

Comparison of dijkstra and genetic algorithms for shortest path guci

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ABSTRACT

This study aims to compare the performance of the Dijkstra algorithm and the Genetics algorithm in determining the shortest path to the Guci tourist destination. The research design combines experimental methods, quantitative analysis, and model validation. The data used is the distance between points on two alternative routes to Guci. Data pre-processing is done to ensure quality and consistency. The relevant variables are selected, and model optimization is performed to obtain the best parameter configuration for both algorithms. Dijkstra and Genetics algorithms are implemented using Python, taking into account computational efficiency and ease of integration. Model evaluation is done through a series of tests with time execution and convergence metrics. The results showed that Dijkstra's algorithm was superior in finding the shortest path with a distance of 43.0 km and an execution time of 0.0017 seconds, compared to the Genetics algorithm which found a path with a distance of 44.7 km and an execution time of 0.0048 seconds. It can be concluded that Dijkstra's algorithm is more effective and efficient in this case, but Genetics algorithms have the potential for more complex optimization problems.

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1. INTRODUCTION

In the era of globalization, transportation plays an important role in supporting various human activities, including tourism (Shah et al., 2021). One of the growing tourist destinations in Indonesia is Guci Tourism, which attracts many visitors every year. Accessibility and ease of travel to these destinations are essential to ensure an optimal travel experience (Pai et al., 2020).

However, accessibility to Urn Tourism still faces various challenges, especially in terms of determining the shortest path (Zhang et al., 2022). The path chosen must not only be time and cost efficient, but must also consider environmental impact (Llopis-Albert et al., 2021). This problem is crucial because non-optimal trails can lead to increased travel costs, longer travel times, and greater environmental impact (Aminzadegan et al., 2022). This can reduce visitor satisfaction and hinder the growth of the tourism sector in the area.

This research was conducted to address the complex and dynamic problem of determining the shortest path (Fragapane et al., 2021). Conventional methods such as Dijkstra's algorithm, while effective, are often not adaptive enough to rapidly changing conditions (Nan et al., 2023). This research aims to solve the problem of determining the shortest path by considering various dynamic factors, using a more adaptive Genetic Algorithm approach and being able to find optimal

solutions through evolutionary processes (Z. Wang & Sobey, 2020). This discussion is important because it can provide more efficient and sustainable solutions to tourism accessibility problems. Thus, this research can help increase visitor satisfaction and support the development of sustainable tourism (Streimikiene et al., 2021). This problem was addressed by comparing the effectiveness of the Dijkstra Algorithm and the Genetic Algorithm in determining the closest path to Urn Tourism (X. Wang et al., 2022). This analysis will involve simulating and evaluating the performance of both algorithms based on various travel scenarios.

This research was conducted because of the need to find a better solution in the determination of the shortest path that is adaptive and dynamic (Abbas et al., 2020). In addition, this study seeks to fill gaps in the existing literature related to the use of Genetic Algorithms for optimization of tourism transportation routes (Z.-G. Chen et al., 2022). This research contributes by providing a comprehensive analysis and direct comparison between two algorithms, namely Dijkstra and Genetics, in determining the shortest path to tourist destinations. This will provide new insights and enrich the existing literature (Liu et al., 2023).

The methods to be used include path modeling using the Dijkstra Algorithm and Genetic Algorithm, travel simulations with various scenarios, and performance analysis of both algorithms based on travel time, cost, and environmental impact (Qadir et al., 2021). The innovation proposed in this study is the use of Genetic Algorithms for the determination of the nearest route in tourism, which is expected to provide a more flexible and adaptive solution compared to conventional methods (Suanpang et al., 2022). This research will conduct simulations and comparative analysis between Dijkstra Algorithm and Genetic Algorithm. (Zheng et al., 2020).

Previous research discussing the development of a Dijkstra-based RLDA algorithm for vehicle lane planning that considers time at intersections, showed increased efficiency and convergence compared to other algorithms (Zhu & Sun, 2021). In later research, Dijkstra's dynamics solution was applied to address the dynamic shortest path problem using retroactive data structures, which showed better performance in terms of time and memory usage (Sunita & Garg, 2021). The third study focused on optimising the location of electric vehicle charging stations in Ireland using a social total cost model and genetic algorithm, which showed that this approach was effective in reducing operational and environmental costs (Zhou et al., 2022). Subsequent research developing parallel genetic algorithm solutions to vehicle routing problems in cloud implementations of intelligent transportation systems, demonstrated increased efficiency through deployments on GPUs and multi-core CPUs (Afero, 2021). And the study proposes an enhanced network topology and an improved Dijkstra algorithm for optimal path selection during link failures in microgrid clusters, demonstrating better reliability and efficiency than conventional approaches (Pradeep Reddy et al., 2022).

Some researchers focused on developing Dijkstra's algorithm and genetics for vehicle path planning and site optimization. However, research comparing the two in determining the nearest path is still limited (Merghadi et al., 2020). This study aims to compare the performance of Dijkstra's algorithm and genetics in determining the closest path to the Urn, focusing on computational time efficiency, and path accuracy.

2. RESEARCH METHOD

Research Design

This research design is a combination of experimental methods, quantitative analysis, and model validation. An experimental approach was used to test both algorithms under various conditions and routing scenarios. Quantitative analysis is applied to process and evaluate experimental data, while model validation aims to verify the accuracy and reliability of the algorithms tested.

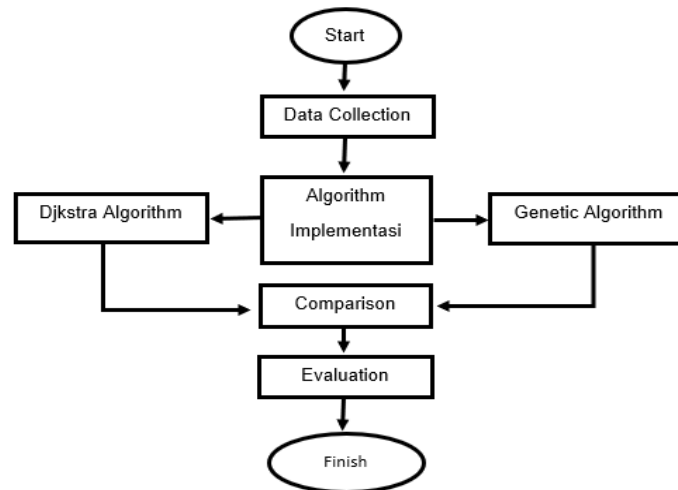


Figure 1. Research flow

Figure 1, is a research flow that begins with data collection which then the data will be processed using two algorithms, namely the djijkstra algorithm and the genetic algorithm. Hail calculations from the algorithm will be compared and then the results will be evaluated.

Data Collection

The data used is as follows:

Table 1. Research data

Line 1	
Line	Distance
Tegal Town Square- talang	5,1 km
Talang - Banjaran Market	3,5 km
Banjaran market - slawi pos	5,7 km
Slawi pos - yomani	8,0 km
Yomani - guci	20,7 km
Line 2	
Line	Distance
Tegal Town Square - pasifik mall	1,2 km
Pasifik mall - adiwerna	7,9 km
Adiwerna - Slawi Town Square	7,9 km
Slawi Town Square - yomani	7,0 km
Yomani - guci	20,7 km

Sumber: <https://www.google.com/maps>

Table 1, is data used for research that contains two paths to be passed, namely line 1 and line 2. Each line has different route points with distances per route on each line.

Data Pre-processing

Before the analysis, the data will go through a pre-processing stage to ensure its quality and consistency. This stage includes cleaning, normalizing, and transforming data if needed, to ensure the data is ready and in accordance with analysis needs.

Variable Selection and Model Optimization

The relevant variables for this study were selected based on literature studies and theoretical understanding of routing algorithms. The variable includes the total distance of the path. (Yang & Shami, 2020). The parameters optimized for the Dijkstra Algorithm include the selection of weights on each route and the priority of path tracing, while for the Genetic Algorithm includes population size, mutation probability, and number of generations.

Algorithm Implementation

The Dijkstra and Genetics algorithms will be implemented using the Python programming language, taking into account factors such as computational efficiency and ease of integration with other systems(C. Liu et al., 2020). This implementation will be tested in various scenarios to assess its performance under different conditions.

$$d[v] = \min(d[v], d[u] + w(u, v)) \tag{1}$$

Where $d[v]$ is the shortest distance found so far to the node v , $d[u]$ is the shortest to the node u currently under consideration, $w(u, v)$ is the weight of the edge connecting you and v .

$$fitness(x) = \text{As good } x \text{ meet the solution criteria} \tag{2}$$

Where this function is used to assess each individual in the population, where x represents a solution or individual(Deng et al., 2021).

Algorithm Configuration and Model Evaluation

The algorithm configuration will be adjusted based on the results of model optimization. Model evaluation is done through a series of tests designed to measure the effectiveness, efficiency, and accuracy of the algorithm in finding the shortest path. The evaluation metrics used are Excecution time and Convergence.

$$convergence = \frac{1}{N} \sum_{i=1}^N \frac{f(x_i) - (f(x^*))}{f(x^*)} \tag{3}$$

Where $f(x_i)$ is the value of the object function on the iteration to- i , $f(x^*)$ is the optimal value known or best found by the algorithm, and N is the number of iterations taken to achieve convergence(H. Chen et al., 2022).

3. RESULTS AND DISCUSSIONS

This study aims to compare between the Dijkstra algorithm and the Genetics algorithm in determining the shortest path to the Guci tourism site.

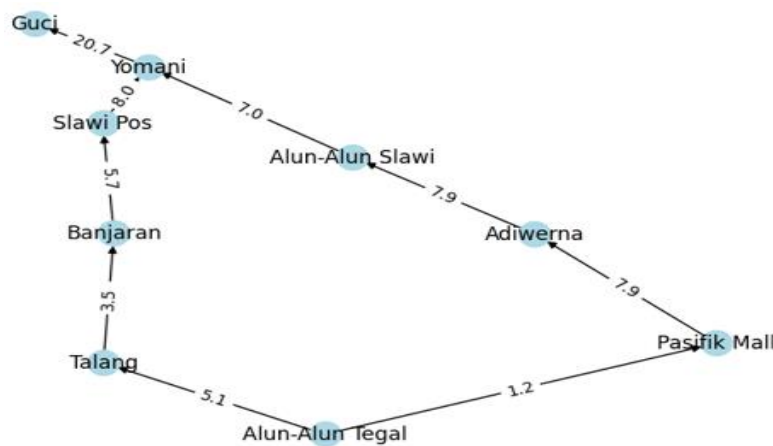


Figure 2.Dijkstra algorithm path

Figure 2, is the result of calculations using the Dijkstra Algorithm which starts the starting point of the path in Tegal City Square and ends directly at the Guci tourist attraction by producing the shortest path length of 43.0 km.

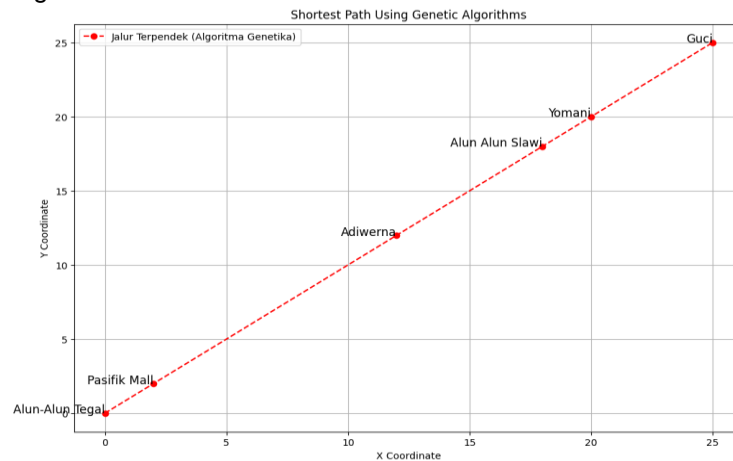


Figure 3. Genetika Algorithm Path

Figure 3, is the result of calculations using the Dijkstra Algorithm which starts the starting point of the path at Tegal Square - Pasifik Mall - Adiwerna - Alun Alun Slawi - Yomani and ends directly at the Guci tourist attraction by producing the shortest path length of 44.7 km.

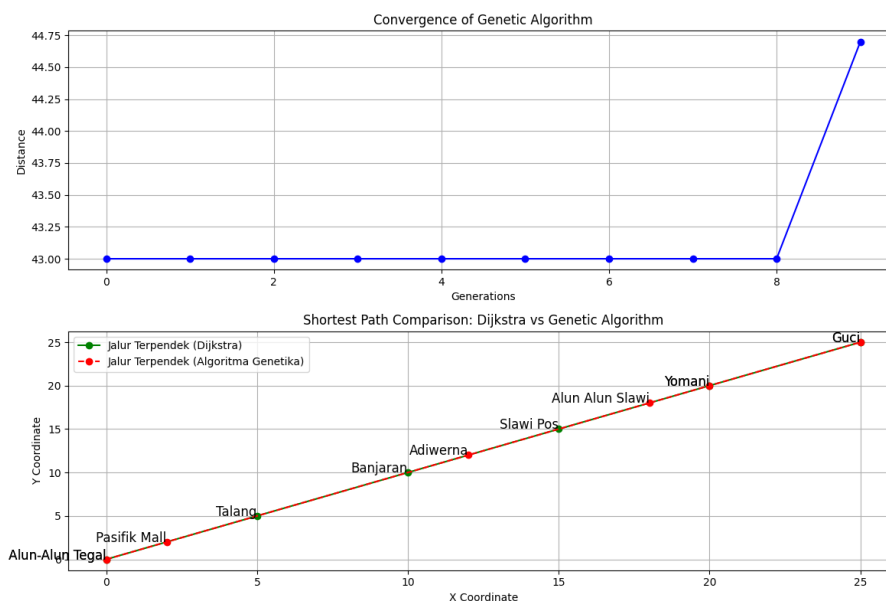


Figure 4. Evaluation visualization

Figure 4, The graph shown compares the shortest path found by Dijkstra's algorithm and the genetic algorithm for the route from "Alun-Alun Tegal" to "Guci". Dijkstra's algorithm found the shortest path with a distance of 43.0 km through "Talang", "Banjaran", "Slawi Pos", and "Yomani", with an execution time of 0.0017 seconds. Instead, the genetic algorithm found a path with a distance of 44.7 km through "Pasifik Mall", "Adiwerna", and "Alun Alun Slawi", with an execution time of 0.0048 seconds. The convergence graph shows that the genetic algorithm underwent small changes in the early few generations and significant distances increases in the last generation, indicating instability in reaching optimal solutions. In this respect, Dijkstra's algorithm is superior

both in faster execution times and in finding the shortest path that is more optimal than genetic algorithms.

This research successfully fills the existing gaps by providing a comprehensive analysis and direct comparison between the Dijkstra algorithm and the Genetic algorithm in determining the shortest path to a tourist destination, demonstrating the superiority of the Dijkstra algorithm in terms of efficiency and accuracy compared to the Genetic algorithm.

4. CONCLUSION

The conclusion of this study shows that Dijkstra's algorithm is superior in finding the shortest path, with a distance of 43.0 km and an execution time of 0.0017 seconds, compared to the Genetic algorithm's 44.7 km path and 0.0048 seconds. However, Genetic algorithms have potential for more complex optimization problems, suggesting further research in more intricate cases and exploring hybrid approaches to leverage both algorithms' strengths. This research, which comprehensively compares Dijkstra and Genetic algorithms for the Guci tourist destination, highlights practical implications for tourism and transportation planning. Incorporating factors like traffic, weather, and user preferences could tailor solutions to real-world needs, enhancing visitor satisfaction and supporting sustainable development.

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