JMSCOWA 4 (1) (2023) Pages:. 16-19

Journal homepage: https://pcijournal.org/index.php/jmscowa

Journal of Mathematics and Scientific Computing with Applications

Published: Pena Cendekia Insani

APPLICATION OF GREEDY ALGORITHM IN FINDING THE SHORTEST PATH TO HAJI ADAM MALIK CENTRAL GENERAL HOSPITAL MEDAN

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Article Info

Article history:

Received 07 30, 2022
Revised 09 27, 2022
Accepted 12 30, 2022

Keywords:

Greedy algorithm, Shortest path

ABSTRACT

This research aims to simplify access to Haji Adam Malik Medan Central General Hospital by using the Greedy algorithm efficiently. With various alternative routes available, the Greedy algorithm is applied to determine the shortest path that minimizes travel time. Data was obtained via Google Maps from four reference points: Belawan, Aceh, Berastagi, and Kualanamu Airport. The results reveal that the optimal route from Belawan is Node A → a1 → a3 → R, covering 37 km in 55 minutes. From Aceh, the best path is Node B → a1 → a3 → R, with a distance of 137 km in 1 hour 19 minutes. For Berastagi, the fastest route is C → R, with a distance of 53 km and a travel time of 1 hour 31 minutes. From Kualanamu Airport, the optimal path is Node D → a4 → a2 → R, covering 46 km in 1 hour 3 minutes. This study demonstrates the Greedy algorithm's effectiveness in solving shortest path optimization problems and highlights its potential to serve as a foundation for navigation system development in Medan. It provides practical solutions for improving travel efficiency to critical locations like hospitals.

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1. INTRODUCTION

Patient safety is a system that aims to improve the safety of patient care. It includes risk assessment, identification and management of patient risks, reporting and analysis of incidents, opportunities to learn from events, and implementation of solutions to reduce risks and prevent injuries due to errors in practice. Patient safety is critical to improving the quality of healthcare services, especially in hospitals. This includes the qualifications of health workers, the availability of service facilities, and the implementation and evaluation of command and control systems in the patient care cycle.[1]

Type A hospitals are chosen for their superior patient safety standards and more efficient care. Type A hospitals are healthcare facilities that provide the most comprehensive and superior medical and nursing services. These hospitals are commonly referred for complex medical cases that require intensive care. Experienced specialists and health workers are ready to provide high-quality services to patients. Haji Adam Malik Central General Hospital is the only type A hospital in Medan. This hospital is a type A hospital that provides complete and sophisticated health services, and has complete and experienced specialist doctors.[2]

To reach Haji Adam Malik Central General Hospital, there are several alternative routes that can be used. However, to ensure that the sick community gets immediate treatment and more efficient health

facilities, an optimal path and minimal travel time to reach the hospital is required. Travel time is defined as the average duration it takes a vehicle to traverse a road segment of a given length, including delays due to stopping, measured in seconds or hours.[3]

The shortest path between two or more connected vertices in a graph is an optimization problem. This problem is generally represented in the form of a weighted graph, which is a graph in which each edge is assigned a value or weight. The weights on the graph edges can represent the distance between cities, message delivery time, construction costs, and so on. Shortest paths can be determined by modeling the road network as a weighted graph, where each edge has a value or weight.[4]

To determine the shortest path, various methods can be applied, including the Greedy algorithm and heuristic methods. The Greedy algorithm is a method used to solve optimization problems, with the goal of finding an optimal solution that can be either maximization or minimization. Literally, "Greedy" means greedy or avaricious, which reflects the algorithm's method of incrementally building a solution. Every step of the way, the algorithm will face various options and immediately choose the optimal step available at that moment. The basic principle of the algorithm is "take what you can get right now!" -prioritizing the optimal option at each stage without considering the next step.

1. At each stage, the algorithm makes a local optimal choice.
2. This step is taken with the expectation that the next step will lead to the global optimal solution.[5]

2. RESEARCH METHODE

This research focuses on four locations that are used as a reference for traveling to the Haji Adam Malik Medan Central General Hospital, namely Aceh Tamiang, Belawan, Berastagi, and Kualanamu Airport. In this study there are 17 alternative routes to determine the efficient trajectory. Google Maps is used in this research to collect data and provide mileage and estimated time obtained from each predetermined route. The Greedy Algorithm is applied in this quantitative research to calculate travel time and distance, resulting in minimum time and efficient trajectory to reach the intended hospital.[6]

Greedy algorithm is a method applied to solve optimization problems with the principle of choosing the optimal step locally at each stage without considering global consequences. In the context of shortest path finding, this algorithm operates by:

1. Selecting the node that has the closest distance to the starting node.
2. Adding it to the solution set.
3. Repeats the steps until it reaches the goal.

The advantage of the Greedy algorithm lies in its simplicity and efficiency in providing a near-optimal solution to the problem. However, it does not always ensure a truly global optimal solution as it does not consider all possible alternatives.[7]

a) The Greedy algorithm for determining the shortest cycle can be formulated as follows: Check all the edges directly adjacent to vertex A. Select the edge with the smallest value. This is the first shortest cycle, let's call it L(1).
b) Identify the second shortest path by the following methods:
    1) Calculate: d(i) = length of L(1) + edge value from terminal vertex L(1) to vertex ii.
    2) Choose the minimum d(i). Compare d(i) with the value of edge (a,i). If the value of edge (a,i) is smaller than d(i), then L(2) = L(1) ∪ (edge from terminal vertex L(i) to vertex i.[5]

3. RESULT AND ANALYSIS

After collecting data through google maps, the distance and travel time are depicted in the following graph:

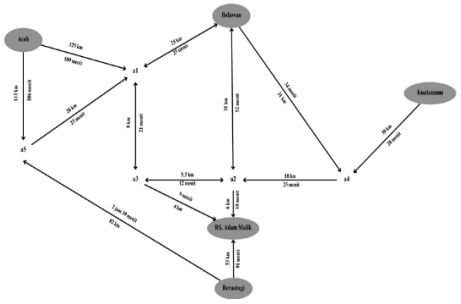

Figure 1. Travel Route Chart

Based on the data obtained, the Greedy algorithm can be used to determine the route with minimal travel time. The first step that must be done is to determine the starting point and destination point, and compile a graph structure that describes the road network in question.[8] In this study, the Haji Adam Malik Medan

Central General Hospital (RSUP Haji Adam Malik) is considered as the destination point, which is symbolized by R. The starting point consists of several reference locations which include:

- Point A: Belawan,
- Point B Aceh,
- Point C: Berastagi,
- Point D: Kualanamu Airport.

Furthermore, for each starting point, nodes representing the main routes in the road network system were mapped, consisting of:

- a1: Helvet Toll Gate,
- a2: Jamin Ginting Post Intersection,
- a3: Selayang Intersection,
- a4: Amplas Toll Gate,
- a5: Binjai area.

With these assumptions, the Greedy algorithm is applied to find the shortest path based on distance and travel time, by selecting the closest node at each step, until it reaches destination R.
The results obtained from applying the Greedy algorithm to these routes will be discussed further in the results and discussion section:
Results from Belawan

- Selected Route: Node A → a1 → a3 → R.
- Distance 37 km.
- Travel Time: 55 minutes.
- Analysis: This route avoids the more congested main roads such as a2 and a4, which tend to have higher traffic. The selection of Selayang intersection (a3) provides efficiency due to the direct connection to Haji Adam Malik Hospital.

Results from Aceh

- Selected Route: Node B → a1 → a3 → R.
- Distance: 137 km.
- Travel Time: 1 hour 19 minutes.
- Analysis: Despite the relatively long distance, this route is optimal as it avoids junction a5 which has lower connectivity to the final destination. This route shows the superiority of the Greedy algorithm in selecting the best local node at each stage.

Result from Berastagi

- Selected Route: Node C → R.
- Distance 53 km.
- Travel Time: 1 hour 31 minutes.
- Analysis: With only one direct node to the destination, this result illustrates a situation where the Greedy algorithm only chooses the shortest path with no other options available. However, the travel time is longer due to the geographical conditions from Berastagi to Medan.

Result from Kualanamu Airport

- Selected route: Vertex D → a4 → a2 → R.
- Distance 46 km.
- Travel Time: 1 hour 3 minutes.
- Analysis: This route optimizes the toll roads (a4 and a2) which have smoother traffic compared to the alternative route. The selection of intersection a2 provides significant efficiency compared to using a3 or

4. CONCLUSION

Patient safety is crucial in healthcare, especially in hospitals such as Haji Adam Malik Central General Hospital. To ensure efficient care, this study uses a greedy algorithm to find the shortest path between interconnected vertices in a weighted graph. This algorithm consists of candidate set, solution set, selection function, feasible function, and objective function. After collecting data through Google Maps, this research determines the most efficient route and fastest time for four reference points: Belawan, Aceh, Berastagi, and Kualanamu Airport. The algorithm used aims to maximize or minimize the solution value. The efficient route and fastest time from the Belawan direction is node A → a1 → a3 → R with a distance of 37 km and a time of 55 minutes. From the direction of Aceh is from node B → a1 → a3 → R with a distance of 137 km and a time of 1 hour 19 minutes. From Berastagi is C → R with a distance of 53 km and a travel time of 1 hour 31 minutes. And from Kualanamu Airport is node D → a4 → a2 → R with a time of 1 hour 3 minutes.

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