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IMPLEMENTATION OF DIJKSTRA'S ALGORITHM IN DETERMINING THE SHORTEST PATH (CASE STUDY: SPECIALIST DOCTOR SEARCH IN BANDAR LAMPUNG)

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Abstract
The shortest route from a trip will shorten the travel time. Likewise, in the case of the search for specialists. In the search for a specialist the community must come to the health service to ask for specialist information needed. The shortest path is a problem to find the path between two or more vertices in the minimum numbered weighted graph. To make it easier to solve the shortest path problems, a search algorithm is needed. The algorithm that is commonly used in solving problems in finding the shortest path or path is Dijkstra's algorithm. The basic idea of Dijkstra's own algorithm is to find the cost value closest to the destination that functions in a weighted graph. In this study, the Dijkstra algorithm finds the shortest path based on the smallest weight from one point to another, so that it can help provide path choices. Based on the trial of Dijkstra's algorithm, it has the ability to find the shortest path, because in the algorithm each graph is selected the side with the minimum weight that connects a selected node with another node that has not been selected.

Keywords: *dijkstra, specialist doctor, shortest path*

1.0 INTRODUCTION

The problem of optimizing search routes for travel that is often encountered in daily life is the search for the shortest path (shortest path). The shortest path problem is one of the most classic algorithm problems in graph theory, which has the goal of finding the shortest path between two or more nodes in a network [1]. This is also the case with the search for specialist doctors. In the search for community specialist doctors must come to the health service to ask for the specialist information needed, but not all health services have certain specialist doctors. In Bandar Lampung, information on the location of health services is very important because there is no mapping of health service locations. Based on data from the Bandar Lampung City BPS in 2015, the number of hospitals in Bandar Lampung was 19 with 229 specialist doctors. The closest travel route is needed to find a specialist doctor because fast handling will affect the patient's safety and health. The shortest path (shortest path) is a problem to find the path between two or more vertices in a weighted graph whose combined side weight of the graph being traversed is the minimum [2].

To make it easier to solve the shortest path problem, a search algorithm is needed. The algorithm is a sequence of problem solving that is arranged systematically and logically to solve a problem [3]. The algorithm that is commonly used in solving problems of finding the path or shortest path is the Dijkstra algorithm. Dijkstra's algorithm solves the problem of finding the shortest path between two vertices in a weighted graph with the smallest total number, by

finding the shortest distance between the initial node and other vertices, so that the path formed from the initial node to the destination node has the smallest number of weights [4].

Dijkstra's algorithm has the effective ability to find the shortest path, where in each graph a side with a minimum weight is selected that connects a node that has been selected with another node that has not been selected [5]. The workings of the Dijkstra algorithm are almost the same as the workings of the BFS algorithm, namely by using the principle of a queue, but the queue used by the Dijkstra algorithm is a priority queue [6]. This algorithm solves the problem with the limitation that there should be no negative weight cycles in the graph [7]. In the research to be carried out, the Dijkstra algorithm is used in determining the shortest path for the search for a specialist doctor so that the nearest route is produced to make it easier for patients to find a suitable doctor and patients can be dealt with quickly.

2.0 RELATED RESEARCH

The shortest path problem is the problem of finding the shortest path or route from the starting point to the final destination. In representing the shortest path problem usually uses graphs. The graph depicts abstract mathematical objects, which consist of a collection of vertices and edges. Each edge is connected by a pair of each node. Along the edges of the graph it is possible to walk by moving from one node to another [8]. In addition, the edge length of each graph is called a weight, and weights are usually used to calculate the shortest path from one point to another. Path is said to be the shortest if the path is often found between the two vertices specified, and the shortest path from a certain point to another [9]. A graph denoted by G is defined as a set of sets (V, E), written with G = (V, E), in this case V is a non-empty set of nodes and E is a set of edges (edges) or arcs) connecting a pair the knot [10].

Related preliminary researches include research into the search for the shortest path with the Dijkstra algorithm. This study solves the problem in determining which points must be traversed so as to get the destination with the shortest distance and the shortest use of time using the Dijkstra algorithm. The results showed that the Dijkstra algorithm was able to facilitate the search for the shortest route pathway and become more effective [11].

Another study, about the selection of the best route using the Dijkstra algorithm to reduce traffic congestion in Purwokerto. This study aims to determine alternative routes that are more effective and efficient so as to reduce congestion in certain road segments by determining the smallest weight of each road using the Dijkstra algorithm. In this study shows Dijkstra is able to produce alternative routes that can be passed by motorists to avoid congestion on certain roads [12].

While research into the implementation of the Dijkstra algorithm as an effective solution for making disaster relief systems. In this research, an information service system and navigation system that can be accessed by a cell phone can be developed that can show the shortest route using the Dijkstra algorithm, and can show an alternative route if a traffic jam or accident occurs on one of the roads or in a disaster location. In this study Dijkstra was able to make the shortest route in real time [13].

Other research, concerning the implementation of the dijkstra algorithm in finding the closest distance from the user's location to the plant that is going to be based on Android (case study in Purwodadi Botanical Gardens). This study aims to develop an Android-based application that is able to display a map of the Botanical Gardens, find the position of plants, display routes and display a list of plants. In this study the application of the dijkstra algorithm in determining the shortest distance from the user's location to the intended plant produces a usability value of 70,916% which can be categorized as a satisfactory application [14].

In the research to be conducted, the Dijkstra algorithm is used in determining the shortest path for the search for a specialist. This research will produce information on the location of the nearest specialist doctor's practice from the user's position and the fastest route to go to the hospital where the specialist doctor practices, in this application also provides information on specialist doctors, hospital information, and doctor's polyclinic information to facilitate patients in finding appropriate doctors and patients can be treated quickly.

3.0 METHODOLOGY

In this study there are several stages that were passed. The following stages of the research will be conducted:

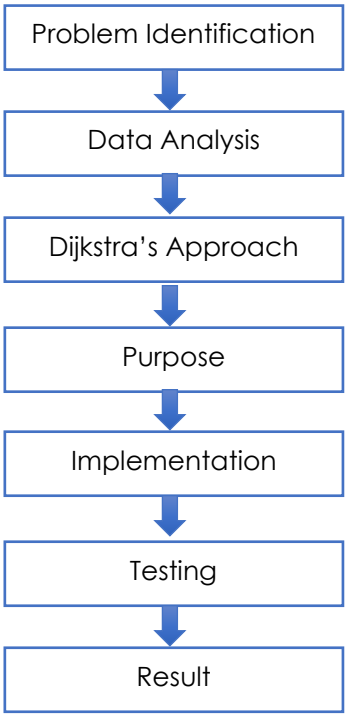

Fig. 1 Research Stages

3.1. Problem Identification

This research stage starts from the identification of problems based on data collection that has been done. Data collection is done by direct observation to the hospital, observing directly the location of the practice of specialist doctors in hospitals in Bandar Lampung. That is, information and the closest location of the hospital where the practice of specialist doctors. In addition, in this study a questionnaire was distributed to the community to determine the level of ease or difficulty of the community in finding the required specialist doctors and to know the community's need for technology. The results obtained from the distribution of this questionnaire most of the people have difficulty in finding the specialist doctors needed at the nearest hospital.

3.2. Data Analysis

After the identification of the problem then carried out an analysis of the data that has been obtained. The following are data analysts that have been carried out:

a. Analyzing specialist practice data at all hospitals in Bandarlampung. The results of the analysis that have been carried out specialist doctor data in the form of names, polyclinics, practice schedules.
b. Analyzing hospital location data, the data used are coordinate points. The results of the analysis of the coordinates of the location of the hospital can be obtained with the help of the Google Maps application to find out the longitude and latitude data.

3.3. Dijkstra's Approach

Dijkstra's algorithm is a greedy algorithm used in solving the shortest distance problem for a directed graph with non-negative side weights [15]. The workings of the Dijkstra algorithm in finding the shortest distance are calculations from the original vertex to the nearest vertex, then to the second vertex, and so on [16]. The basic idea of the Dijkstra algorithm itself is to find the cost value closest to the goal that functions in a weighted graph, so that it can help provide

path choices. Suppose the point represents the building and the line represents the road, the Dijkstra algorithm calculates all the smallest possible weights of each point. Broadly speaking, this algorithm aims to find the shortest path based on the smallest weight from one point to another [17].

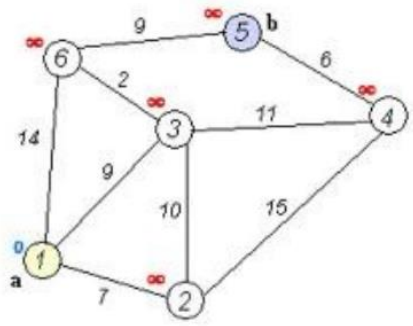

Fig. 2 Example of a Shortest Route Search Case with the Dijkstra Algorithm

3.4. Purpose

The purpose of this study is to search for specialist medical practices at the nearest hospital based on Android, which aims to facilitate the public in conducting the search for specialist doctors needed at the nearest hospital in Bandar Lampung.

3.5. Impelemtnation

The proposal submitted in this study is to search for the location of the practice of specialist doctors at the nearest hospital in the Bandarlampung area using the Dijkstra algorithm.

3.6. Testing

The test will be carried out on the research by testing the accuracy of the application of the Dijkstra algorithm in finding the location and the shortest route of the practice of specialist doctors. This test serves to measure the level of accuracy of the implementation of the Dijkstra algorithm in finding the fastest route of the practice of a specialist doctor whether it is in accordance with the path that will be traversed to get to the destination location.

3.7. Result

This research resulted in the research of the application of Dijkstra's algorithm to find the route of the location of the hospital where the nearest specialist is practiced by displaying the map of the fastest path to the destination location

4.0 RESULANTS AND DISCUSSION

Searching for Dijkstra's algorithm focuses on finding the path with the least cost between one point and another [14]. The final result of algroitma is to find the shortest path based on the smallest weight from one point to another [18]. Suppose G is a directed graph labeled with points V (G) = {v1, v2, ..., vn} and the shortest path sought is from v1 to vn. The dijkstra algorithm starts from point v1. In the iteration, the algorithm will find a point whose total weight is from the smallest point 1. The selected points are separated, and these points are no longer considered in the next iteration [19]. In the Dijkstra algorithm, the node is used because the dijkstra algorithm uses directed graphs to determine the shortest path route. The following dijkstra algorithm process can be briefly explained in the flowchart below:

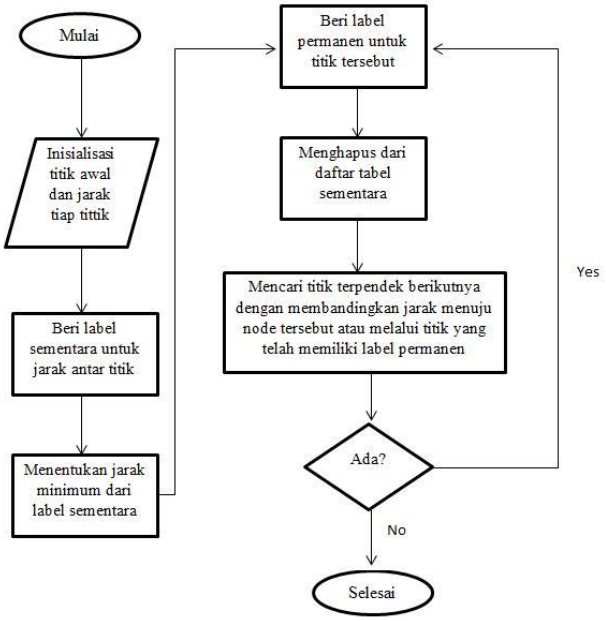

Fig. 4 Flowchart Dijkstra

At the completion of the Dijkstra algorithm the researcher gave a case study of the user's distance to reach the closest distance to reach the location of the specialist doctor's practice sought. The specified weight value is based on the Google map to get the closest distance results. Take a look at Figure 5 for the graph of solving algorithm dijkstra as follows:

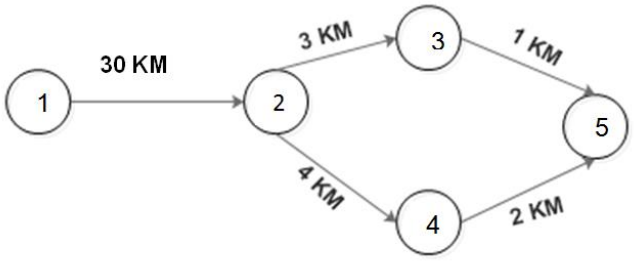

Fig. 5 Example Dijkstra Algorithm

1. Point 1 is the user's position located in the Rajabasa area
2. Point 2 is the position which is located on the Zainal Abidin road
3. Point 3 is a position located on Sultan Agung street
4. Point 4 is a position located on the Teuku Umar road
5. Point 5 position of the hospital to be addressed

In the case study in solving the Dijkstra algorithm that has been determined in the Dijkstra algorithm completion graph there are 5 points to get the closest distance to reach the destination. The following is a calculation from the dijkstra algorithm to determine the closest distance to the destination:

a) First create a dijkstra algorithm table in format (s-j, D), where s-j shows the route and node s to node j, while D shows the total distance between the two nodes.

Table 1. Calculation of First Step Dijkstra

N	D2	D3	D4	D5
1	{1-2, 30}	∞	∞	∞

b) The first line is initialization, i.e. Dj will have a value if it is connected directly and has no value

if it is not connected directly. Because node 1 only has 1 path, namely node 2, i = 2 is entered in the N set.

Table 2. Calculation of Second Step Dijkstra

N	D2	D3	D4	D5
{1}	{1-2,30}	∞	∞	∞
{1.2}	{1-2,30}	{1-2-3,33}	{1-2-4,34}	∞

c) Node 2 has served as an extension of the source node, namely node 1, so that now the node connected to node 2 can be reached by node 1 via node 2. It is known that node 3 and 4 are connected directly to node 2, so the route is written (1-2 -3) and (1-2-4).
d) Next, choose node i that has been connected to node s but is not included in the set N, known as node 3 and node 4. Selected node has the minimum amount of distance, namely node 3. In order to obtain the next table row as follows:

Table 3. Calculation of Third Step Dijkstra

N	D2	D3	D4	D5
{1}	{1-2,30}	∞	∞	∞
{1.2}	{1-2,30}	{1-2-3,33}	∞	∞
{1.2.3}	{1-2,30}	{1-2-3,33}	{1-2-4,34}	{1-2-3-5,34}

e) Then i is selected that is connected with the previous node, node 3 will be connected to the neighbor node, node 5. So the table can be as follows:

Table 4. Calculation of Fourth Step Dijkstra

N	D2	D3	D4	D5
{1}	{1-2,30}	∞	∞	∞
{1.2}	{1-2,30}	{1-2-3,33}	∞	∞
{1.2.3}	{1-2,30}	{1-2-3,33}	{1-2-4,34}	{1-2-3-5,34}
{1.2.3.5}	{1-2,30}	{1-2-3,33}	{1-2-4,34}	{1-2-3-5,34}

To implement the Dijkstra algorithm on Android applications, the first thing to do is to create graphs. Making graph is done to make the basic path that will be used for the calculation of the value, then the value obtained will be calculated according to the nodes that are connected. The following is the display image of making graph:

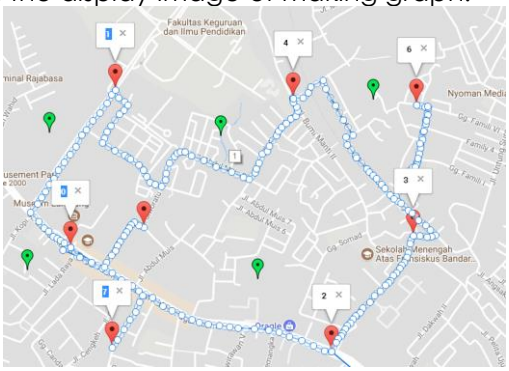

Fig. 6 Display Making Graph

Implementation of the application generated an application that can search for needed specialist Doctors. In the application there is a marker where the specialist is located, click the marker to get information on the doctor's name, doctor's practice schedule and there is a view path button to find out the fastest route to the location.

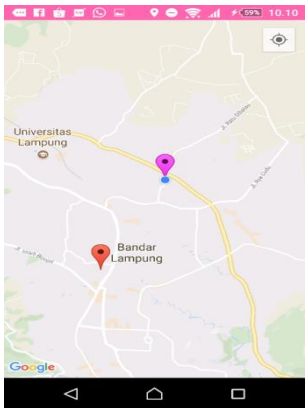

Fig. 7 Display Marker Location of Specialist Doctors

If the user wants the shortest route to see the doctor's detailed information in the search for the closest location menu, the application will bring up the fastest route to the hospital, as in Fig. 8 of the following:

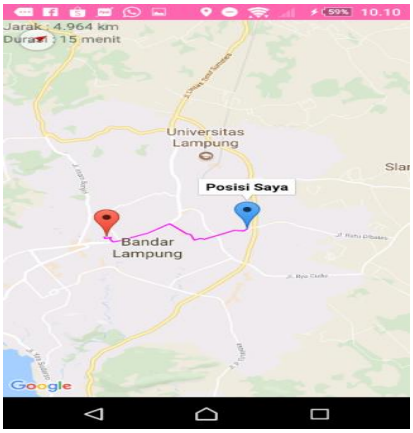

Fig. 8 Display of the Closest Route to the Location of the Specialist Doctor

After the application is implemented then testing is done. Testing is useful for knowing the level of performance of the function [20]. Researchers conducted testing of the Dijkstra algorithm calculation in the search application for specialist doctors that have been made, whether the dijkstra algorithm can complete and display in the form of a map. In this test the researchers conducted a test based on a random sample of the initial location and the intended specialist doctor, following the test table that was conducted:

Table 5. Testing Dijkstra Algorithm

Initial coordinates : -5.38261949, 105.25646077	
Goals: -5.425076, 105.251030 (Rs Bumi Waras)	
Distance	6.607 Km
Duration	20 Menit

With the user's main point located at Jl. Beringin, Kedaton, Bandar Lampung. In the application route to the hospital location, the destination path starts from the user's coordinate point and is completed via the Panglima Polim road to the destination coordinate point with the distance and time shown in the above table. These results show the accuracy in determining the shortest

route that has been done by Dijkstra's algorithm. The map path display to the destination location can be seen in the following figure:

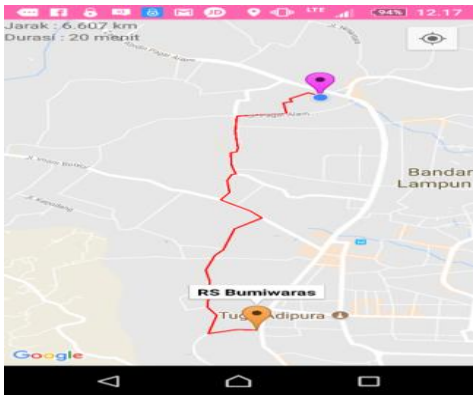

Fig. 9 Test Results for Nearest Route Search

5.0 CONCLUSION

5.1. Conclusion

Based on research that has been done on Dijkstra's algorithm in determining the shortest path (shortest path) for specialist specialist doctors in Bandar Lampung), shows that Dijkstra's algorithm finds the shortest path based on the smallest weight from one point to another. The steps taken in the Dijkstra algorithm start from determining the starting point, then weighting the distance from the first node to the closest node one by one, Dijkstra's algorithm will develop the search from one point to another and to the next point step by step.

Based on trials using the Dijkstra algorithm, researchers take test samples that have different destination locations, the test results in the application can display the destination path from the user's position coordinate points. Dijkstra's algorithm has the effective ability to find the shortest path, because in the algorithm each graph is selected with the minimum weight connecting a selected node to another unselected node.

5.2. Suggestion

From the research that has been done, there needs to be further development related to the use of other algorithms in overcoming uncertainty, especially for cases of oral cancer diagnosis to get better accuracy.

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