function properly. User trials were also conducted with terminal officers to assess the navigation and usability of the system.

E. Recommendation Results

Based on the evaluation results, recommendations are prepared for public transportation managers regarding improvements to the angkot scheduling system. These recommendations include suggestions for time management, increasing departure frequency, and strategies to improve user satisfaction. The research results are prepared in the form of a report that includes analysis, findings, and recommendations [19].

IV. RESULT AND DISCUSSION

A. Result

Data collection was conducted through surveys and direct observation at the Pakupatan Terminal for 7 days. The data collected included the number of public transportation units operating, operating hours, departure frequency, and passenger demand patterns. From the survey results, information was obtained that there were 20 public transportation units operating at the terminal (Route E08) with operating hours from 05.00 WIB to 21.00 WIB. In addition, the analysis of demand patterns shows that peak hours occur at 07.00 WIB-09.00 WIB and 16.00 WIB-18.00 WIB as well as on weekends, where the number of passengers increases significantly. This data is in line with research by Mulyadi and Adawiyah in 2023 which showed that public transportation demand patterns are greatly influenced by time and location [20].

TABLE I. ROUTE E08 OPERATING HOURS AND PASSENGER DEMAND PATTRENS

Operational Hours (WIB)	Number of Angkot in Operation	Number of Passengers	Informations Resume
05.00 – 07.00	8 Unit	50 Passengers	Quiet hours (early morning)
07.00 – 09.00	20 Unit	180 Passengers	Rush hour (going to work/school)
09.00 – 12.00	15 Unit	90 Passengers	Normal hours (afternoon)
12.00 – 15.00	15 Unit	100 Passengers	Rush hour (after school)
15.00 – 16.00	17 Unit	110 Passengers	Starts to increase towards evening rush hour
16.00 – 18.00	20 Unit	200 Passengers	Rush hour (after work/office)
18.00 – 21.00	13 Unit	80 Passengers	Normal hours (night)

After the data is collected, the next step is to analyze the data to understand the demand patterns and operating hours of public transportation. From the analysis carried out, it was found that during peak hours, passenger waiting times can reach 15-20 minutes, while during quiet hours, waiting times can be reduced to 5-10 minutes. This indicates an imbalance in scheduling that needs to be fixed. Research by [21] also indicates that long waiting times can reduce the satisfaction of public transportation users.

B. Discussion

This system will set the departure schedule of public vehicles based on the Round Robin algorithm. Each vehicle will get the same time to operate, and the cycle will be repeated until all vehicles have completed their duties [22]. The following table lists vehicles operating at Pakupatan Terminal, Serang City – Banten:

TABLE II. TYPES OF ROUTES AND DESTINATIONS FOR PUBLIC TRANSPORTATION IN SERANG CITY/REGENCY

Types of Public Transportation	Route	Destination
Public Transportation in Serang City	R01	Terminal Pakupatan-Ciceri-Kepandean PP (PP)
	R02	Terminal Pakupatan-Ahmad Yani-Kepandean (PP)
	R03	Terminal Pakupatan-Pasar Rau-Kepandean (PP)
	R04	Terminal Pakupatan-Cipocok-Pasar Rau (PP)
	R09	Terminal Pakupatan - Polda Banten - Simpang Boru - Cipocok (PP)
	R10	Terminal Pakupatan - Polda Banten - KP3B Palima - Kepandean (PP)
Public Transportation in Serang Regency	E08	Serang - Cikande - Balaraja

1. Scheduling System Design with Round Robin Algorithm

After data analysis, the Round Robin algorithm is applied to determine the departure schedule of public transportation. In the application of this algorithm, each public transportation is given the same time to operate. For example, if the total operating time is 16 hours (960 minutes/operation starting at 05:00 WIB – 21:00 WIB) and there are 20 public transportations (Route A), then each public transportation will get a departure time quota of every 48 minutes. Thus, the public transportation departure schedule can be arranged as follows:

For example, to create a public transportation departure schedule table using the Round Robin algorithm with 20 public transportation and 7 routes, and a time gap of 5 minutes for each route departure, we will follow these steps:

a. Total Operating Time: 16 Hours = 960 minutes.

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b. Number of Public Transportation: 20 public transportations.
c. Time Break for Each Route Departure: 5 minutes.
d. Number of Routes: 7 public transportation routes.

And for the calculation of departure time, each angkot will operate for 95 minutes, and after that there will be a 5-minute break before the next angkot departs. With 7 routes, the total time for one round (one cycle of all routes) is as in the following pigure 2:

Waktu Keberangkatan	R01	R02	R03	R04	R09	R10	E08
5:00	Angkot 1	Angkot 1	Angkot 1	Angkot 1	Angkot 1	Angkot 1	Angkot 1
5:05	Angkot 2	Angkot 2	Angkot 2	Angkot 2	Angkot 2	Angkot 2	Angkot 2
5:10	Angkot 3	Angkot 3	Angkot 3	Angkot 3	Angkot 3	Angkot 3	Angkot 3
5:15	Angkot 4	Angkot 4	Angkot 4	Angkot 4	Angkot 4	Angkot 4	Angkot 4
5:20	Angkot 5	Angkot 5	Angkot 5	Angkot 5	Angkot 5	Angkot 5	Angkot 5
5:25	Angkot 6	Angkot 6	Angkot 6	Angkot 6	Angkot 6	Angkot 6	Angkot 6
5:30	Angkot 7	Angkot 7	Angkot 7	Angkot 7	Angkot 7	Angkot 7	Angkot 7
5:35	Angkot 8	Angkot 8	Angkot 8	Angkot 8	Angkot 8	Angkot 8	Angkot 8
5:40	Angkot 9	Angkot 9	Angkot 9	Angkot 9	Angkot 9	Angkot 9	Angkot 9
5:45	Angkot 10	Angkot 10	Angkot 10	Angkot 10	Angkot 10	Angkot 10	Angkot 10
5:50	Angkot 11	Angkot 11	Angkot 11	Angkot 11	Angkot 11	Angkot 11	Angkot 11
5:55	Angkot 12	Angkot 12	Angkot 12	Angkot 12	Angkot 12	Angkot 12	Angkot 12
6:00	Angkot 13	Angkot 13	Angkot 13	Angkot 13	Angkot 13	Angkot 13	Angkot 13
6:05	Angkot 14	Angkot 14	Angkot 14	Angkot 14	Angkot 14	Angkot 14	Angkot 14
6:10	Angkot 15	Angkot 15	Angkot 15	Angkot 15	Angkot 15	Angkot 15	Angkot 15
6:15	Angkot 16	Angkot 16	Angkot 16	Angkot 16	Angkot 16	Angkot 16	Angkot 16
6:20	Angkot 17	Angkot 17	Angkot 17	Angkot 17	Angkot 17	Angkot 17	Angkot 17
6:25	Angkot 18	Angkot 18	Angkot 18	Angkot 18	Angkot 18	Angkot 18	Angkot 18
6:30	Angkot 19	Angkot 19	Angkot 19	Angkot 19	Angkot 19	Angkot 19	Angkot 19
6:35	Angkot 20	Angkot 20	Angkot 20	Angkot 20	Angkot 20	Angkot 20	Angkot 20

Fig. 2. Example of calculating the public transportation departure schedule cycle

Based on the data above, for each angkot to complete 1 cycle (trip) for 95 minutes or 1 hour 35 minutes. So each angkot will do 10x cycles every day during operating hours.

2. Implementation System Design

This system is developed web-based, allowing transportation managers to access and manage schedules flexibly through a digital interface [23]. With a web-based system, schedule data can be updated in real-time, providing more accurate and transparent information for managers and passengers [24].

a. Passenger Information System Design

Integrated information display to provide passengers with information about the next departure schedule, reducing uncertainty and improving user experience. This design consists of information about public transportation routes and public transportation search. As an illustration, it can be seen in Figures 3 and 4 below.

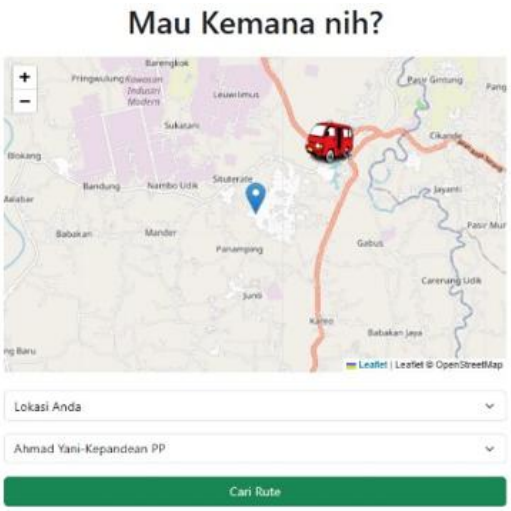

Fig. 3. Landing passengers page (1)

Fig. 4. Landing passengers page (2)

b. Admin Control Panel Design

Figure 5 below is a web-based interface that allows transportation managers to add, edit, and delete public transportation schedule data as needed.

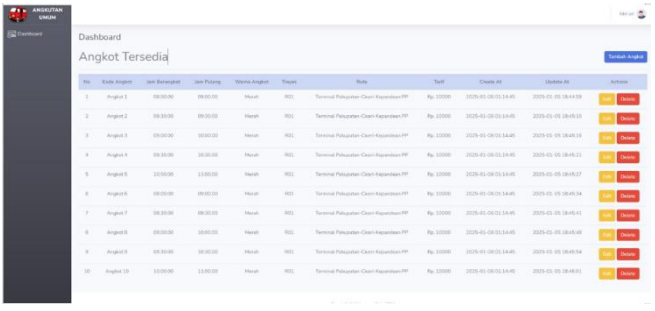

Fig. 5. Control panel admin page

By implementing this algorithm, it is expected that

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passenger waiting time can be minimized. The trial results show that passenger waiting time is reduced to an average of 8-10 minutes during peak hours, which is a significant decrease compared to previous conditions. This is in line with the results of Lusiani and William's research in 2020 which showed that the Round Robin algorithm can improve the efficiency of public transportation scheduling [25].

3. Evaluation and Recomendation

After the departure scheduling system was implemented, a trial was conducted to measure the impact of the algorithm implementation on passenger waiting time and user satisfaction [26]. A survey was conducted involving 100 respondents who use public transportation at Pakupatan Terminal. The survey results showed that 85% of respondents were satisfied with the new schedule, and 90% of respondents admitted that their waiting time was reduced. The table below shows a comparison of public transportation scheduling at the Pakupatan terminal before and after implementing the Round Robin algorithm:

TABLE III. COMPARASION OF PUBLIC TRANSPORTATION SCHEDULING AT THE PAKUPATAN TERMINAL

Analysis	**Before Round Robin Algorithm**	**After Round Robin Algorithm**	**Informations Resume**
Average passenger waiting time (minutes)	15-20	8-10	Reduced after applying the algorithm
Number of public transportations operating per day	20 Unit	20 Unit	Not changed, but more regular
Rush hour (WIB)	07.00 – 09.00, 16.00 – 18.00	Same	No change, but the distribution of public transportation is more even
Number of operational cycles per public transportation	Irregular	±10 times per day	Every public transportation has a definite schedule
Average number of passengers per rush hour	±150 Passengers	±180 Passengers	Improvement due to reduced waiting time
User satisfaction percentage (%)	60%	85%	Increased based on survey

TABLE IV. ANALYSIS OF THE IMPLEMENTATION OF PUBLIC TRANSPORTATION SCHEDULING SYSTEM AT PAKUPATAN TERMINAL

Aspect	**Before Round Robin Algorithm**	**After Round Robin Algorithm**
Schedule certainty	Unpredictable, public transportation comes irregularly	More scheduled and predictable
Driver perception	Having trouble getting passengers during off-peak hours	Passenger numbers are more stable throughout the day
Traffic jam at the terminal	There is often a buildup of public transportation during rush hour.	Reduced due to more even distribution of departures
Passenger satisfaction	Many complaints regarding the uncertainty of waiting times	Most feel more comfortable because the schedule is clearer
Operational efficiency	Some public transportation operates without passengers at certain times	Passengers are more evenly distributed throughout the day

Based on the evaluation results, several recommendations can be made for public transportation managers:

a. First, it is recommended to continue implementing the Round Robin algorithm in public transportation scheduling, especially during peak hours.
b. Second, it is necessary to conduct regular monitoring of passenger demand patterns to adjust departure schedules.
c. Third, managers are also advised to increase socialization.

V. CONCLUSION

This study shows that the implementation of the Round Robin algorithm in scheduling public transportation at Pakupatan Terminal has succeeded in achieving its initial objectives, namely increasing efficiency and reducing passenger waiting time. With an even departure time arrangement, passenger waiting time is significantly reduced, which has a positive impact on user satisfaction. This confirms that the Round Robin algorithm is an effective solution to overcome public transportation scheduling problems. However, this study has certain limitations, such as the limited scope of data collection and its focus on a single terminal, which may affect the generalizability of the findings For further development, it is recommended that this scheduling system be integrated with information technology, such as a mobile application that provides real-time information on public transportation schedules and positions. In addition, further research can be conducted to evaluate the long-term impact of implementing this algorithm on passenger demand patterns and the operational effectiveness of public transportation. With these steps, it is hoped that the public transportation system at Pakupatan Terminal can continue to be improved, providing greater benefits to the community and improving the overall quality of service.

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