Analysis Determination Of Shortest Route Delivery Using Dijkstra Algorithm

S A Lestari[1], A K Puspa[1]
[1.] Information Systems, Computer Science Faculty, Bandar Lampung University, Indonesia

1. Introduction

1.1 Background

Over the rapid technological developments in the field of business especially now a lot of companies that create delivery services goods. With various bustle owned, service users delivery of goods more want something practical, fast, and economical especially for local communities urban areas. In perform delivery services goods main concern is the time and cost efficiency, by sending goods via freight, of course we expect the optimal route in order to arrive on time and do not takes a lot of travel expenses such as gasoline. The shortest route problem is a classic problem often encountered in daily life in various sectors of life, including in the field of transportation. This problem becomes an important issue because it deals with the problem minimizing the cost and time required efficiency. *Shortest path* is the search for the shortest route or path between nodes that exist in graph. Cost generated is minimum. the shortest path is one problem that can be solved by using graph. if given a weighted graph, the shortest path problem is how do we seek a path in the graph that minimizes the weighted sum forming the side of the track. (arix oyouz: 2013). Transport is one of the most important part in our daily lives that will enable us to reach the place of destination faster and eficient. Transport users in his journey would require so much faster shortest path to the place of destination and it takes a lot of time and transport costs.

The above problem can be solved by creating a system that can determine the path of transport desired, this system once can be determine the shortest route to transport users do not need to travel long distances to reach goal. Therefore, the authors are interested in doing research in analyzing determine the shortest path entitled "**Determination Analysis Shortest These Djikstra Delivery Algorithm**".

2. Basis Theory

2.1 Literary Review

Literary Reviews obtained from several journals referenced by the researchers. The literature review in this study are as follows:

2.1.1. "Determining the Shortest These Towards Health Center-Based Web GIS Using Dijkstra's algorithm" (Mandy Anisiyah, Fahrul Agus, and Hamdani Program of Computer Science, State University of Mulawarman in 2011) .For residents of the city of Balikpapan, especially newcomers are still many who do not know the location-location of health center building. This matter could slow in handling patients who are critically. To overcome this then be made to the system of determining the shortest route to the medical center Kota using Dijkstra based Web GIS is expected that users can easily find information on the health center nearest to minimize the risk that web based (Web GIS), time spent by users of the system (user) to search for health centers becoming shorter and closer service. The theory in this journal that Dijkstra's algorithm is an algorithm that is applied to determine the shortest path in a number of steps in a directed graph or not directed. System geographical Information is a computer-based information system, designed to work with data that have spatial information (referenced spatial). Map Server is there a CGI program *(CGI: Common Gateway Interface)* which installed and running but is not active in the server (active only when called). Quantum GIS is free GIS application that includes mapping, spatial analysis, and several other Desktop GIS features.

2.1.2. "Determining the Shortest These Merauke City Garbage Collection Using Dijkstra Algorithm" (Sri Andayani Department of Information Engineering, College of Engineering Musi 2014, and Endah Wulan Perwitasari Department of Informatics, University of Musamus 2014). Selection of these

vehicles is essential to determine the total travel the shortest distance fleet. To be able to determine the shortest route then built an application using Dijkstra's algorithm. Dijkstra's algorithm choose the side with the smallest weight connecting a node that has been selected by the node that has elected to another node that has not been selected. Dijkstra's algorithm requires a parameter point of origin and destination so as to produce the shortest distance from point of origin to destination along route. In this journal to produce waste with Dijkstra's algorithm performed by stages as follows: create table range, this table contains related distance between the point and determine the distance between the point of the depot and other points. then made the point relating table and determine the distance between the point of the depot and another point later with Dijkstra's algorithm search for the depot to the landfill, the distance between points that do not relate directly and within all after it determines the shortest route.

2.1.3). *"Finding the Shortest Paths Among Cities In Java Island Combination Node Using Dijkstra Algorithm Based On "*(Bilqis Amaliah, Chastine Fatichah, and Olyn Riptianingdyah Informatics Engineering, Fakulty of Information Teknology Institute of Technology November). finding the shortest path between cities in Java by repeatedly combining the initial node nearest neighbors to implement Dijkstra. Combination Node Algorithms used to find the shortest path between cities in Java by removing the nodes closest to the node early. Wrong an algorithm known and highly commonly used in finding the shortest path algorithm Dijkstra is algorithm Dijkstra. But, use Dijkstra's algorithm is very simple and requires more memory. Combination find the nearest neighbors of the initial node. Second, the combination of node combines (remove) node to the start node, and then modify the edge weights are connected to the nearest neighbor. Combination Node implement Dijkstra's algorithm to remove the node closest to the initial node. Memory usage more efficient by removing nodes from the Node original. Combination Dijkstra's algorithm based on Dijkstra's algorithm is presented in Section 2, the use of algorithms Combination Node to find the shortest path to remove the node closest to the initial node between cities in Java, introduced in Section 3, and experimental results and conclusions.

2.1.4).*"Modified Dijkstra's Shortest Path Algorithm "*(S.Sivakumar, Dr. C. Chandrasekar Tamilnadu, India, 2014). Due to a variety of applications introduced to address the problem by developing various shortest path algorithm. Even now the problem still remains to find the shortest path in the road network, and troubleshoot the shortest path. Algorithm proposed comparison with existing algorithms to prove the efficiency of finding the shortest path in the road network. Graph theory is a mathematical concept is formally defined by a set of vertices (or nodes) V and a set of edges E connecting these nodes. Edges is called directed if for a pair of nodes, but can be used to travel from one node to the other but not vice versa. Computing the street or the shortest distance between two points is one of the keys of the most fundamental and important problems on the road network. Many people often face a lot of problems when planning their trip with them own vehicle. The last day many applications developed to solve the problem by finding an efficient service to network path. The literature of the past shows that various shortest path algorithm is developed to find a valid for network the road. But still the problem refused. Therefore, there is a need to propose a new shortest path algorithm for provide solution better for tourists through the road network.

3. Analysis And Results

3.1 *Analysis*

3.*1)."Determining the Shortest These Towards Health Center-Based Web GIS Using Dijkstra's algorithm* "(Mandy Anisiyah, Fahrul Agus, and Hamdani Program of Computer Science, State University of Mulawarman in 2011). The picture below is a map of the city of Balikpapan, East Kalimantan. Source Balikpapan City maps obtained from Balikpapan City Government BAPPEDA a scale of 1: 50000, as shown in Figure 3.1. The map is the result of aerial photography in 2006.

Figure 1 map Balikpapan

Figure 2 Result City Map Digitizing Turn The Board

Digitizing Map Balikpapan At Quantum GIS map previously obtained will be used for the process of digitization. Mechanical digitized maps in principle is creating maps through a computer process. Storage of files on the computer from the digitized maps were grouped by layer in accordance with the type of each. In each of the digitization process, added a number of attributes according to the needs of each object, which will be displayed as information on the object. Here's what the final result of Balikpapan City map digitization process: Once the maps are digitized, followed by a map to export in the form of a file * .map to be displayed in the web. Then create a database on Admin with the name of Balikpapan, which is obtained from the contents of the table in the database import Quantum GIS.

3.2 Draft System

Here is a design of a system built using four types of UML modeling and a brief explanation, among others

Use Case Diagram

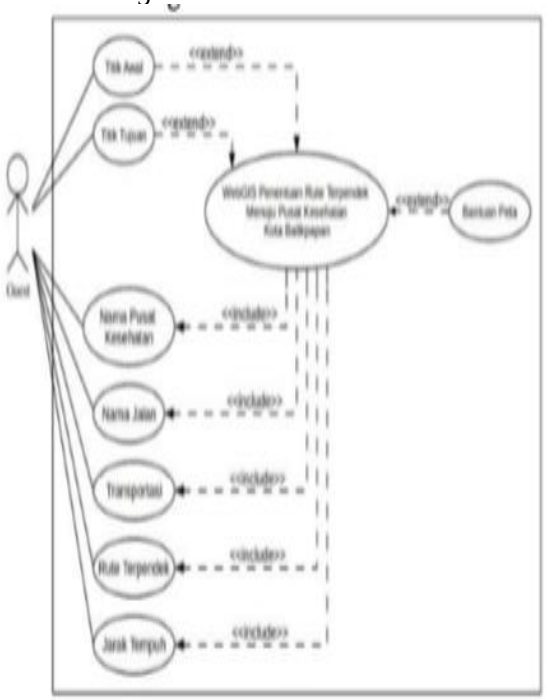


Figure 3. Use Case Diagram web GIS Determination These Shortest To Wards Health Center

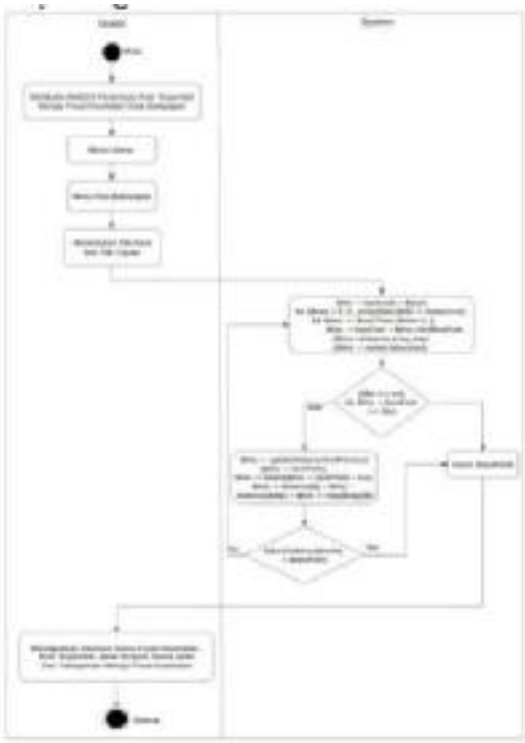


Figure 4 Activity Diagram web GIS Determination These Shortest Towards Health Center

A Use Case describes the interaction between actors with the system and the functionality of applications Determination These Shortest towards Health centers Based Dijkstra method Using Web GIS. Diagram consists of one actor and nine Use Case. Where between Use Case interrelated with one another if certain conditions are met.

3.3 Activity Diagram

In this diagram the flow originated from the guest who open systems Determining These Shortest Towards Health Center Balikpapan, then choose Menu, Map Balikpapan and do a search by selecting a starting point and a destination point, then the system will make the process of comparing the shortest possible route. Flow ends with users get information about the hospital or health center intended, Route Shortest, Mileage, Street Name, and transportation.

Sequence Diagram

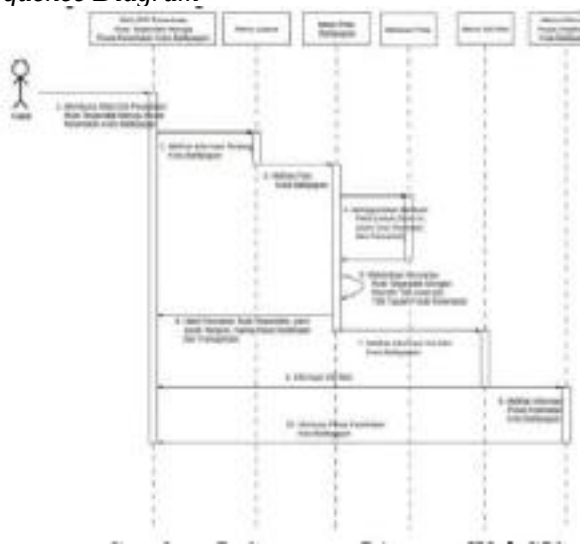


Figure 5 Determination web GIS Shortest These Towards Health Center Sequence Diagram

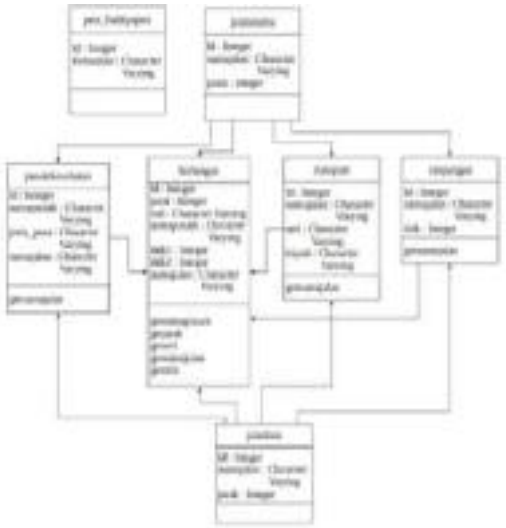


Figure 6 Determination Shortest These Towards Health Center Class Diagram

Sequence diagram illustrates the interactions between objects in the system. Where in the diagram illustrates the steps performed in a system consisting of one actor, the six participant with lifeline and 10 messages.

Class Diagram

Class diagram illustrates the relationship of structure and description of classes, objects and their package between tables contained in the system. Where there are seven tables map, main road, health center, transport, relationship, and deviations are interconnected with one another.

3.4 Implementation

Implementation of the system include the implementation environment and implementation of programs. Implementation environment, is the scope where the storage files are used and interconnected to support application development. Namely by creating folders that are used to accommodate applications that have created. Scope where storage files are used and interconnected to support the development apps. Its by creating folders that are used to accommodate applications that have created. Subfolder "map" contains PETA_BPP.map file that is used to connect between the file extension shp and Mapscript Postgre SQL database. And subfolders "Mapscript" contains files to manage web GIS finding the shortest route to the medical center of Balikpapan.

Figure 7 Interface Weather Map

3.4.1 *Procedure Dijkstra's Algorithm*

Dijkstra's algorithm is an algorithm determining the shortest path in a number of steps in a directed graph and non-trending graph that at every step of the selected side minimum weighted and put in the solution set. In this system dijkstra algorithm procedure is carried out as follows:

1. Given a starting point (start node) and point of interest (best node) to find the shortest route. Then do the experiment as much as possible to obtain the shortest route
2. to Do update point (s) latest and prior to trial maximal possibilities found. In this section dijkstra calculation is done by adding each distance traveled by each point to obtain the results of the distance is then compared with the results of an experiment to find the shortest distance.
3. If maximal experiments have get the final result then best node shortest route (shortest route) will be displayed as search results.

The results of the comparison finding the shortest route manually and using the system is the same, This system is also shown of the road and public transport that can be used towards the health center have been.

2). "Determining the Shortest These Merauke City Garbage Collection Using Dijkstra Algorithm"(Sri Andayani Department of Information Engineering, College of Engineering Musi 2014, and Endah Wulan Perwitasari Department of Informatics, University of Musamus 2014).

3.4.2 Table Delivery Point Mutually Connecting

Roads are represented as a dot (node) there are interconnected and there are not interconnected. In this phase will be created table that contains the length of roads that are assumed distance between two points (nodes), or the distance between two interconnected roadway. Examples of manual calculation using a 10 point consumers in the form of 10 polling stations or demand accumulated volume. With the number of vehicle 1 which has a capacity of 2 m3

Table 1. spacing of the interconnected than 10 road

	1	2	3	4	5	6	7	8	9	10
1	0	1,60	~	~	0,56	~	~	~	~	~
2	1,60	0	2,06	~	~	~	~	1,81	~	~
3	~	2,06	0	1,01	0,56	~	0,98	1,81	~	1,5
4	~	~	1,01	0	0,56	1,77	~	~	~	1,69
5	0,56	~	0,56	0,56	0	~	~	~	~	1,69
6	~	~	~	1,77	~	0	~	~	~	~
7	~	~	0,98	~	~	~	0	~	0,26	~
8	~	1,81	1,81	~	~	~	~	0	~	~
9	~	~	~	~	~	~	0,26	~	0	0,26
10	~	~	1,5	1,69	1,69	~	~	~	0,26	0

Specification

1. Street Sesate.
2. Street Gak.

3. Street Irian Seringgu.
4. Street Parako.
3. Street Mandala II.
6. Street Ermasu.
7. Street Kampung Timor.
8. Street Ternate.
9. Street Timor.
10. Street Mandala I.

2. Finding the distance between points using Dijkstra's algorithm

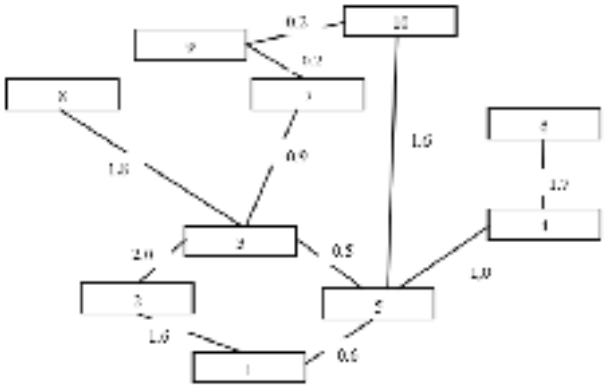
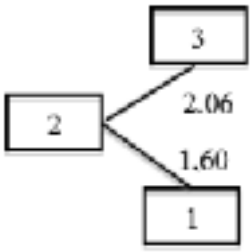


Figure 8 Point TPS / Consumers

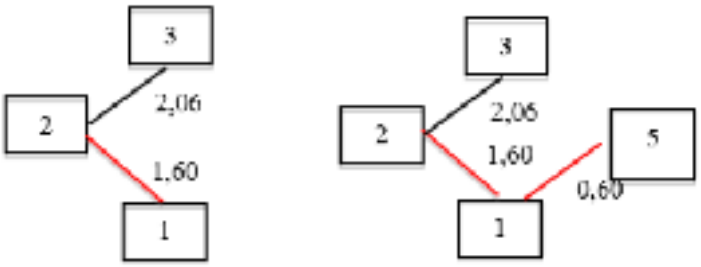
From Figure 1, the draft settlement with Dijkstra's algorithm is as follows:

a. Distance from Street Not Into Street Madala II:



2 → 1 = 1,60 2 → 3 = 2,06 (1)

The distance the smallest is 1.60 then the selected point is 2 1. Then add in the list of values connected with the selected point (point 1).



(2)

List of distances to be selected increases, ie from 1 → 5 = 0.60. So the question becomes: 2 → 1 = 1.60 2 3 = 2.06 → 1 → 5 = 0.60 Value selected are those which have the smallest value that is 1 → 5 = 0.60. So the value of the distance of 2 → 5 = 1.60 + 0.60 = 2.20.

	Irian seringgu	sesare
gak	2,06	1,60

	mandala
Gak-irian seringgu	2,06 + 0,56 = 2,62
Gak-sesate	1,60 + 0,60 = 2,20

So the shortest distance from street Not to mandala street is 2.20 through Sesate

b. Distance between street Not to street Parako: Because that is connected to street Parako only street Mandala, the nearest distance calculations can be started from the mandala with the smallest weight. Ie 2.20 + 1.02 = 3.22 through street Sesate and street mandala.

c. Distance between Street Not to Street Ermasu Calculated from Street Parako. Ie 3.22 + 1.77 = 4.95 From the table will be searched distances between all the points that are not interconnected and distance of all points of the depot using dijkstra algorithm

Table 2 Table Distance

	0	1	2	3	4	5	6	7	8	9	10
0	0	14,48	16,08	14,44	14,90	13,88	16,67	15,44	16,25	15,70	15,57
1	14,48	0	1,60	1,16	1,62	0,56	3,39	2,14	2,97	2,40	2,29
2	16,08	1,60	0	2,06	3,22	2,20	4,99	3,04	1,81	3,30	3,56
3	14,44	1,16	2,06	0	1,01	0,56	3,35	0,98	1,81	1,24	1,5
4	14,90	1,62	3,22	1,01	0	0,56	1,77	2,56	3,39	2,82	1,69
5	13,88	0,56	2,20	0,56	0,56	0	2,79	1,54	2,37	1,80	1,69
6	16,67	3,39	4,99	3,35	1,77	2,79	0	4,33	5,10	4,59	4,48
7	15,44	2,14	3,04	0,98	2,56	1,54	4,33	0	2,79	0,26	0,52
8	16,25	2,97	1,81	1,81	3,39	2,37	5,10	2,79	0	3,05	3,31
9	15,70	2,40	3,30	1,24	2,82	1,80	4,59	0,26	3,05	0	0,26
10	15,57	2,29	3,56	1,5	1,69	1,59	4,48	0,52	3,31	0,26	0

3.4.3 Implementation

At this distance setting section will be presented in the form of a matrix , Columns and rows are filled only at the point that interact directly and give a value of -1 on the point that are not directly related. Not all roads are connected directly to another road. So the usefulness of this matrix to provide value in the form of the distance between the road that connect directly to other roads. If the road does not connect directly it will be given a value of -1.

If the matrix is formed so that it will work then is dijkstra algorithm. This algorithm will find a way or the shortest route between the depot and between all points.

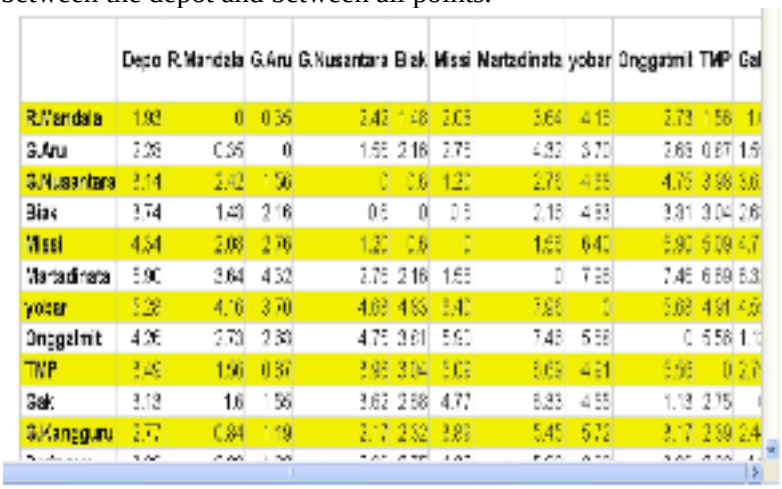


Figure 9 Matrix And Distance Shortest

3)."Finding *the Shortest Paths Among Cities In Java Island Combination Node Using Dijkstra Algorithm Based On "*(Bilqis Amaliah, Chastine Fatichah, and Olyn Riptianingdyah Informatics

Engineering, Fakulty of Information Teknology Institute of Technology November). This combined method iteratively knot find the shortest path to search for the nearest neighbor of the initial node, combine that with the initial node and updating the weight of the edge connected to the nearest node. The steps of the method node combination is as follows:

1. Determine the initial node.
2. Find the nearest node to see the weight of the smallest connected with the initial node.
3. Delete the node and updating the weights edge early. If node connected to two or more weight then choose the smallest
4. Repeat steps until only two nodes remain following is an example of the method node combination of Java is the fifth largest and most populous island in Indonesia. Problem state transport such as traffic congestion, high shipping costs, finding the shortest path is commonly encountered in Java. Research aims to find the shortest path between cities in Java using a combination of Node based on Dijkstra's algorithm.

The distance between the start and destination node taken from Google Maps on April 22, 2014, with the following steps:

1. Determine the initial city and the destination city.
2. Obtain the distance between the two cities. This distance is achieved by activating the "Direction" feature in Google Maps. The names of cities are connected typed on features, then "Directions" feature appears at a distance of two cities.
3. If there are two or three distances shown on Google Maps, we choose the shortest distance between the two cities.

Table 3. Submit A Sample Of The Route Between The Cities In Java Based Feature "Direction" in Google Maps

Start – Destination City	Distance (km)
Surabaya – Malang	92.8
Gresik – Tuban	87.5
Surabaya – Malang	92.8
Malang – Blitar	75.3
Surabaya – Mojokerto	49.5
Malang – Kediri	102

The cities selected to be tested are shown in Table 1 (there are 46 cities). For this experiment, the cities began the city of Malang, Banyuwangi and Surabaya. Figure 3.8 shows the results of Google Maps, from the city of Surabaya to Mojokerto. Using Google Maps distance is 49.5 km and the distance by using the proposed method is also 49.5 km. Road using the proposed method is similar to Google Maps: Surabaya-> Mojokerto.

Figure 10 Shows The Results Of Google Maps, From The City of Surabaya to Mojokerto

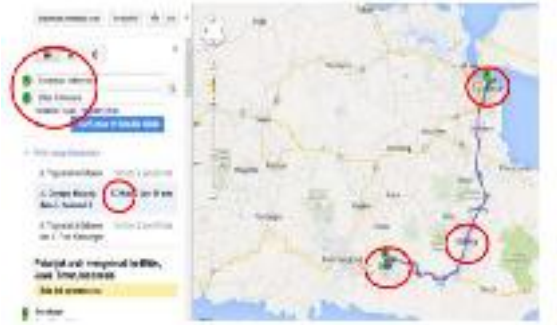


Figure 11 Shows The Results Of Google Maps, From The City Of Surabaya To Blitar City

Distance using Google Maps is 172 km and the distance by using the proposed method is 168.1 km. It's smaller 3.9 km from Google Maps. Road using the proposed method is similar to Google Maps: Surabaya-> Malang> Blitar Using Google Maps distance is 172 km and the distance by using the proposed method is 168.1 km , It's smaller 3.9 km from Google Maps. Road using the proposed method is similar to Google Maps: Surabaya-> Malang> Blitar

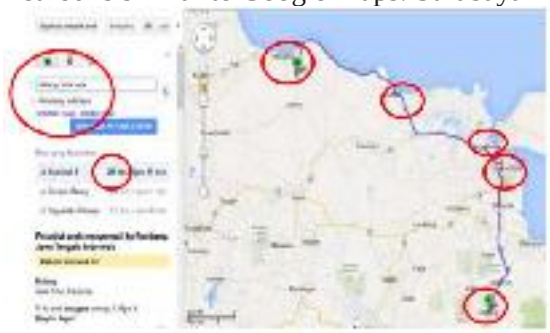


Figure 12 Shows The Results Of Google Maps, From Malang City To City Rembang

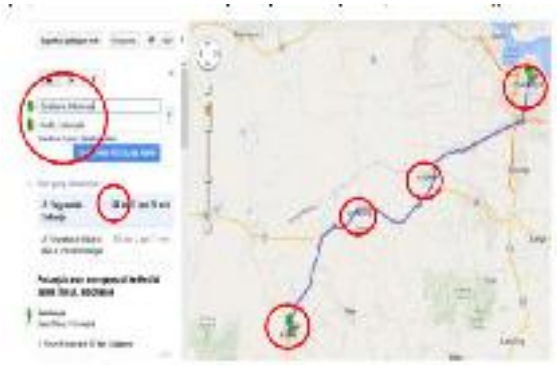


Figure 13 Shows The Results Of Google MAPPS, From The City Of Surabaya To Kediri

Using Google Maps distance is 124 km and the distance by using the proposed method is 127.4 km , Road using the proposed method is similar to Google Maps: Surabaya-> Mojokerto-> Jombang-> Kediri. Use Google Maps distance is 390 km and the distance by using the proposed method is 433.5 km. Using the proposed method is similar to Google Maps: Banyuwangi-> Probolinggo-> Pasuruan -> Surabaya-> Gresik-> Tuban

Figure 14 Shows The Results Of Google MAPPS, From The Town Of Banyuwangi Tuban

shortest path between cities in Java can be found with the combination of the node based on dijkstra algorithm with an accuracy of 92.88%. There are different results between the proposed method and Google Maps for the proposed method applies the direct distance between the two towns and Google Maps use alternative roads between the two cities. The proposed method can show the city that you visit. There are 4 lines result from the proposed method is smaller than Google Maps. There are 4 lines result from the proposed method is similar to Google Maps

4). *"Modified Dijkstra's Shortest Path Algorithm" (S.*Sivakumar, Dr. C.Chandrasekar Tamilnadu, India, 2014). MDSP algorithm efficiency verified in terms of the node (it shows the shortest path) and time using the Database of Jaipur city. For this experiment tool developed using this tool Java. On existing and proposed algorithm is implemented. To perform the analysis of the experiment, we considered the database Jaipur. The proposed algorithm is compared with the modification of existing algorithms Dijkstra, Dijkstra's algorithm with Ember (DKB), Dijkstra's algorithm with Double Bucket (DKD), Dijkstra's algorithm with Ember Estimates (DKA). To prove that the algorithm MDSP proposed efficiently select the shortest is achieved by calculating a node is taken to select the shortest

path efficient, Node for three different algorithms and algorithms we proposed are calculated and the results are shown in Table 3.4 Figure 3.13 shows a comparative analysis of existing algorithms and algorithms MDSP that proposed. The comparative analysis shows that MDSP take the minimum number of nodes of three other existing algorithms.

Table 4 Comparison of MDSP Nodes, DKB, DKD, and DKA Algorithm

Algorithms	Nodes
MDSP	16
DKA	25
DKD	32
DKB	35

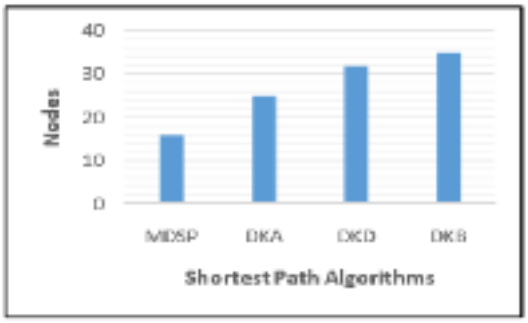


Figure 15 Comparison of MDSP, DKB, DKD, and DKA Algorithm Nodes

MDSP proposed algorithm reduces the time complexity. This is achieved by calculating the time needed to find efficient shortest path. Table 3.4 shows the result of the time required for the shortest path algorithm that is and algorithm MDSP proposed. A comparative analysis conducted by three shortest path algorithm which there with MDSP and the results shown in Figure 5:15 The comparative analysis shows that MDSP take more low time to calculate the shortest path efficient than existing algorithms. From table 3.4 results of the analysis showed that the proposed shortest path shortest path algorithm MDSP find valid as compared with existing algorithms that only take the minimum number of nodes required about calculating. Therefore MDSP proposed algorithm performs better than the existing 3 algorithm shortest path modified Dijkstra. The results of research by the author of several journal wording for different cases prove that using Dijkstra's algorithm is able to determine the shortest route to the weighted positive numbers that can not be traversed by the negative node. so it can be easier for users to find the optimal shortest path to follow. The advantages and disadvantages of Dijkstra's algorithm in research determining the shortest route are:

Table 5 comparison between the journal

No.	Title of the journal	Excess	shortage
1	Determination These Shortest Towards Health Center Method Using Dijkstra Based Web GIS	step-step in determining the shortest route to the medical center in the city of Balikpapan can understood by the author and easy to solve the problem in terms of taking the shortest route.	-
2	Determination Shortest These Merauke City Garbage Collection receipts Dijkstra's algorithm	In this paper the steps in determining the distance and the shortest route to be followed very detail is the calculation of each of the road as well as program code calculates the shortest distance.	The algorithm explanation in this journal are difficult to understand.

3	Finding The Shortests Paths Among Cities In Java Island Node Using Combination Based On Dijkstra Algorithm	-	Algorithm to find the shortest path in Java using the node combination is difficult to be understood by the author is the step in finding the shortest path on the island of Java making it less effective.
4	Modified Dijkstra's Shortest Path Algorithm	Modified Dijkstra's algorithm is able to solve the problem of finding the shortest path to the road network with the complexity.	The steps in the modification of the path in this journal is less efficient so difficult to understand by the author.

4. Conclusions And Recommendations

4.1 Conclusion

Based on the conclusion that I can in this study by Dijkstra's algorithm method is able to produce the shortest route which is more efficient and easier to be understood by researchers, so that I can further develop the Determinants These applications Shortest Delivery Using Dijkstra's algorithm.

4.2 Recommendations

The suggestions from the research and that discussion obtained in this study are expected to be able to develop a future Determinants These applications Shortest Delivery Using Dijkstra's algorithm.

References

[1] Bilqis Amaliah, CF (2016). *Finding the Shortest Paths Among Cities In Java Island Node Using Combination Based On Dijkstra* Algorithm,16.International journal on smart sensing and intelligent systems **vol 9,** No. 4, December 2016.

[2] Edsger W, 1 (2015).*About Dijkstra'*salgorithm.Retrieved February 12, 2017, from https://wirasetiawan29.wordpress.com/: https://wirasetiawan29.wordpress.com/2015/04/02/tentang-algoritma-dijkstra/

[3] (Harsono, 2 (nd). *9 understanding Implementation according to*experts.Retrieved February 11, 2017, from www.gurupendidikan.com> Management: https://www.google.com/search?q=pengertian+implementasi+menurut+ahli&ie=utf-8&oe=utf-8&aq= t & rls = org.mozilla: en-US: official & client = firefox-a

[4] Murdick, RG (2014). *36 Understanding System According to the*experts.Retrieved February 12, 2017, from hedisasrawan.blogspot.com/: http: //hedisasrawan.blogspot .co.uk / 2014/01/25-definition-system-by-the-ahli.html

[5] RJ (2013). *definition According to expert*analysis.Retrieved February 11, 2017, from https://pengertiandefinisi.com: https: / /pengertiandefinisi.com/pengertian-analisa-menurut-ahli/

[6] S. Sivakumar, DC (nd). International Journal on Recent and Innovation Trends in Computing and Communications ISSN: 2321-8169 **Volume: 2** Issue: 3. *Rallway Route Optimization System Using Dijkstra* Method,8.

[7] S., M. (2010). *Understanding observation method* definition.Retrieved February 12, 2017, from www.sarjanaku.com/.../pengertian-metode-observasi-definisi.html:

[8] https://www.google.com/search?q=pengertian+metode+observasi&ie=utf-8&oe = utf-8 & aq = t & rls = org.mozilla: en-US: official & client = firefox-a

[9] Sri Andayani, EW (2014). ISBN: 979-29-0276-3. *Determination Shortest These Merauke City Trash Collection Using Dijkstra's* algorithm,7.

[10] Mandy Anisiyah, FA (2011). **vol. 6.** 3 September 2011. *The determination of Rue Shortest Towards Health Centers Based Dijkstra Method Using* WebGIS,6