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THE USE OF TSP FOR THE APPLICATION OF POS INDONESIA DELIVERY SERVICE

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ABSTRACT. *Traveling salesperson problem-TSP problem is an optimization problem to find the optimal way for the traveling salesman who wants to visit several cities, and returned to the original departure city. TSP is a difficult problem when viewed from the point of computing. Several methods have been used to solve these problems but until now not been found mangkus algorithms to solve them. The easiest way to solve TSP is to try all possible routes and find the optimal route. However, at the time of the very practical now required to complete an algorithm that quickly so that the TSP solution obtained near optimal solutions. shortest distance in post package delivery from Post Office Lhoksumawe is very important due to; hard terrain, traffic, etc. Therefore, the use of TSP to determine the shortest distance is very crucial.*

Keywords*:* Graph algorithm, traveling salesperson problem, Package Tracking.

1. **Introduction.** Developments in science and technology growing rapidly, it can be seen and felt directly or indirectly. The development is central impact on all aspects of human life. Globalization is happening now resulted in changes that impact affects all aspects of life and occurs in a sustainable manner, including in the national shipping company standard. Globalization is happening today resulted in changes that impact affects all aspects of life and occurs on an ongoing basis on the company's environmental standard delivery nationwide.

One type of the development of science and technology is the development of the computing world, one of which is the advancement of information systems. Almost no boundaries of space and time in connection with the information system, information from distant places are physically able to quickly and easily known by us. Through information technology-based Information Systems job becomes easy, effective and efficient.PT. Pos Indonesia is a national scale shipping companies that provide services of delivery of goods between inter-provincial city that has various branches located throughout Indonesia. Lhokseumawe post office has several operational areas of delivery package. To deliver a package from one city to another, the post office must be able to perform proper route selection so that the package can get to the destination in quick time. PT.Pos Indonesia as a mediator company in the field of dispatch and have a tough challenge in the face of the impact of the current changes, among others, that is the shift pattern in which the public demand service units still not up, but on the other hand is also increasing consumer needs , in addition to the problems associated with service facilities, freight forwarding, shipping rates, the state of goods, customer satisfaction, safety, etc. also need to get serious attention and handling. The process of packet delivery is ongoing at the post office, particularly Aceh area using public transport route, with a fleet of very limited so it takes a long time. If the post office subdistricts wants to send a packet to another city then the packet should be processed first by the post office examiner and then sent to the destination city, although the distance between the sub-district post office is closer to the destination city.

The problem is how to determine the right so that the package can get to the destination in the shortest possible time using the service, the package came to a town or post office can be directed to the appropriate post office next to the package to the city or the post office with the receiver the delay time minimum. In other words, should determine the shortest path and the approach that will be traversed by the packet sender of the post office to post office recipient.In the conduction process packets from one city to another course there needs to be consideration of the time and cost efficiency by the Company so that the required accuracy in determining the shortest route between the cities. The results of the determination of the shortest route can be obtained by using the method algorithm approach Travelling Salesperson Problem (TSP), which is an algorithm that search for the shortest path length and nearly optimal from the point of origin to point of destination and back to the point of origin in a connected weighted graph with minimal cost.

2. Literature Review and Theoretical Framework. *A. Review of Literature*, Previous research conducted Mukti (2005) with the title of building a geographic information system for mapping a billboard in Yogyakarta. In these studies still use additional software macromedia flash as the interface so that the files generated by the digitization programmed ArcView must be exported into a file with extension * .dxf so do twice the work in addition to the digitization onscreen in ArcView program if exported into a file dxf be less than perfect. ArcView software in the design it actually has quite complete even ArcView interface can create your own using the facility to customize and do not need to use any other device. Here the author uses ArcView software and Microsoft Access to store the database.

The study also draws on research conducted by Wijayanto (2005), with the title of GIS for mapping transceiver station BTS. Telkom Flexi PT.Telkom Bantul branch. In the study researchers used the software ArcView but its use has not been using the hotlink to display more detailed information so that the information is generated only in the form of the attributes of an existing theme. ArcView has hotlink facilities that can help display information more complete and exciting. And this study the authors have used the facility so that it can be displayed information hotlink broader and more detailed. Because hotlink facility can accept input in the form of text files, images, and doc files, so it can display information that is wider and more interesting.

Of the thesis by Arleadi (2002) Analysis of Design e-Commerce on the online bookstore just designing the design process from the manufacturer booksellers to consumers who will buy the book from the site are made, do not display the information in detail and interesting as well as in research This writer. The final task of the information system ordering products online with ASP applications in Timboel Ceramic Kasongan Bantul, Yogyakarta by Pamujianto (2004), it appears that the system made limited information and ordering products not include online sales that can be accessed directly by prospective customers through a specific web address .

The final task by Waluyo Basuki (2005) E-Commerce Web Design as a media and marketing information on software house IQSOFT Yogyakarta has a system by using facilities such as discussion forums, guest books, news and free downloads, and this type of transaction using the transaction cash payment / cash if the person concerned to stay in one area, for example in the region of Yogyakarta, but the system is experiencing weakness in the administration that the absence of the automation system of the subscriber data deletion has confirmed, in this case I will complement the deficiencies in previous studies that the internet or web can be felt more reliable and professional.

B. Basis Theory, System, The system consists of a number of components that interact means of a system work together to form a single unit. Component systems can co-exist in order to achieve a particular goal or objective. The system emphasizes the components are defined as follows: The system is a collection of elements that interact to achieve a goal, Muyawarah (2004). While the systems approach emphasizes the procedure is defined as follows; The system is a network of procedures interconnected, gathered together to perform an activity or to accomplish a certain goal; A system has the characteristics or specific traits, which have components, system boundaries outside the system environment connector, input, output, processing, and goals or objectives. Because it is a system composed of interrelated parts that operate together to achieve some goal or purpose. For that a system is not a set of elements arranged in an irregular, but is composed of

elements that can be known as complementary because the only purpose, goals and objectives, Kadir (2002). *Algorithms Graph-Traveling Salesperson Problem*, In the real world, we often face problems that have one or more of the following characteristics; The room is very big problem, complex, and difficult to understand; can not be solved using conventional methods; There is a time limit, for example, in real-time systems (real-time system). The solution is not expected to be the most optimal, but 'good' or acceptable; Less or no knowledge adequate to represent the problem into a more narrow the search space; Not available adequate mathematical analysis;

One example that has the characteristics of the above is the Traveling Salesman Problem (TSP). For example, a letter or package delivery services, manufacture of transport and so on. In the mail service, the problem is how to get the order delivery letter to all recipients, in which each receiver location only visited one time, so that the total cost required is minimal? In the manufacture of transportation, the problem is how to make the transportation line to reach, for example 10 cities in Aceh, with a minimum total cost? Costs here can be mileage, time, customer satisfaction, or other sizes [1].Mathematical problems of the Traveling Salesman Problem proposed in 1800 by the Irish mathematician William Rowan Hamilton and the British mathematician Thomas Penyngton. Originally from Hamilton Icosian game that requires the player to complete the journey of 20 points using only certain lines, as shown in figure 1.

Figure 1. Game Icosian Hamilton

The general form of TSP first studied by mathematicians began in 1930. Initiated by Karl Menger in Vienna and Harvard. After the TSP problem published by Hassler Whitney and Merrill Flood at Princeton.

Simple Procedures Solving TSP, In solving the TSP we can divide into two methods, ie the optimal method and the method of approximation. Optimal method will yield optimal results (minimum) while the approximation method will produce near-optimal results. Optimal method [4], Since TSP problems discovered in 1800 by the Irish mathematician Sir William Rowan Hamilton and the British mathematician Thomas Penyngton Kirkman, the focus of this study is to find the exact minimum value of TSP problem with the consequences it takes a long time to complete.

Complete Enumeration, This method will enumerate all the possibilities contained in the graph, then the algorithm will compare the trajectory where the minimum. For example for the following cases in Figure 2.

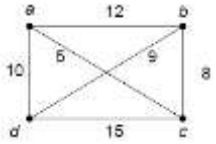

Figure 2. Example four-point trajectory of cases

is the number of points contained four and a lot of the tracks are three possibilities. Yes It Is in Figure 3:

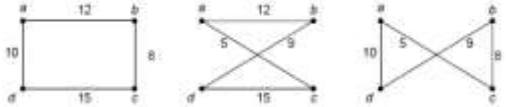

Figure 3. examples of three kinds of trajectories case

The first trajectory = (a, b, c, d, a) or (a, d, c, b, a) Having a length = 10 + 12 + 8 + 15 = 45. Running Second = (a, c, d, b , a) or (a, b, d, c, a) Having a length = 12 + 5 + 9 + 15 = 41, trails Third = (a, c, b, d, a) or (a, d, b, c, a) mempunyi length = 10 + 5 + 9 + 8 = 32. From the results of this enumeration results obtained minimum is 32. But the number of enumeration of this algorithm is (n - 1)! which will not be efficient if the number n is very large.

Branch and Bound, In figure 4 Same with complete enumeration, the algorithm Branch and Bounpun proved to have algorithmic complexity (n-1) !, where n is the number of cities. For the above cases the results achieved are 15.

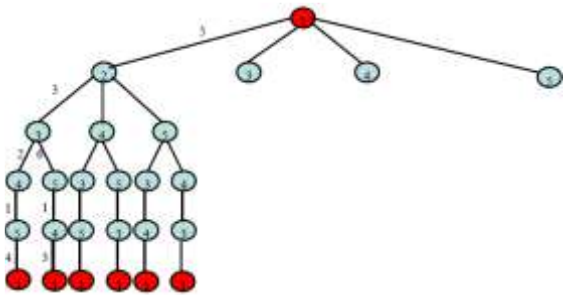

Figure 4. Branch and Bound

3. Research Methodology: A. Location Research, Location of the study is PT.Pos Indonesia (Persero), a branch office in Lhokseumawe, North Aceh Department of Transportation, North Aceh and Bapedda Lhokseumawe.

B. Equipment and Materials Research;
1) Research Tools, Hardware, The hardware used in this study are: hardware specifications (hardware) used in this study is in the form of laptops with high specification Intel Core2Duo, 2GB memory, and 512MB nVidia Graphics, And the printer's print tool to facilitate researchers in conducting research.
Software, The software used in this study are: The software used in this study are: PHP, MySQL and other supporting devices.

2) materials Research Materials research is needed are as follows: Data post office in Aceh, the data package at the post office, the data on the route of the conduction current packag, post office location data, data distances between cities and districts in Aceh, street map of Aceh, data news about the company, company profile data, data Rate

3) Data Collection Methods, The methodology used is the structured analysis and design stages as follows:
• Field Research;
- In conducting this study the authors conducted observations, ie data collection method using direct observation and systematic recording with the symptoms or related phenomena without asking questions. interview with the head of the data processing and the head of the post office information center in Lhokseumawe. Mechanical analysis of the existing system or ongoing.
- Implementation, ie the method by implementing the results of the design which has been made into an attractive display to facilitate the learning of the research object.
- Test method, ie a method in which the design has been implemented into the program can be tested truth to others who want to learn it.
• Research Library
This method is a method of data collection by studying literature, package modules and guides, handbooks, library books and any other literature that is deemed necessary and support.

4) Steps Research: The steps in conducting this research are as follows
• System Design Phase
• The system is designed by using DFD (Data Flow Diagram) is to determine the input and output processes in the system.
• Designing graphs and algorithms for the TSP is
- Determine the graph that will be used.
- Describe the graph correspond to the road map across Aceh.
- Determine the points in the graph.
- Enter the weight value in the graph.
- Determining the routes that can be passed to the conduction package from the starting point to points further.

- Determining the shortest route or the minimum value by using TSP algorithm.
• Phase Making System, The steps used to create the system are as follows:
- Specifies the programming language to be used.
- Creating the database tables.
- Designing the interface menu system.
- Implement the system into the programming language.
• System Testing Phase, The steps used in the test system are as follows:
- Perform Test Case
- Gives the type of test Black Box test
- Gives the type of test Alpha test

4. Results and Discussion: A. Analysis System Requirements

• Context Diagram, Context diagram is a diagram illustrating the flow of data on the application system is optimal conduction Determination These outline package that represents the whole of the system being designed. Context diagram is also a depiction of the system in general and describes the relationship between the input and output systems with the world outside. This diagram inventory data into the system along with the source and the information produced by the system and its goals, as shown in figure 5.

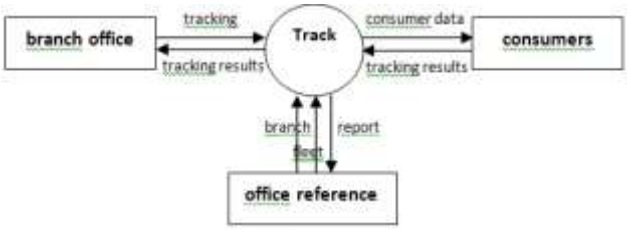

Figure 5. Context diagram

• DFD Level 1 Process 1

DFD level 1 process 1 shows the branch data record, starting with the input data by a branch of the Office of Reference. In this process also made the process data update and delete data branch branches. The process is then entered into the data store branches, as shown in figure 6.

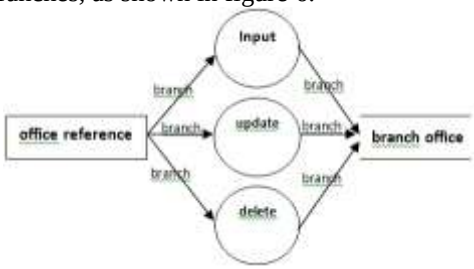

Figure 6. DFD Level 1 Process 1

• DFD Level 1 Process 2

DFD Level 1 process 2 shows the data record fleet, starting with a fleet of input data by the Office of Reference. In this process also made the process of fleet data update and delete data fleets. Prosses are then entered into the data store fleet, as shown in figure 7.

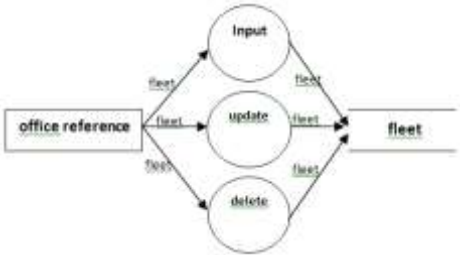

Figure 7. DFD Level 1 Process 2

• DFD Level 1 Process 3

DFD Level 1 process 3 shows the packet data record, starting with the inputting of data packets by the Branch

Office. In this process also made the process of updating the data packet and delete data packet. Prosses are then entered into the data store package, as in figure 8.

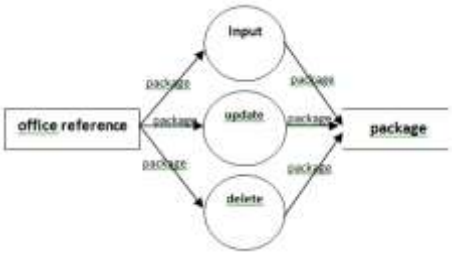

Figure 8. DFD Level 1 Process 3

B. Calculation adjacency matrix Graf

Adjacency matrix of the graph above is:

Table 1. Matrix of neighborhood graph calculating the optimal route to the post office in Aceh

i=A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
A	0	40	∞	∞	∞	56	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
B	∞	0	60	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
C	∞	60	0	40	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	140	∞	∞	∞	∞	∞
D	∞	∞	40	0	30	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
E	∞	∞	∞	30	0	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
F	∞	∞	∞	∞	∞	0	106	∞	∞	∞	70	∞	∞	∞	∞	∞	∞	∞	∞	∞
G	∞	∞	∞	∞	∞	106	0	102	112	∞	∞	∞	211	∞	∞	∞	∞	∞	∞	∞
H	∞	∞	∞	∞	∞	∞	102	0	60	80	∞	∞	∞	140	∞	∞	∞	∞	∞	∞
I	∞	∞	∞	∞	∞	∞	112	60	0	156	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
J	∞	∞	∞	∞	∞	∞	∞	80	156	0	∞	∞	89	∞	∞	∞	∞	∞	∞	∞
K	∞	∞	∞	∞	∞	70	∞	∞	∞	∞	0	40	∞	∞	∞	∞	∞	∞	∞	∞
L	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	40	0	160	∞	162	∞	∞	∞	∞	∞
M	∞	∞	∞	∞	∞	∞	211	∞	∞	89	∞	∞	0	45	∞	∞	∞	∞	∞	∞
N	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	45	0	140	∞	81	∞	∞	∞
O	∞	∞	140	∞	∞	∞	∞	∞	∞	∞	∞	162	∞	140	0	106	∞	∞	∞	∞
P	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	106	0	∞	∞	160	∞
Q	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	81	∞	∞	0	74	∞	∞
R	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	74	0	200	
S	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	160	∞	200	0	60
T	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	60	0

C. Shortest route Using TSP Algorithm

Table 2. Calculation of the optimal These initial node A = A (Lsm) all of the other node. (To Value S):

Initial	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A	A	A	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	B	A,B	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	F	A,F	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
D	C	A,B,C	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	K	A,F,K	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
F	D	A,B,C,D	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	G	A,F,G	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
H	L	A,F,K,L	1	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0
I	E	A,B,C,D,E	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J	O	A,B,C,O	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
K	H	A,F,G,H	1	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0
L	M	A,F,K,L,M	1	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0
M	I	A,F,G,H,I	1	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0
N	P	A,B,C,O,P	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
O	N	A,F,K,L,M,N	1	0	0	0	0	1	0	0	0	0	1	1	1	1	0	0	0	0	0
P	J	A,F,K,L,M,J	1	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	0
Q	Q	A,F,K,L,M,N,Q	1	0	0	0	0	1	0	0	0	0	1	1	1	1	0	0	1	0	0
R	S	A,B,C,O,P,S	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
S	T	A,B,C,O,P,S,T	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1
T	R	A,B,C,O,P,S,R	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1

Table 3. Calculation of the optimal These initial node A = A (Lsm) all of the other node. (To Value D)

Update	Yang dipilih	Lintasan	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Inisial	-	-	0	40	∞	∞	∞	56	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
A	A	A	∞	40	∞	∞	∞	56	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
B	B	A,B	∞	40	100	∞	∞	56	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞
C	F	A,F	∞	40	100	140	∞	56	162	∞	∞	∞	126	∞	∞	∞	∞	∞	∞	∞	∞	∞
D	C	A,B,C	∞	40	100	140	∞	56	162	∞	∞	∞	126	∞	∞	∞	328	∞	∞	∞	∞	∞
E	K	A,F,K	∞	40	100	140	∞	56	162	∞	∞	∞	126	∞	∞	∞	328	∞	∞	∞	∞	∞
F	D	A,B,C,D	∞	40	100	140	∞	56	162	∞	∞	∞	126	166	∞	∞	328	∞	∞	∞	∞	∞
G	G	A,F,G	∞	40	100	140	170	56	162	274	∞	∞	126	166	∞	∞	328	∞	∞	∞	∞	∞
H	L	A,F,K,L	∞	40	100	140	170	56	162	274	∞	∞	126	166	326	∞	328	∞	∞	∞	∞	∞
I	E	A,B,C,D,E	∞	40	100	140	170	56	162	274	∞	∞	126	166	326	371	328	434	∞	∞	∞	∞
J	O	A,F,K,L,O	∞	40	100	140	170	56	162	274	∞	∞	126	166	326	371	328	434	∞	∞	∞	∞
K	H	A,F,G,H	∞	40	100	140	170	56	162	274	334	∞	126	166	326	371	328	434	∞	∞	∞	∞
L	M	A,F,K,L,M	∞	40	100	140	170	56	162	274	334	415	126	166	326	371	328	434	∞	∞	∞	∞
M	I	A,F,G,H,I	∞	40	100	140	170	56	162	274	334	415	126	166	326	371	328	434	∞	∞	∞	∞
N	N	A,F,K,L,M,N	∞	40	100	140	170	56	162	274	334	415	126	166	326	371	328	434	452	∞	∞	∞
O	P	A,F,K,L,O,P	∞	40	100	140	170	56	162	274	334	415	126	166	326	371	328	434	452	∞	∞	∞
P	J	A,F,K,L,M,J	∞	40	100	140	170	56	162	274	334	415	126	166	326	371	328	434	452	∞	594	∞
Q	Q	A,F,K,L,M,N,Q	∞	40	100	140	170	56	162	274	334	415	126	166	326	371	328	434	452	∞	594	∞
R	S	A,F,K,L,O,P,S	∞	40	100	140	170	56	162	274	334	415	126	166	326	371	328	434	452	∞	594	∞
S	T	A,F,K,L,O,P,S,T	∞	40	100	140	170	56	162	274	334	415	126	166	326	371	328	434	452	794	594	654
T	R	A,F,K,L,O,P,S,R	∞	40	100	140	170	56	162	274	334	415	126	166	326	371	328	434	452	794	594	654

Table 4. From the above calculation, the optimal conduction These package at the post office to post office Lhokseumawe objectives are as follows:

A (Lasi)	B (Lhoksukon)	A,B	40 Km
	F (Bireun)	A,F	56 Km
	C (Idi)	A,B,C	100 Km
	K (Simpang Tiga)	A,F,K	126 Km
	D (Langsa)	A,B,C,D	140 Km
	G (Sigli)	A,F,G	162 Km
	L (Takengon)	A,F,K,L	166 Km
	E (Kuala Simpang)	A,B,C,D,E	170 Km
	O (Blangkejren)	A,F,K,L,O	240 Km
	H(Jantho)	A,F,G,H	274 Km
	M (Meulaboh)	A,F,K,L,M	326 Km
	I (BandaAceh)	A,F,G,H,I	334 Km
	N (Janarata)	A,F,K,L,M,N	371 Km
	P (Kutacane)	A,F,K,L,O,P	434 Km
	J (Calang)	A,F,K,L,M,J	415 Km
	Q (Blang Pidie)	A,F,K,L,M,N,Q	452 Km
	S (Subulussalam)	A,F,K,L,O,P,S	594 Km
	T (Singkil)	A,F,K,L,O,P,S,T	654 Km
	R (Tapak tuan)	A,F,K,L,O,P,S,R	794 Km

D. Implementation System

Figure 9 is the main page of the web which has a variety of menus, especially menus finding a route between packets.

Figure 9. Index page

E. System usage rate statistics

The following is a statistical comparison of the level of use of the old system and the new system based on usage per year, before and after the implementation of relevant research conducted path-based package tracking algorithm. year comparison results can be seen in table 5 and figure 10 below.

Table 5. Level of ease and satisfaction

ID	The City	Year	
		2014	2015
1	Banda Aceh	389443	507787
2	Lhokseumawe	329537	453732
3	Meulaboh	308940	402657
4	Takengon	312268	357491
5	Blangkerjen	223640	376757
6	Singkil	298780	332166

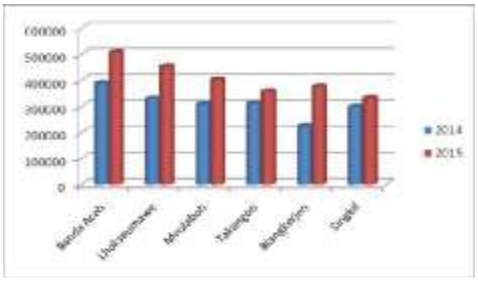

Figure 12. Level of ease and satisfaction

5. Conclusion, After making the application of delivery tracking system using the algorithm TSP package at PT.
Pos Indonesia Persero Lhokseumawe, it can be concluded as follows:
A. The system can find a sequence of site visits (one location only visited one time) the total "value" of the optimum (minimum or maximum can rely purpose). "Value," here could be a distance, cost, convenience, and so on. The goal is to find the sequence of the total package delivery location most minimal distance.
B. Application Tracking System This package can be used to improve the search packet and determining the route in the delivery package as well as shorten the search time of delivery route packets effectively and efficiently and provide information quickly and easily.
C. Tracking System This package is very effective in providing accurate results and updates on the status and conditions of the package.
D. Tracking System This package provides data security to every branch and head office also has a right of access, by providing a user ID and password can be encrypted.

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