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Geografic Information System for Optimization of Lane Road in Bandar Lampung Using Dijkstra Algorithm

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Abstract

Geografic Information System (GIS) is a tool to store, manipulate, analyze and display back with the help of natural conditions and spatial attribute data. One implementation of a Geografic Information System is the shortest route search in order to obtain the efficiency of time and travel expenses. In this research the method used to find the shortest lane is by using Dijkstra's algorithm. This algorithm uses a greedy principle, greedy is negative implies that takes all the possibilities that exist without thinking about the future consequences. These algorithms solve the problem step by step. Of the various measures taken the best decision in determining which is the best step. This research aims to resolve problems on the network routing lane, Geografic Information System (GIS) in Bandar Lampung using dijkstra algorithm.

Keywords : *Dijkstra Algorithm, GIS, Shortest Lane*

1 INTRODUCTION

Geografic Information System (GIS) is a technology that provide a tool to store, manipulate, analyze and display back of natural conditions with the help of attribute data and spatial. Geografic Information Systems (GIS) not only displays the attribute data, but also can display data grafically and their attributes, making it easier for users to obtain information.

Geografic Information Systems (GIS) can be used as a tool, an example of the determination of lanes in a region with the provisions of getting the right lane to pass in order to get the efficiency of travel time, and determining an alternate lane to be traversed. For the purpose of this research is to design a lane optimization system in Geografic Information Systems (GIS) of Bandar Lampung city.

This system is expected to determine the optimum lane road from two different places in order to get the efficiency of travel time by choosing the right lane. As well as providing information about the public facilities located in the city of Bandar Lampung. Search the shortest lane become indispensable in daily life example for motorists, routing computer networks and telephone networks. Determination of shortest lane has the advantage of time and cost efficiency.

2 RESEARCH METHODOLOGY

Geografic Information System (GIS) is a system or set of objects, ideas interconnected that aims to display geografic information so that it can be a software technology that can process, store, analyze, manipulate and transform spatial data or return information on natural conditions and their attributes and spatial. The data model used in Geografic Information Systems (GIS) is used data presented form the real world into the database. Form of representation of spatial entity is the concept of raster and vector. In this case the use of two models of raster data (images) and vector data model (lines and points).

Graf is a representation of discrete objects and the relationships between these objects, the visual representation of a graf is to declare the object as node, circles, or dots, whereas the relationship between the object represented by a line. Graf is expressed by the symbol G is defined as the set of pairs (V, E, K), which in this case;:
V = The set is not empty of vertices (node)
= v1, v2, v3,vn
E = The set of sides (edges or arcs) connecting a pair of vertices
= e1, e2, e4,,en
K = Bobot

Vertices or nodes can not be empty while the edges or arcs can be empty. so, a possible graf does not have any side, but vertices there must be, at least one. Vertices of the graf can be represented with letters such as a, b, c ....., z with the natural numbers 1, 2, 3 ... .n or a combination of both. While connecting the node vi to node vj expressed by (vi, vj) or the symbol e1, e2, e4, ... If e is the side that connects node vi to node vj, then e can be written as e = (vi, vj).

In determining the shortest path there are various algorithms such as exhaustive search, Greedy algorithm, dynamic program, Kruskal algorithm and Dijkstra's algorithm. In this research used dijkstra algorithm, because this algorithm has advantages compared with other algorithms. The algorithm has a faster execution time in finding the shortest route compared with other algorithms.

Dijkstra's algorithm is a greedy algorithm to solve the problem of the shortest distance (shortest lane problem) for a directed graf or undirected graf with edge value are worth no negative so it is assumed that k (vij) > = 0 for all edges (vij) E. With dijkstra algorithm can resolve the path / shortest route from a vertex of origin and destination vertices in a value graf G = (V, E). The shortest distance is obtained from two vertices if the total value of all the edges in the graf network is the most minimal.

Here are the steps to finding the shortest path using Dijkstra's algorithm:

1. Graf made represented in the matrix K=[vij]
   vij = edge value (i,j).
   vii = 0
   vij = , if there is no path from node vi to node vj.

2. Create a table S = [si]
   si = 1, if node i including the shortest path.

Table 1: Representation graf with 6 vertices

	A	B	C	D	E	F
A	O	8	2	6	∞	∞
B	8	0	∞	∞	12	∞
C	2	∞	0	∞	15	∞
D	6	∞	∞	0	∞	4
E	∞	12	15	∞	0	6
F	∞	∞	∞	4	6	0

si = 0, if node i is not including the shortest path.

3. Create table D = [di] is the distance from the start node to the start node to the start node to the destination node.

function Dijkstra (G, k, s) // dijkstra function declaration
for each vertex v in V[G] // initialize all vertex value in a graf G
d[vj] := infinity // vertex value to j be stored on an infinite array previous[vj] := undefined // vertex value to j previously unknown
d[s] := 0 // set 0 in the array to the node s not including the shortest path
S := empty set // set variabel S = 0
Q := V[G] // set variable Q with vertex value in a graf G
while Q is not an empty set // variable Q initialization
vi := Extract_Min(Q) // vertex value set to i
S := S union vi // set of variabels S
for each edge (vi,vj) // initialization of each edge in the graf
if d[vi] + k(vi,vj) ¡ d[vj]
d[vj] := d[vi] + k(vi, vj)
previous[vj] := vi

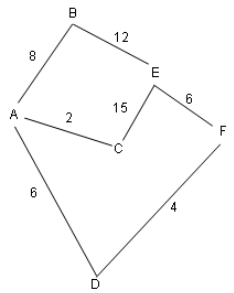

Figure 1: Graf with 6 vertices

3 RESULTS AND DISCUSSION

In this research the object under research is on the main road located in the city of Bandar Lampung and their attributes. Research is also carried out by looking at the location of public places, hotels, hospitals, restaurants, and tourist spot located in the city of Bandar Lampung. In the search for the shortest route in the city of Bandar Lampung lane researchers used data obtained by measuring the length of a conventional is lane road from one place to another on the map with a scale of 1: 27,500 which means that 1 cm on the map represent the actual distance of 0.27 kilometer in the actual distance. The data obtained is the distance between the location of public places such as hospitals, hotels, tourism objects, universities, colleges, restaurants, terminals, ring road and other public places.

Here is the implementation of Dijkstra's algorithm on a graf having 11 vertices with value each of which represents the distance between the vertex. Vertices in the graf can represent a place or a ring road in a geographical area.

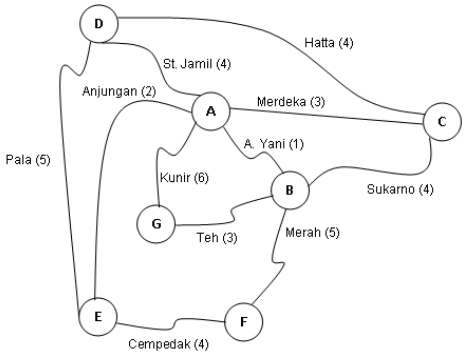

Figure 2: Graf lane with 7 edge

In determining the shortest path in the graf above the required starting point and destination point. For example the initial point D to point destination F with the tree diagram we can know which path can be passed, with provisions lane road that has been passed by the same route should not be passed again and if it has arrived at the destination point on the route stop search and resume by another route, if the route has traversed all we can infer which route to be traversed with the optimum distance or shortest.

From the tree diagram can be determined route to reach the goal of vertices D to F vertices are:
D⇒ A⇒ B⇒ F with total distance = 10
D⇒ A ⇒ G⇒ B⇒ F with total distance = 18
D⇒ C⇒ B⇒ F with total distance = 13
D⇒ E⇒ F with total distance = 9

From these results the shortest distance is D E F with a total distance of 9. In the application of Dijkstra's algorithm on the graf above is not a directed graf, but Dijkstra's algorithm can also be applied on a directed graf.

In the search for the shortest route in the city of Bandar Lampung lane be required data such as data lanes, places and regions. The data is then processed in the database so that it

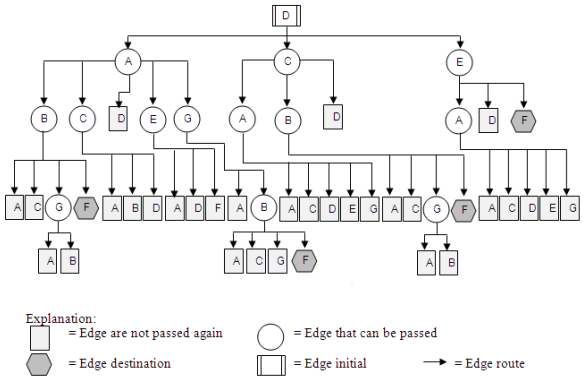

Figure 3: Shortest route search tree diagram

will form a closed graf representing a network of roads in the city of Bandar Lampung. The place and the ring road is assumed as the vertex is a point on the graf and lane as the edge value is within two vertex G = (V, E). All edge value are not negative so it is assumed that k (u, v)> = 0 for all edges (u, v) ∈ E.

Figure 4: Map of road network Bandar Lampung city

From lane road network map of Bandar Lampung we can make a graf of the road network by entering the data vertex and edge with the value of each lane which is the distance to the database. From the graf that has been formed we can find the shortest route for example from the starting point is the point A is the vertex representing the Islamic Center Mosque and point B which is the goal of vertices representing Urip Sumoharjo hospital. From these two places we can find the shortest route to dijkstra algorithm. With the same method on the shortest route search graf Figure 3 obtained with the shortest distance 5107 km route Start =¿ Jl Campus Unila =¿ Jl Sumantri Bojonegoro =¿ Jl ZA Pagar Alam =¿ Jl Teuku Umar =¿ Jl Urip Sumoharjo =¿ Finish .

With optimum distance we can determine the travel time to determine the speed of the vehicle as an example of an average vehicle speed of 60 km / hour, the time required from the Islamic Center Mosque to Urip Sumoharjo hospital is 0.08511666666666667 hours or 5.1070000000000002 minutes or 5 minutes 107 seconds, with never stop at all travelled.

The results obtained from:

$$t = \frac{s}{v} \tag{1}$$

4 CONCLUSION

In optimization lane in the city of Bandar Lampung with dijkstra algorithm takes the initial position and the position of the destination which is two places or ring road, the two positions will be formed with the optimum distance or shortest. Distance of the search results can be used to find the shortest travel time is faster than the travel time to the other with the same destination and the same determination vehicle speed. This lane optimization system can help the Bandar Lampung community or tourists to find the shortest route to reach the public places and facilities available in the city. In search of the shortest route possibilities other vertices are not passed because it is too far away and not used in the calculation. In the graf on the lane formation of Bandar Lampung, the more complex will reduce the efficiency of the time because it takes a long time. The more complex road network then the search will require considerable time. By determining the shortest path route path will produce the advantage that the efficiency of time and travel expenses.

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