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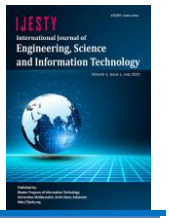

Hiace Transportation Departure Scheduling Information System in Lhokseumawe With Genetic Algorithm

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Abstract

This study aims to address challenges in transportation scheduling by employing a suitable algorithm to ensure the scheduling process operates efficiently and effectively. One algorithm identified as appropriate for this task is the Genetic Algorithm, which is widely recognized for its robust capabilities in optimization tasks. Known for its adaptability and robustness, the Genetic Algorithm is well-suited for scheduling applications, including academic timetabling, as it can handle complex problems involving multiple criteria and objectives. Inspired by principles of biological evolution and natural selection, this algorithm iteratively explores solutions to approach optimal outcomes, refining the schedule in each iteration until an effective solution is achieved. Based on the analysis of experimental results using real-world data and evaluation of the system's design, the study concludes that the Hiace transportation departure scheduling system was successfully developed using a web-based approach. This web-based system offers significant advantages, as it facilitates more efficient management of departure schedules and eliminates the need for manual checks. As a result, it reduces the risk of human error and allows for better resource allocation. The integration of Genetic Algorithms into the development of the Hiace transportation scheduling system demonstrates the potential of evolutionary computation in solving practical, real-life scheduling problems. The resulting system is supported by internet-based technologies, providing easy access to passengers and system administrators. Despite the positive outcomes achieved, the current implementation is not without limitations. Further refinement and continued development are essential to enhance system performance, increase reliability, and ensure it can adapt to evolving needs and operational complexities, ensuring its long-term effectiveness.

Keywords: *Scheduling System, Genetic Algorithm, Buses, Hiace, Transportation.*

1. Introduction

Information systems are one of the needs that humans cannot separate in today's digital era; Information systems are used to increase the accessibility of data presented precisely and accurately. An information system is a set of organizational procedures that, when implemented, will provide information to make decisions or control information [1]. The development of information systems is now speedy and rapid, and not a few use information systems to help facilitate work. One form of information system that is easy to develop is web-based [2]. Web-based information systems are not used to display information but to interact with data to provide information to make the right decision [3].

The problem that often arises in public transportation businesses is that the scheduling system is still manual and still uses bookkeeping, which, of course, is prone to errors and requires more accuracy if the number of transportation fleets is enormous, because later it will cause a lot of problems for the company [4]. Scheduling is an activity that must be owned by someone to help manage activities in everyday life. Especially in transportation companies, which have an essential agenda that must be carried out regularly and neatly [5]. So important is the Scheduling that can be made for activities to run according to plan, so that information is also expected to overcome problems in data processing, so that in the end it can help simplify and expedite the task of managing data in presenting information from the issues that have been described, if a public transportation service company has a transportation information system that provides all types of information needed by employees and owners for the process of advancing the company and for customers as a source of information on the needs of the desired transportation fleet [6]. In addition to containing information, this information system can be used to determine bus scheduling and fleet reservations [7].

Another problem in the transportation sector is manual bus planning with bookkeeping. This is error-prone and needs to be more thorough for huge vehicles because it will cause many problems in the future [8]. Transportation Public, such as bus companies, can thrive well with many customers, so customers become the primary goal. A common problem for customers is that they get stuck because they don't know

the bus schedule and can switch to another mode of transportation [9]. To overcome the problem of the company's irregular bus schedule, which caused a buildup of Haice buses that are not operating, This is following research which states that the problem that often arises from the user/customer side is ignorance of the bus schedule that will pass so that many customers will accumulate [10]. Problems often arise from the manual bus scheduling system that still uses bookkeeping, which is prone to errors and requires extra accuracy if the fleet is large.

2. Literature Review

An information system within an organization brings together daily transaction processing needs that support managerial organizational functions in an organization's strategic activities to provide reports required by certain external parties [11].
An information system is a series of components in the form of people, procedures, and technology (such as computers) used to carry out a process that produces valuable information for decision making [12]. Information systems can be defined as a system within an organization which is a combination people, facilities, technology, media, procedures and controls aimed at obtaining essential communication lines, processing certain types of routine transactions, qualifying management and others for important internal and external events and providing basic information for intelligent decision making [13].
Time Tabling is a significant administrative activity in most institutions. The operation of the institution will depend entirely on the timetable created; Scheduling is defined as follows:

1. Scheduling is allocating resources to objects in time and space subject to constraints such that a set of objectives is met as much as possible. In simple terms, Scheduling can be defined as allocating available resources in the available time space to fulfill certain conditions.
2. Scheduling involves two things: the allocation of resources and the predictability of the timing of activities. The means of activity, i.e., speakers, other means, and time, should be balanced and incorporated into monthly programs and daily activities.
3. Scheduling can be defined as allocating resources within a specific period to perform a series of tasks. Scheduling is organizing, selecting, and timing the use of resources to perform all necessary activities that meet activity and resource constraints [14].

3. Methods

The type of research used in the development of the Bus scheduling system is based on its function, which is applied research, and based on its purpose, it is case research because it is structured according to the problems in Scheduling. Before the application is used, it must be ensured to run correctly and produce the expected output. It is necessary to test the product to find errors that may occur, and this testing stage is carried out so that the application can run properly [15].

4. Results and Discussion

The author conducted this test using the black box testing method. Blackbox testing is a software testing method that focuses on functionality, especially application input, to determine whether it matches what is expected. The testing stage is one of the stages that must exist in the software development cycle before the software is released. The author uses the black box testing method to determine the validation function and the system's reaction to input.
Black Box Testing is analogous to seeing a black box; we can see the outside appearance, without knowing what is behind the black wrapper. Like black box testing, evaluating only from the outside appearance (interface), and functionality. Without knowing what happens in the detailed process (only the input and output). The following are the test results using the black box method. The application test results are presented in the following table:

Table 1. Admin Testing

Test Class	Test Item	Testing Type	Testing Technique	Results
Validate the Login to the admin page	Log in to the admin page successfully	System	Blackbox	*Valid*
	Login to the admin page failed.	System	Blackbox	*Valid*
Schedule	Print Schedule Data	System	Blackbox	*Valid*
	Delete Schedule data	System	Blackbox	*Valid*
Value	Value Result	System	Blackbox	*Valid*

Table 2. Admin Testing Results

Testing Type	Description	Results
Dashboard Page	On the dashboard page is a display First seen by the user	Successfully executed
Bus Page	On this page Explain adding a bus and deleting a bus	Successfully executed

Schedule Page	On this page, explain and shows the schedule of each bus	Successfully executed

Based on the system test results subchapter, it can be concluded that the built software is free from functional syntax errors and displays the results as expected. The test results table explains that all menus and buttons tested run and function properly without any obstacles. So that all applications are said to be running well.

4.1. Genetic Algorithm Accuracy

Forming Chromosomes

The chromosome comprises five genes, each representing a weight variable in the perceptron. To see the chromosome, look at the picture. The codification used in the chromosome is real codification. Chromosome formation can be seen in the following figure:

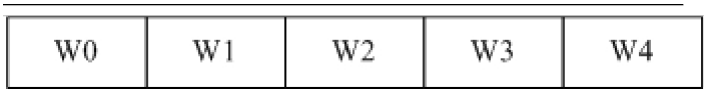

Fig 1. Chromosome Formation

Initialization of Genetic Algorithm (GA) parameters:
Number of generations : 2
Mutation probability (pm) : 0,1
Crossover probability (pc) : 0,9 J
Number of individuals : 5
Before starting the genetic algorithm, the chromosome values or the initial Population are generated randomly. The initial Population (randomly generated) can be seen in Table 3.

Table 3. Initial Population (randomly generated)

Chromosomes	Chromosome value				
C1	0,1	0,2	0,3	0,4	0,5
C2	0,2	0,3	0,5	0,4	0,1
C3	0,3	0,4	0,5	0,2	0,1
C4	0,4	0,5	0,1	0,2	0,3
C5	0,5	0,1	0,2	0,3	0,4

After the initial Population is randomly formed, fitness evaluation is carried out to determine the accuracy value (RMSE) per chromosome, as seen in Table 4.

Table 4. Fitness for Chromosome 1

Chromosomes	Chromosome value				
C1	0,1	0,2	0,3	0,4	0,5

Data 1
Y = W0*b+ W1*X1+ W2*X2+ W3*X3+ W4*X4
= 0.1*1+ 0.2*0.02+ 0.3*1+ 0.4*1+ 0.5*0
= 0.1+ 0.004+ 0.3+ 0.4+ 0
= 0,804

Data 2
Y = W0*b+ W1*X1+ W2*X2+ W3*X3+ W4*X4
= 0.1*1+ 0.2*1+ 0.3*0.30+ 0.4*0.25+ 0.5*1
= 0.1+ 0.2+ 0.09+ 0.1+ 0.5
= 0,99
Data 3

Y = W0*b+ W1*X1+ W2*X2+ W3*X3+ W4*X4
= 0.1*1+ 0.2*0+ 0.3*0+ 0.4*0+ 0.5*0.33
= 0.1+ 0+ 0+ 0+ 0.165
= 0,265

The results of the calculation of chromosome 1 generation 1 can be seen in Table 5. After the initial Population is randomly formed, fitness evaluation is carried out to determine the accuracy value (RMSE) per chromosome, as seen in Table 5.

Table 5. Chromosome 1 Generation 1 Calculation Results

Chromosomes	Target	Y	Error	Error^2
Data 1	0,60	0,804	-0,204	0,041616
Data 2	1	0,99	0,01	0,001
Data 3	0	0,265	-0,265	0,070225
		Average		0.03761367
		RMSE		0,19394244

Table 6. Fitness for Chromosome 2

Chromosomes	Chromosome value				
C2	0,2	0,3	0,5	0,4	0,1

Data 1
Y = W0*b+ W1*X1+ W2*X2+ W3*X3+ W4*X4
= 0.2*1+ 0.3*0.02+ 0.5*1+ 0.4*1+ 0.1*0
= 0.2+ 0.006+ 0.5+ 0.4+ 0
= 1,106
Data 2
Y = W0*b+ W1*X1+ W2*X2+ W3*X3+ W4*X4
= 0.2*1+ 0.3*1+ 0.5*0.30+ 0.4*0.25+ 0.1*1
= 0.2+ 0.3+ 0.15+ 0.1+ 0.1
= 0,85

Data 3
Y = W0*b+ W1*X1+ W2*X2+ W3*X3+ W4*X4
= 0.2*1+ 0.3*0+ 0.5*0+ 0.4*0+ 0.1*0.33
= 0.2+ 0+ 0+ 0+ 0.033
= 0,233
The results of the calculation of chromosome 2 generation 1 can be seen in Table 7.

Table 7. Calculation Results of Chromosome 2

Kromosom	Target	Y	*Error*	*Error*^{2}
Data 1	0,60	1,106	-0,506	0,256036
Data 2	1	0,85	0,15	0,0225
Data 3	0	0,233	-0,265	0,054289
		Average		0,11094167
		RMSE		0,33307907

Table 8. Fitness for Chromosome 3

Chromosomes	Chromosome value				
C3	0,3	0,4	0,5	0,2	0,1

Data 1
Y = W0*b+ W1*X1+ W2*X2+ W3*X3+ W4*X4
= 0.3*1+ 0.4*0.02+ 0.5*1+ 0.2*1+ 0.1*0
= 0.3+ 0.008+ 0.5+ 0.2+ 0
= 1,008
Data 2
Y = W0*b+ W1*X1+ W2*X2+ W3*X3+ W4*X4
= 0.3*1+ 0.4*1+ 0.5*0.30+ 0.2*0.25+ 0.1*1
= 0.3+ 0.4+ 0.15+ 0.05+ 0.1
= 1
Data 3
Y = W0*b+ W1*X1+ W2*X2+ W3*X3+ W4*X4
= 0.3*1+ 0.4*0+ 0.5*0+ 0.2*0+ 0.1*0.33
= 0.2+ 0+ 0+ 0+ 0.033
= 0,233

The results of the calculation of chromosome 3 generation 1 can be seen in Table 9.

Table 9. Calculation Results of Chromosome 3

Chromosomes	**Target**	**Y**	***Error***	***Error*^{2}**
Data 1	0,60	1,008	-0,408	0,166464
Data 2	1	1	0	0
Data 3	0	0,233	-0,233	0,054289
		Average		0,07358433
		RMSE		0,27126432

Table 10. Fitness for Chromosome 4

Chromosomes	**Chromosome value**				
C4	0,4	0,5	0,1	0,2	0,3

Data 1
Y = W0*b+ W1*X1+ W2*X2+ W3*X3+ W4*X4
= 0.4*1+ 0.5*0.02+ 0.1*1+ 0.2*1+ 0.3*0
= 0.4+ 0.01+ 0.1+ 0.2+ 0
= 0,71
Data 2
Y = W0*b+ W1*X1+ W2*X2+ W3*X3+ W4*X4
= 0.4*1+ 0.5*1+ 0.1*0.30+ 0.2*0.25+ 0.3*1
= 0.4+ 0.5+ 0.03+ 0.05+ 0.3
= 1,28
Data 3
Y = W0*b+ W1*X1+ W2*X2+ W3*X3+ W4*X4
= 0.4*1+ 0.5*0+ 0.1*0+ 0.2*0+ 0.3*0.33
= 0.4+ 0+ 0+ 0+ 0.099
= 0,499
The results of the calculation of chromosome generation 1 can be seen in Table 11.

Tabel 11. Calculation Result Chromosome 4 Generation 1

Kromosom	Target	Y	*Error*	*Error*^{2}
Data 1	0,60	0,71	-0,11	0,0121
Data 2	1	1,28	-0,28	0,0784
Data 3	0	0,499	-0,499	0,249001
		Rata-rata		0,113167
		RMSE		0,33640303

Table 12 Fitness for Chromosome 5

Chromosomes	Chromosome value				
C5	0,5	0,1	0,2	0,3	0,4

Data 1
Y = W0*b+ W1*X1+ W2*X2+ W3*X3+ W4*X4
= 0.5*1+ 0.1*0.02+ 0.2*1+ 0.3*1+ 0.4*0
= 0.5+ 0.002+ 0.2+ 0.3+ 0
= 1,002
Data 2
Y = W0*b+ W1*X1+ W2*X2+ W3*X3+ W4*X4
= 0.5*1+ 0.1*1+ 0.2*0.30+ 0.3*0.25+ 0.4*1
= 0.5+ 0.1+ 0.06+ 0.075+ 0.4
= 1,135

Data 3
Y = W0*b+ W1*X1+ W2*X2 + W3*X3+ W4*X4
= 0.5*1+ 0.1*0+ 0.2*0+ 0.3*0+ 0.4*0.33
= 0.5+ 0+ 0+ 0+ 0.132
= 0,63
The results of the calculation of chromosome 5 generation 1 can be seen in Table 13

Table 13. Calculation Result of Chromosome 5 Generation 1

Chromosomes	Target	Y	*Error*	$Error^2$
Data 1	0,60	1,002	-0,402	0,161604
Data 2	1	1,135	-0,135	0,018225
Data 3	0	0,632	-0,632	0,399424
		Average		0,19308433
		RMSE		0,43941362

4.1.1. Questionnaire Results

The results of the questionnaire answers will be processed according to the Likert scale with a weight of 1-5, where STS (Strongly Disagree) is 1, TS (Disagree) is 2, N (Neutral) is 3, S (Agree) is four and SS (Strongly Agree) is 5. To determine the percentage in each variable, it can be seen by the formula:

$$\% \text{ Actual Score } = \frac{\text{Actual Score}}{\text{Ideal Score}} X\ 100\% \ldots = \quad (1)$$

Description:
Actual score: The result of calculating the weight of all respondents' income. Ideal score: prediction of the highest weight value multiplied by the number of respondents.

Table 14. Score intervals

Interval	Description
0% - 19.99%	Strongly Disagree
20% - 39.99%	Disagree
40% - 59.99%	Neutral
60% - 79.99%	Agree
80% - 100%	Strongly Agree

The results of the questionnaire for 10 respondents are as follows:
1. Question 1
   Bus scheduling is always on time and according to procedure.

Table 15. Question 1

Answer	Number of Respondents	Weight	Actual score (JR*weight)
Strongly Disagree	0	1	0
Disagree	0	2	0
Neutral	5	3	15
Agree	5	4	20
Strongly Agree	0	5	0
Total	10	-	35

$$\% \text{ Actual Score} = \frac{35}{5x10} X\ 100\% = 70\% \quad (2)$$

2. Question 2
Bus managers make it easy for passengers to view bus departure schedules.

Table 16. Question 2

Answer	Number of Respondents	Weight	Actual score (JR*weight)
Strongly Disagree	0	1	0
Disagree	0	2	0
Neutral	2	3	6
Agree	7	4	28
Strongly Agree	1	5	5
Total	**10**	**-**	**39**

$$\% \text{ Actual Score} = \frac{41}{5x10} X\ 100\% = 82\% \quad (3)$$

3. Question 3
Haice buses provide convenience for users in determining their departure schedule.

Table 17. Question 3

Answer	Number of Respondents	Weight	Actual score (JR*weight)
Strongly Disagree	0	1	0
Disagree	0	2	0
Neutral	1	3	3
Agree	7	4	28
Strongly Agree	2	5	10
Total	10	-	41

$$\% \text{ Actual Score} = \frac{41}{5x10} X\ 100\% = 82\% \quad (4)$$

4. Question 4
Scheduling has been set up by the system, making it easier for users and haice drivers to access.

Tabel 18 Question 4

Answer	Number of Respondents	Weight	Actual score (JR*weight)
Strongly Disagree	0	1	0
Disagree	0	2	0
Neutral	0	3	0
Agree	9	4	36
Strongly Agree	1	5	5
Total	10	-	41

$$\% \text{ Actual Score} = \frac{41}{5x10} X\ 100\% = 82\% \quad (5)$$

The results of the system testing questionnaire for 10 respondents are as follows:

Table 19. Results of System Testing for Respondents

Haice Company Name	Results
Ark	The results of the actual % score of each question summed up 70% + 82%+ 82%+ 78%= 312% Then the sum of the actual % scores is calculated at the average value $^{312}\%/4$= 78%. From the calculation results and the score interval table, it can be concluded that the average number of actual %scores is classified in the Agree category, so that the system that has been built is easy for users to use.

Mulia Wisata	From the results of the actual score of each question, summed up 86% + 78% + 82% + 82% = 328%. Then the sum of the exact score % is calculated, and the average value is 328% / 4 = 82%. From the results of the calculations and looking at the score interval table, it can be concluded that the average amount of the actual score % is classified as a Very Agree category, so that the system that has been built is helpful for users.

5. Conclusion

After observing the results of research trials using real data and comparing them with the design of the application system, the conclusions of this study are:

1. The Hiace transportation departure scheduling system is built using a web-based system to make it easier to manage the passenger departure schedule, without having to check manually one by one.
2. Implementing Genetic Algorithms in building the Hiace transportation departure scheduling system ensures that the bus scheduling transportation information system runs well. Scheduling is implemented in web technology that provides information to passengers because it can be accessed via the internet. The research that has been done still cannot be perfect, so further development is needed to get maximum results.
3. Some development suggestions that can be made include developing this bus scheduling information system application into a web service so that customers can access bus scheduling information more easily. Whether accessing through a PC, notebook, netbook, gadget, cellphone, or on a different operating system, web services only require internet access and a web browser.

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