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Optimization of the Shortest Route Using the Djikstra Algorithm to the Nearest Covid-19 Referral Hospital for Communities Exposed to the District of Medan Baru

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ABSTRACT

Abstract: Finding the shortest route is a problem to find a path that connects two nodes with the least amount of weight. Many methods are used in finding the shortest route. One of the methods used is Dijkstra's algorithm. Dijkstra's algorithm is an excellent algorithm used in determining the shortest route from a startingpoint toan end point (destination). In this study, the determination of the shortest route from each kelurahan in the Medan Baru District to the nearest Covid-19 referral hospital can be searched maximally using the Dijkstra algorithm with the distance taken through the google maps application. However, there are some limitations that are limitations in this study. The drawbacks are traffic jams, traffic lights, one-way streets. This cannot be ignored on routes in urban areas. In the future, researchers will look for optimization of determining the shortest route by including some of the problem constraints that occur. The Dijsktra algorithm is an application that must be modernized for more complex constraints.

Keywords: shortest route, covid-19, traffic, Optimization, Dijkstra's algorithm

INTRODUCTION

The route is the distance or direction that must be traversed while the path is the space that extends between two straight boundary lines. The shortest route is a path that is a choice between two or several available options. The search for a shortest route is to minimize the distance traveled. On a path, the starting location and the destination location are symbolized by nodes (dots). To find the shortest route from the initial node to another node is a fundamental thing in graph theory. According to graph theory, the shortest route problem is to find a route between two vertices on a weighted graph that has the minimum combined number of weight values on the side of the graph traversed. In the shortest route problem, it is assumed that the parameters are distance, time and others between different nodes (Kumar and Kaur, 2011). The problem of the shortest route is most often encountered, namely in the field of transportation, such as in the search for the shortest route to take two cities (Irsyad and Rasila, 2015).

Searching for the shortest route is one of the solutions in finding the closest location if there are several paths that can be passed. As is the case, in the search for a COVID-19 referral hospital by exposed people in the Medan Baru District. Medan Baru District is a sub-district consisting of 6 (six) urban villages and has quite a lot of routes.

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To reach the targeted COVID-19 referral hospital, information on the shortest route optimization is needed to minimize costs and make time more efficient for immediate treatment.

The There are many algorithms to search for the shortest route, one of which is Dijk stra's algorithm. Dijkstra's algorithm is a graph search algorithm that solves the single-source shortest path problem where Dijkstra will find the shortest path from one start vertex by examining and comparing each path. However, Dijkstra can be modified so that it can be used to find the shortest path from each vertex. For a sparse graph, which is a graph with a smaller number of edges than V2, Dijkstra can have a smaller time complexity (Orlando, 2015).

Currently, to search for the nearest path using a google map or GPS (Global Position System), the GPS available in the application is used to determine the user's distance from the place he wants to go (Zamrony, 2016). As the initial node, namely the village located in Medan Baru District, which consists of Babura Village, Darat Village, Merdeka Village, Padang Bulan Village, Petisah Hulu Village, and Titi Chain Village, and as the final node, the COVID-19 referral hospital. But on google maps can not recommend which route is closest to the destination. Therefore, by applying the Dijkstra's algorithm, it is hoped that it can assist in finding and determining the shortest route so that an optimal path is obtained to achieve the goal

LITERATURE REVIEW

Dijkstra's algorithm is one of the effective algorithms used in determining the shortest path/route from one location to another. The principle of this algorithm is to find a location point by searching for the two shortest paths (Shivakumar and Chandrasekar, 2014). In each iteration, the known point distance (from the starting point) is updated if it turns out that there is a new point that provides the shortest distance (Huijuan, 2011). The graph used in this algorithm is a directed graph or a graph that has a value (weight) (Lyle, 2018).

Dijkstra's algorithm was discovered by Edsger Wybe Dijkstra in 1959 (Siti and Ardiansyah, 2020). Dijkstra's algorithm is included in the Greedy algorithm, where at each minimum weight connects a node that has been selected with another node that has not been selected (Shivani, 2015). Dijkstra's algorithm can find the shortest route in a number of steps.

This algorithm aims to find the shortest path based on the smallest weight from one point to another (Sathi, 2012). Suppose the point describes the location/place, and the line describes the path, then Dijkstra's algorithm performs calculations on all possible smallest weights of each point.

Medan Baru District is one of 21 sub-districts in Medan City. The district of Medan Baru is bordered by Medan Sunggal and Medan Selayang to the west, Medan Polonia to the east, Medan Johor to the south, and Medan Petisah to the north. In 2016, this sub-district had a population of 40,560 people. The area of this sub-district is 5.41 km2 and the population density is 7,497.22 people/km2. Medan Baru District has 6 villages.

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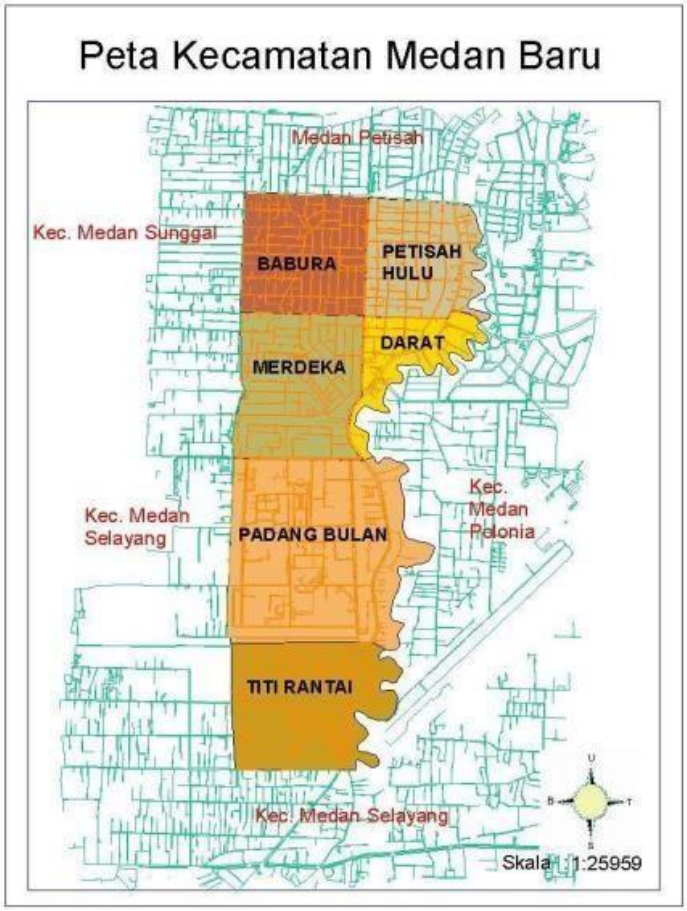

Figure 1. Maps of Medan Baru District

METHOD

The method used in this research is literature study and case study. Graphs are very much instrumental in helping solve problems about the internet, transportation, routes, and artificial intelligence. In addition, graphs are also very useful in data mining or data mining, namely finding patterns or information in big data. In this st udy, what is discussed is the problem of the route, namely the shortest route. The first thing to do is to discuss the theory of graphs, types of graphs, terminology, Dijkstra's Algorithm and the relationship between graphs and these algorithms in determining the shortest route in a case. Furthermore, field studies to obtain information about the Medan Baru District and the Covid-19 Referral Hospital in Medan City. To measure the distance between the nodes, researchers used google maps and based on a map with a manual scale calculation. After each regional distance is known, the shortest route is determined using the Dijkstra algorithm to determine the shortest route from the kelurahan in Medan Baru District to the nearest COVID-19 referral hospital.

RESULT

In this section, Before carrying out the research, the researchers first conducted site observations in the District of Medan Baru. In this observation, the researcher conducted a direct review of the location of the village in Medan Baru District, then the possible routes to go to the nearest referral hospital. In the District of Medan Baru there are 6 villages that are interconnected. These villages are:

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1. Titi Rantai village
2. Padang Bulan village
3. Merdeka village
4. Darat village
5. Babura village
6. Petisah Hulu village

For the initial location in this study, the researchers took Titi Rantai Village as the starting point. Then for the second location in the Padang Bulan village, Merdeka, Darat, Babura, and Petisah Hulu. For the route point, the researcher made it right in the village as the starting point. Then the next observation is the determination of possible routes to the hospital. In this case, the researcher limits the route taken to the referral hospital. For each kelurahan, the route taken to get to the nearest Covid referral hospital is through:

1. Jamin Ginting street
2. Wahid Hasyim street
3. Pattimura street
4. Cut Nyak Makam street
5. Diponegoro street
6. Sriwijaya street
7. Irian Barat street
8. Darussalam street
9. Sei Mencirim street
10. Jenderal Soedirman street

After the route and distance are determined, the researcher uses the Dijkstra algorithm to determine the route. In Dijkstra's algorithm, the determination of the shortest route is done by adding up the minimum weight of each distance from the starting point to the end point. The graph used in Dijkstra's algorithm is a graph that has weights and directions. In the research to get the results sought by using matlab programming. Next, the researcher will display the source code in matlab programming using the Dijkstra algorithm:

Source Code

```
Jarak = [8.2 3 2 3.9 2 2.3 0.5 3.9 1.1 1.5 0.8 1.8 7.9 5.6 5.6] ;
A = [1 1 3 4 3 6 4 9 6 5 7 10 7 9 11]
B = [2 3 4 5 6 7 8 8 4 9 10 8 11 11 9]
DG = sparse(A,B,Jarak)

>> h = view(biograph(DG,[],'ShowWeights','on'))

>> [dist,path] = graphshortestpath(DG,1,11)

>> set(h.Nodes(path),'Color',[1 0.4 0.4])
edges = getedgesbynodeid(h,get(h.Nodes(path),'ID'));
set(edges,'LineColor',[1 0 0])
set(edges,'LineWidth',2)
```

Figure 2.Source Code of Dijkstra's Algorithm

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In the picture above, there are distances, A, and B. The distance in the source code is the distance of each point from A to B. The distance is the result of a search using google maps. A is the starting point of departure which in this case is the kelurahan and B is the end point (destination) which in this case is the closest COVID-19 referral hospital from the Medan Baru District. For the results of determining the shortest route from the starting point to the end point with matlab programming, it will be marked with a red thick line meaning that it is the shortest route chosen to the destination location.

In this picture it is explained that there are 15 paths connecting the kelurahan and the destination hospital. There are 6 (trajectories) village and 5 (trajectories) the closest COVID-19 referral hospital. The other four paths are reverse directions.

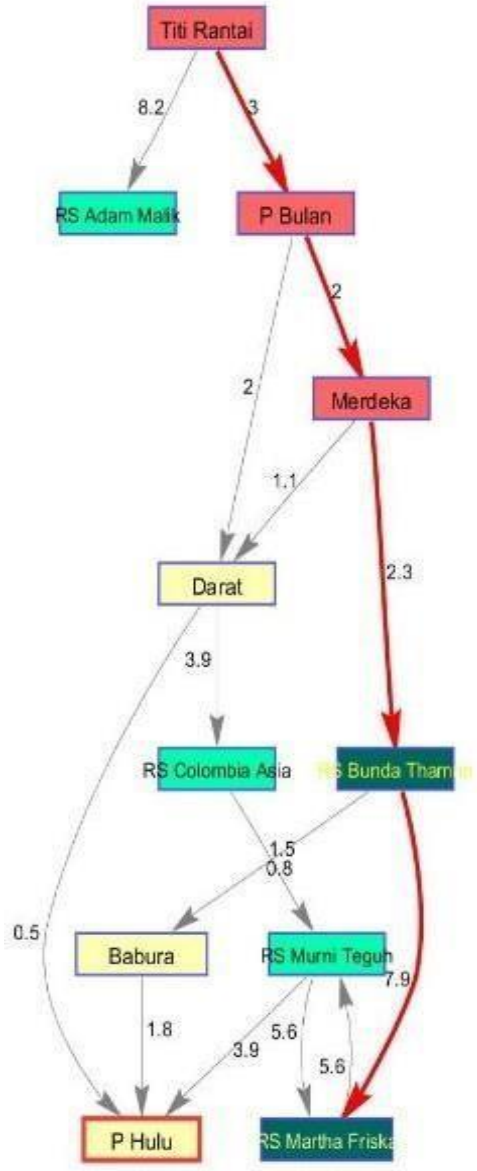

Figure 3. The Shortest Route from Kelurahan Titi Rantai to the Nearest COVID-19 Hospital

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The image above shows the shortest route from Titi Rantai village to the nearest COVID-19 referral hospital. Using Dijkstra's algorithm on matlab programming, it was found that the shortest route was through Padang Bulan Village with a distance of 3 kilometers via Jamin Ginting street, then to Merdeka village with a distance of 2 kilometers via Wahid Hasyim street and then to Bunda Thamrin Hospital with a distance of 2.3 kilometers via Wahid Hasyim Street. Hospital options that may be addressed from Titi Rantai Village are Adam Malik Hospital with a distance of 8.2 kilometers, Columbia Asia Hospital with a distance of 8.9 kilometers. By programming the Dijkstra algorithm, the shortest route is chosen with a distance of 7.3 kilometers to Bunda Thamrin Hospital. Each shortest route that will be chosen from each village to the nearest COVID-19 referral hospital will automatica ly be given a thick red line as the route that must be chosen to get to the hospital. Dijkstra's algorithm is very effective in determining the shortest route from one node to another. Although in urban lanes congestion, traffic lights, and one-way lanes should not be ignored which are the limitations in this study

In this section, the researchers can give a simple discussion related to the results of the research trials.This section contains the author's opinion about the research results obtained. Common features of the discussion section include the comparison between measured and modeled data or comparison among various modeling methods, the results obtained to solve a specific engineering or scientific problem, and further explanation of new and significant findings

CONCLUSION

Dijkstra's algorithm is an excellent algorithm used in determining the shortest route from a starting point to an end point (destination). In this study, the determination of the shortest route from each village in the Medan Baru District to the nearest Covid-19 referral hospital can be searched maximally using the Dijkstra algorithm with the distance taken through the google maps application. However, there are some limitations that are limitations in this study. The drawbacks are traffic jams, traffic lights, one-way streets. This cannot be ignored on routes in urban areas. In the future, researchers will look for optimization of determining the shortest route by including some of the problem constraints that occur. The Dijsktra algorithm is an application that must b e modernized for more complex constraints.

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