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FINDING THE SHORTEST ROUTE BETWEEN EAST OKU'S ISLAMIC BOARDING SCHOOLS USING THE DIJKSTRA ALGORITHM

Amanah Yulianti [1*], Denix Aricho Sundawa[2], Beni Hermansyah[3]
[1]Department of Mathematics, Universitas Nurul Huda, Indonesia
[2]Department of Mathematics, Universitas Nurul Huda, Indonesia
[3]Department of Mathematics, Universitas Nurul Huda, Indonesia
[*]Corresponding Author: E-mail: amanah@unuha.ac.id

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ABSTRACT

Penelitian ini bertujuan untuk mengukur jarak antara pondok pesantren yang ada di Oku Timur, dengan menggunakan metode Algoritma Dijkstra dapat dengan mudah menentukan rute terbaik dari Pondok Pesantren Nurul Huda Sukaraja menuju Pondok Pesantren Subulussalam Sriwangi. Pada penelitian sebelumnya yaitu menentukan rute terpendek saat melakukan distribusi dari kebun sayur ke gudang antara jalur *toll* dan bukan *toll* untuk meminimalisir biaya. Algoritma Dijkstra merupakan algoritam dalam teori graf yang digunakan untuk menemukan jalur terpendek antara semua pasangan simpul dalam sebuah graf berbobot, baik yang berbobot positif maupun negatif, dengan waktu komputasi yang efisien. Algoritma ini bekerja dengan prinsip dynamic programming dan mampu mengatasi graf yang memiliki bobot negatif selama tidak ada siklus negatif. Dalam implementasinya, algoritma Dijkstra secara iteratif memperbarui jarak terpendek antar simpul melalui pembandingan jalur yang lebih langsung dengan jalur yang melewati simpul lainnya. Keunggulan dari algoritma ini terletak pada kesederhanaannya dan kemampuannya untuk menghitung jarak terpendek antara semua pasangan simpul dalam satu proses. Hasil penelitian menunjukan bahwa Algoritma Dijkstra dapat menunjukan rute alternatif tercepat dan efisien dibandingkan rute konvensional. perhitungan dengan metode Algoritma Dijkstra menghasilkan lintasan terpendek dimulai dari titik 1-4-5 dengan jarak tempuh adalah 48 km, rute paling optimal antara titik lokasi dengan titik tujuan.

This study aims to measure the distance between Islamic boarding schools in East Oku, using the Dijkstra Algorithm method to make it easier to determine the shortest route from the point of the Nurul Huda Sukaraja Islamic Boarding School to the Subulussalam Sriwangi Islamic Boarding School. In previous research, namely determining the shortest route when distributing from vegetable gardens to warehouses between toll and non-toll routes to minimize costs. In graph theory, the Dijkstra algorithm efficiently calculates the shortest path between any pair of nodes in a weighted graph, both positive and negative. This algorithm works with the principle of dynamic programming and can overcome graphs with a negative weight as long as there are no negative cycles. In its implementation, the Dijkstra algorithm iteratively updates the shortest distance between nodes by directly comparing paths with paths passing through other nodes. The advantage of this algorithm lies in its simplicity and ability to calculate the shortest distance between all pairs of nodes in a single process. The study

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results show that the Dijkstra Algorithm can show the fastest and most efficient alternative routes compared to conventional routes. Calculations using the Dijkstra Algorithm method produce the shortest trajectory starting from point 1-4-5 with a distance of 48 km, the most optimal route between the location and destination points.

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INTRODUCTION

Advances in information technology have affected various aspects of life, including navigation and transportation. One of the challenges in navigation is finding the fastest route that can save time and fuel, especially in areas with high traffic density. The Dijkstra algorithm is one of the algorithms commonly used in graph programming to find the shortest path on a map that is mapped as a directed graph. In the context of transportation and navigation, the Dijkstra algorithm has been widely used in GPS systems and digital map applications to determine the best route from one point to another. This study aims to find the shortest path between the Nurul Huda Sukaraja Islamic Boarding School and the Subulussalam Sriwangi Islamic Boarding School using the Dijkstra Algorithm. By mapping the road network of the East Oku area as a graph, this study is expected to offer a practical solution to support users in finding the fastest route between two important points. The implementation of this algorithm is also expected to contribute to the improvement of local navigation systems with better accuracy and efficiency.

Algorithms for route optimization, especially in regional environments, have been a concern in information technology and transportation research over the past few decades. The Dijkstra method is one of the often utilized algorithms in routing systems since it is well-known for its incredible speed and efficiency in determining the shortest path in a positive-weighted graph (Harahap & Khairina, 2017). Previous studies have shown that the Dijkstra algorithm can be effectively applied to urban navigation systems that require quick decision-making of route choices (Perayoga et al., 2023; Zaki, 2017). This algorithm is implemented in many navigation applications, such as Google Maps, to provide optimal routes based on road network analysis (Arumsari et al., 2016). Given the traffic conditions that often experience congestion, especially in economic centers such as Eastern Oku, this algorithm can provide an efficient solution for local navigation.

Research on finding the shortest path has been done a lot, including by (Masri et al., 2019), who used the Dijkstra Algorithm. This system helps visitors a lot because they can find the shortest path to and from any tourist spot near Lake Toba. Using this system, tourists can get information about the fastest way to reach places. This helps them choose the best route that saves time and money, and gives them all the details about the tourist attractions in the Lake Toba area. The research conducted by (Awalloedin et al., 2022; Harahap & Khairina, 2017) is a problem in finding the shortest path along with the shortest time savings. This is important in the dynamism of urban society. The number of routes taken is also a separate problem when reaching the destination. "Determination of the Shortest Route Using the Dijkstra Algorithm on School Bus Lines," the follow-up study by (Gautama & Hermanto, 2020), was published in Hermanto (2020). Furthermore, by (Juniawan & Sylfania, 2020), The project focuses on finding the shortest path for tourists visiting different attractions in Toboali City by using a web-based version of the Dijkstra algorithm. This method helps in determining the most efficient route between various tourist spots. The algorithm works by calculating the shortest distance between points, and it is implemented through a web application so that users can easily access and use it. The goal is to provide tourists with a convenient way to plan their trips and navigate the city effectively. From the results of the elaboration of previous studies, it is known that the Dijkstra algorithm has been and can be applied to solve many problems. Therefore, from the level of use, this algorithm is considered suitable as a determinant of the shortest distance.

This algorithm utilizes a greedy approach by determining the next node based on the minimum distance from the initial node. The algorithm works by selecting the node with the lowest cumulative weight value that has not been visited, and then updating the distance to the neighboring node until it reaches the destination node (Pratiwi, 2022). Using the Dijkstra algorithm, this study seeks to ascertain the path or distance between the Nurul Huda Sukaraja Islamic Boarding School's starting point and the Subulussalam Sriwangi Islamic Boarding School via other boarding schools. Researchers used the Dijkstra Algorithm because it is presented in a simpler form compared to the Floyd-Warshall Algorithm, making it easier to determine the shortest path. Both algorithms look for the shortest path in a graph where each connection has a weight, but they work in different ways. The Dijkstra Algorithm finds the shortest path from one specific starting point to every other point in the graph. The Floyd-Warshall Algorithm, on the other hand, finds the shortest path between every pair of points in the graph (Angreni et al., 2024; Harahap & Khairina, 2017).

METHOD

The research method is a step taken to get solutions to all problems. Finding an efficient route using the Dijkstra Algorithm to solve the problem of determining the shortest route of a road network is a relevant problem, especially in areas with a high level of mobility. This algorithm prioritizes the route with the smallest cumulative distance on a weighted graph (Wulandari & Sukmasetya, 2022). The type of research used in this study is applied research. Applied research is research that examines practical realities in various fields. In addition, applied research has a position as research on applying knowledge resulting from basic research. In this study, a test of benefits can be carried out by knowing the empirical relationship between theory and implementation in the practical world.

The Dijkstra algorithm finds the shortest path by focusing on one node at a time. In each step, it ensures that at least as many nodes as the step number have the shortest path determined. It uses a greedy method, always picking the shortest known path at each stage. This makes it good for finding the quickest route from one point to many others, like in navigation systems or network routing (Ferdiansyah, 2013; Lakutu et al., 2023). The research aims to have data on the distance of the starting point from the Nurul Huda Sukaraja Islamic Boarding School and the Subulussalam Sriwangi Islamic Boarding School, connected to the side, which is the distance of travel time required along the route. This data can be obtained from the map application (Google Maps (km)). To get these results, it is necessary to process the data first. The initial stage is to design a graph, then determine the weight of each point based on the distance.

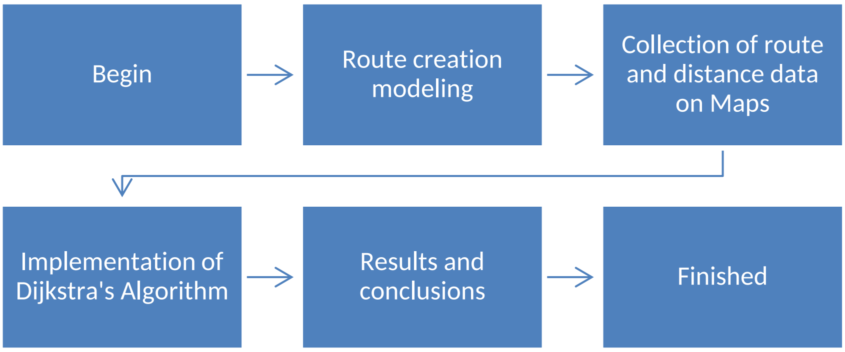

Figure 1. Research Procedure

RESULTS

A. Modeling of Regional Road Graphs

- Identification of Points: Identification of starting points (points of Nurul Huda Sukaraja Islamic Boarding School to Subulussalam Sriwangi Islamic Boarding School) and other location points. Each of these locations will be considered a point in the graph.
- Determination of Connecting Points: Connect each point with a corresponding path, where each side represents the path connecting the two points.
- Determination of Weight on Each Side: The weight of each side is determined based on the distance or travel time on the road connecting the points.

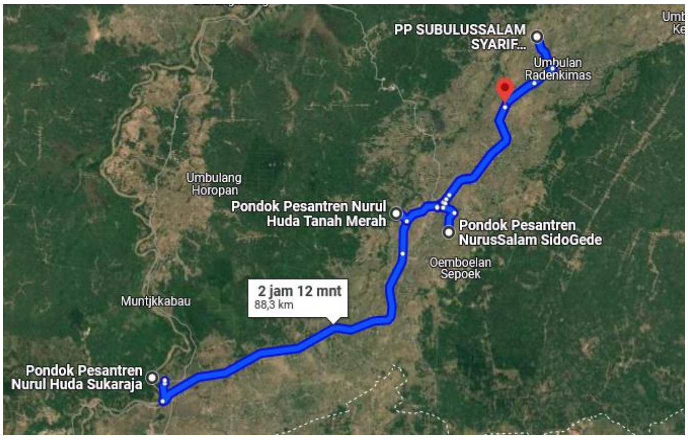

Figure 2. Google Maps

B. Data

In its implementation, this study determined the point of the Nurul Huda Sukaraja Islamic Boarding School to the Subulussalam Sriwangi Islamic Boarding School. Between the starting point and the destination point, 5 points or nodes are manually generated. The weight value is determined based on the distance shown on *the Google Maps Map (Haversian method)* taken on December 28, 2024.

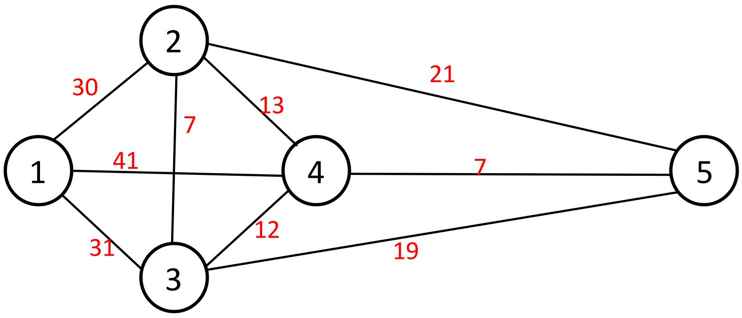

Figure 3. Graph Trajectory

Table 1. Path Implementation

LODGE NAME	POINT	ADDRESS
PPNH 1 Sukaraja	1	Number 237 RT/RW 012, 004, Sukaraja, Buay Madang District, Ogan Komering Ulu Timur Regency, South Sumatra 32367
PPNH 2 Tanah Merah	2	VJPF+C8X, Jl. Tanah Merah, Rejodadi, Kec. Belitang Madang Raya, Ogan Komering Ulu Timur Regency, South Sumatra 32382
PP Nurussalam Sidogede	3	VMF5+HCG, Sidogede, Belitang District, Ogan Komering Ulu Timur Regency, South Sumatra 32382
PP Darul Falah Sugiwaras	4	Sugih Waras, Tulung Sari, Kec. Belitang Mulya, Ogan Komering Ulu Timur Regency, South Sumatra 32385
PP Subulussalam Sriwangi	5	2P39+F6C, Sriwangi, Semendawai Suku III District, Ogan Komering Ulu Timur Regency, South Sumatra 32383

C. Implementation of the Dijkstra Algorithm

Dijkstra's algorithm aims to locate routes between two points with a small t-weight. The algorithm's ultimate goal is to find the fastest route between two points using the lightest weight (Dijkstra et al., 2021; Ihsan et al., 2024; Pradhana, 2013).

The whole procedure for determining the closest route to the museum is shown in the flowchart. From the initial stage to the destination of the intended museum visit, a search process is conducted by analyzing the route to determine the most effective path (Galih & Krisdiawan, 2018; Gautama & Hermanto, 2020). The steps in the Dijkstra algorithm technique are briefly explained in the flowchart in Figure 4.

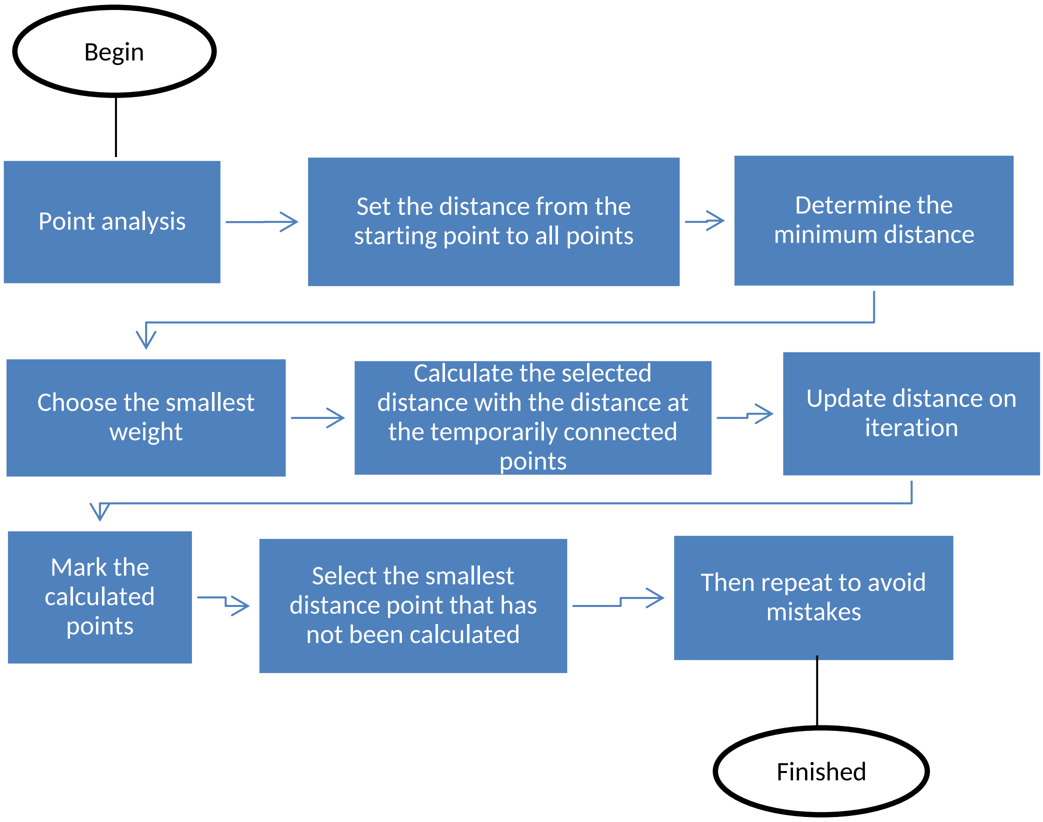

Figure 4. Dijkstra Algorithm Flowchart

In the case study, the steps for completing the Dijkstra algorithm have been determined in Figure 2. The completion of the Dijkstra method has 5 points to obtain the shortest distance and meets the objectives as shown in Table 2.

Table 2. Distance between points

From ->To		**Distance**
1	2	30
1	3	31
1	4	41
2	3	7
2	4	13
2	5	21
3	4	12
3	5	19
4	5	7

The shortest distance between the initial location (1) and the destination point (starting point) is calculated using the Dijkstra algorithm. Location (1) and the destination point (5) are calculated using the Dijkstra algorithm. For each step from the selected point, add the previous smallest weight by all distances from the selected point to the connected point whose box is colorless, as follows:

Step 1. The calculation starts from the starting point (point 1). Point 1 is connected to point 2 with a distance of 5, point 1 is connected to point 3 with a distance of 4, and then point 1 is connected to point 4, which is **∞ apart,** so that the weight of the smallest distance selected from point 1 to point 3 is four distances. Calculate a new value with the formula:

$$D_j = \min(D_j, D_i + C_{ij})$$

Information:

D_i : minimum distance from starting point s to point i

C_{ij} : weight from point i to point j. if there is no path from i to j, then C_{ij} is considered infinite(∞)

N : set of points

—a point whose shortest distance from the starting point is known.

Step 2. Next, select point 3. Point 3 connects to the next point, then repeat step 1 until there are no more points that can be updated in distance.

Table 3. Calculation of the Dijkstra Algorithm

Iteration	**N**	**D2**	**D3**	**D4**	**D5**
0	{1}	30	31	41	∞
1	{1,2}	30	37	43	51
2	{1,2,4}	30	37	43	51
3	{1,4,5}	30	37	43	48

Figure 5 illustrates the results of the Dijkstra algorithm computation, which showed that the shortest track distance was 48 km, beginning at points 1-4-5.

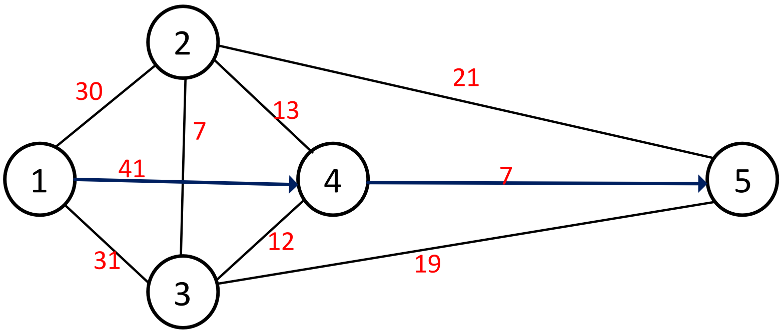

Figure 5. Graph with the shortest trajectory path

The results show a significant difference between the shortest route and the distance traveled on Google Maps and the Dijkstra Algorithm estimate. This is partly due to the condition of the roads between the Islamic boarding schools.

CONCLUSION

Based on studies conducted on the Dijkstra Algorithm's ability to find the shortest path. The manual Dijkstra Algorithm computation results show that the shortest track distance, with the smallest weight from one point to another, is 48 km, beginning at points 1-4-5. Based on the calculations, the application that uses the Dijkstra Algorithm can display the shortest route according to the desired destination location point. Using the Dijkstra Algorithm proves that optimizing the shortest route can be or has been optimal for the distance traveled. Research using the Dijkstra Algorithm can also be applied to local navigation systems and other regions.

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The authors did not use AI in any way in the preparation, writing, or completion of this manuscript. The authors confirm that they are the sole authors of this article and take full responsibility for its content, as outlined in the COPE recommendations.

INFORMED CONSENT

The authors have obtained informed consent from all participants.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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