Shortest Path Finding Using Dijkstra's Algorithm

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Abstract

In the professional work, discipline is a very important to see work ethic of an employee. Discipline has also the most important element of good behavior, both as individual and social. A problem is when people on the road in finding the shortest path in order to get to the destination on time. Finding shortest path improves workers discipline and add value to employees. With the Dijkstra's Algorithm, we can find the shortest route. The value on the edge of a graph can be expressed as the distance between nodes (roads). Through this proposed application, it easier for us to find the shortest route in a more effective time.

Keywords: dijkstra's algorithm, shortest distance, graph, node, edge

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1. Introduction

Discipline is very important aspect for employee, because it related to work ethic of a person. It also important for someone who works in education, e.g. a teacher. The teacher is a role model of his/her students, hence, when a teacher wants to teach discipline to his students, the teacher should show a discipline attitude first.

Discipline is the most important element for every human being, both as an individual and social aspects. A disciplined person can carry out his duties regularly, in accordance with the existing order, and will make their life orderly too (Trisnawati, 2013).

There are so many disciplinary behaviors that we can take as an example, one of which is coming to school on time. In particular, the distance between a residence and the school is quite far and many route alternatives that confusing in making the route choice. Therefore, a system to find the route will be proposed in this study.

In this research, I created a simulation to find the shortest distance using a digital algorithm with a predetermined and described scheme. The article will answer how to find the shortest path from   P. Antasari avenue 2 towards Urip Sumoharjo road and what factors should be taken into account in finding this route. This study also use a study case for the road that can be passed through by a car or motorcycle. A Google Map is used for presenting the result.

2. Research Methods

2.1. Graph

A graph is composed of several nodes joined by arcs. The notation to describe a graph is (G, E), where G is a combination of several nodes (vertices) and E is a combination of several arcs (edges) with associated values at each node. The associated values are the number of nodes, the number of arcs, and the length of the arc connecting nodes i and j which are denoted as d (i, j). A network can be described as a graph. Some examples of network models that are described as a graph are the design of oil pipelines, physical networks such

as roads, railroads, or airplane routes, electric cable networks, and so on (Purwananto et al., 2005).

According to the direction the graph is differentiated into 2, namely: 1.) Undirected graph, a graph whose sides have no direction. In an undirected graph, the order of the pairs of vertices connected by edges is not considered. So, (u, v) = (v, u) is the same side, and 2). Directed graph (directed graph), a graph where each side has a directional orientation, on a directed graph (u, v) and (v, u) represent two different sides; in other words, it can be written (u, v) ≠ (v, u) (Harahap, 2019).

2.2. Weighted Graph

A weighted graph is a graph where each side has a weight or value. Each content of the weight is different, depending on the problem modeled by the graph. Weights can state the distance between two cities, the cost of traveling from a node, and others (Fitria & Triansyah, 2013).

2.3. Matrix

Matrices can be used to represent a graph. It is very helpful for creating computer programs that deal with graphs. By recording the graph as a matrix, the necessary calculations can be done easily (Siang, 2002). For example, an adjacency matrix, suppose a graph G = (V, E) with n vertices. The neighbor matrix G is a square matrix of size n × n. or M = [mij], where mij = 1 if vertices i and j are adjacent, otherwise mij = 0 if vertices i and j are not neighboring (Salaki, 2011).

2.4. Shortest Path Problem

The shortest route calculation is the process of finding the shortest distance or smallest cost of a route from the initial node to the destination node in a network. In the process of calculating the shortest route, there are two kinds of processes, namely the labeling process and the node checking process. The labeling method is a method for identifying each node in the network. In most of the shortest route calculation algorithms, there are 3 information labels that are managed for each node i in the labeling process, namely: distance label d (i), parent node p (I)), and the status of the node S (i) (Purwananto et al., 2005).

2.5. Dijkstra's Algorithm

In its application, the Dijkstra's Algorithm is used to find the shortest route on a directed graph but basically the Dijkstra's Algorithm can also be applied to undirected graphs. The principle used in the Dijkstra's Algorithm is the greedy algorithm, where the principle is that we choose a weight that has a minimum value and then enter it in a set of solutions (Andayani & Perwitasari, 2014).

The weight value of each edge on a graph is the distance from one vertex to another vertex on a weighted graph. The weight must be positive (weight> = 0). This algorithm works by finding the shortest distance by calculating the distance from the original vertex to the closest vertex, then to the second vertex, etc. (Harahap, 2019).

Dijkstra's algorithm uses the adjacent list to represent a network. In general, the Dijkstra's Algorithm divides all nodes into two parts, then put them in different tables, namely the permanent table and the temporal table. The permanent table contains the initial nodes and the nodes that have gone through the process of checking and their labels have been changed from temporal to permanent. The temporal table contains nodes associated with nodes in the permanent table (Retnani et al., 2015).

2.6. Methods and Data

The object of this research is the search for the shortest route to SMPN 6 Samarinda. In this study, two data collection methods was used, namely: observation and literature study.The author made observations by directly observing the journey he had taken, starting from Antasari Avenue Gg 8 towards the Urip Sumoharjo road, and then using google map the distance was measured. In literature study stage, the authors collect material or materials that will be used in designing the program by collecting through literature books, journals and the internet in accordance with the research title to be discussed.

3. Results and Discussion

An implementation has been conducted to travel from P. Antasari avenue 2 Gang 8 to SMPN 6 SAMARINDA which is located at JL. Urip Sumoharjo.
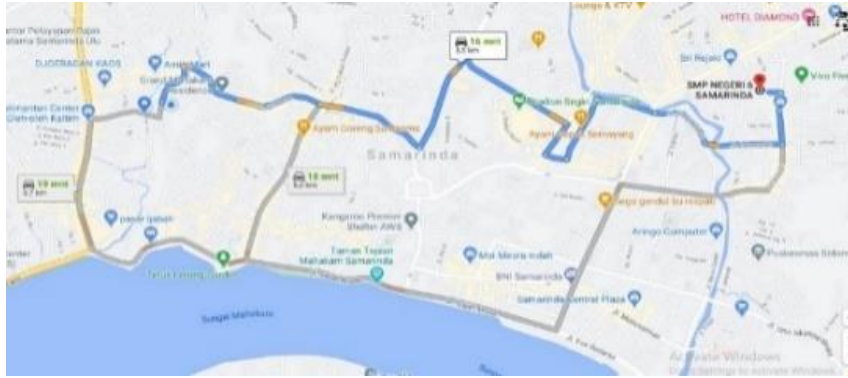
Figure 1. Map of the Trajectory from Home to SMPN 6 Samarinda

There are many paths that can be traversed to get to the destination, but only describes a few points of the road that is often travele. The following is the point of intersection and the distance made by the author in the form of a graph:
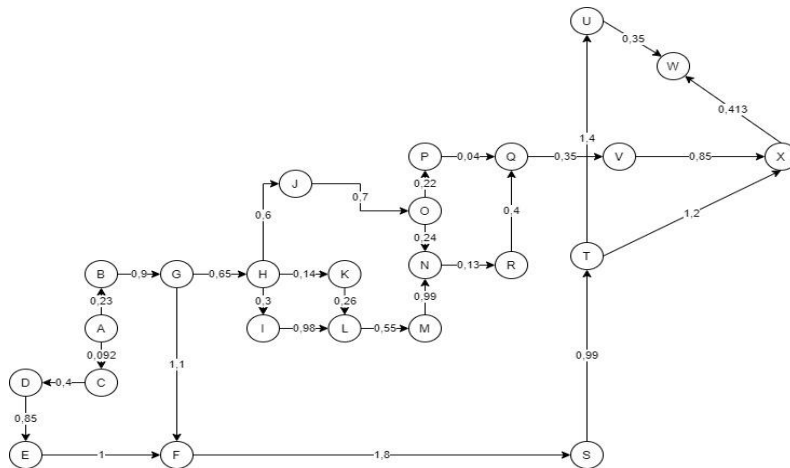
Source: Research Results (2020)

Figure 2. Path Graph

Where:

A.   Jl. P. Antasari 2 Gang 8

B.   Jl. Sirad Salman

C.   Jl. Antasari 2

D.   Jl. Antasari

E.   Muara

F.   Jl. RE Martadinata

G.   Simpang Jl. Sirad Salman & Jl. Pasundan

H.   Simpang Jl. KS. Tubun & Jl. Bhayangkara

I.   Jl. Bhayangkara

J. Jl. Kusuma Bangsa

K. Jl. Cempaka

L. Simpang Jl. Cempaka & Jl. Basuki Rahmat

M. Jl. Basuki Rahmat

N. Simpang Jl. Agus Salim & Jl. Danau Toba

O. Simpang Jl. Kusuma Bangsa dan Jl. Agus Salim

P. Jl. Tarmidi

Q. Simpang Jl. Tarmidi & Jl. Danau Semayang

R. Jl. Danau Toba

S. Jl. Yos Sudarso

T. Simpang Jl. Imam Bonjol & Jl. Arief Rahman Hakim

U. Jl. Lambung

V. Jl. Abdul Muthalib

W. Simpang Jl. Kehewanan & Jl.Urip Sumoharjo

X. Jl. Urip Sumoharjo (SMP N 6 SAMARINDA)

At each node, the author gives a number symbol starting from 1 to 30, where the number 1 is the starting point, which is the author's home address on Jl. P. Antasari 2 Gang 8 and ends at Jl. Urip Sumoharjo. For the distance between nodes, the weight is given in Kilometers (KM).

The next step is carry out the calculation of the weight for each passed, starting from node 1 to node 30. From the path, the 8 paths have been created that usually take to get to Urip Sumoharjo road.
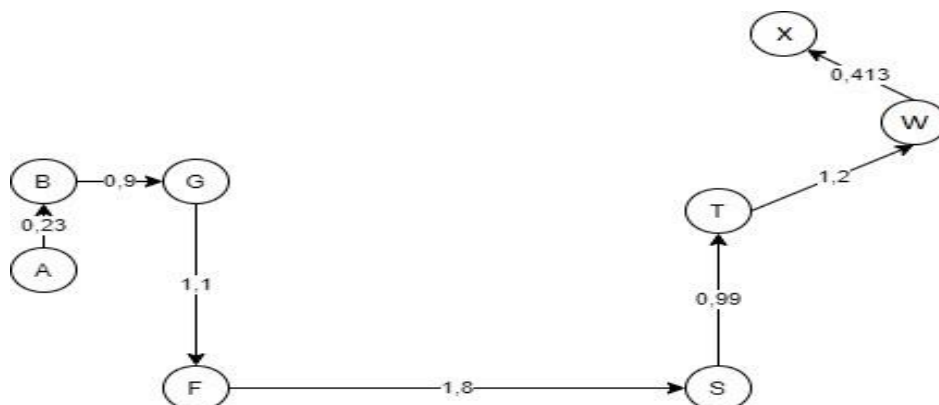
Source: Research Results (2020)

Figure 3. First Iteration

Table 1. First Iteration Results

No	Route	Weight (KM)
1	{A}	0
2	{A,B}	0.23
3	{A,B,G}	1.13
4	{A,B,G,F}	2.23
5	{A,B,G,F,S}	4.03
6	{A,B,G,F,S,T}	5.02
7	{A,B,G,F,S,T,W}	6.22
8	{A,B,G,F,S,T,W,X}	6.633

Source: Research Results (2020)
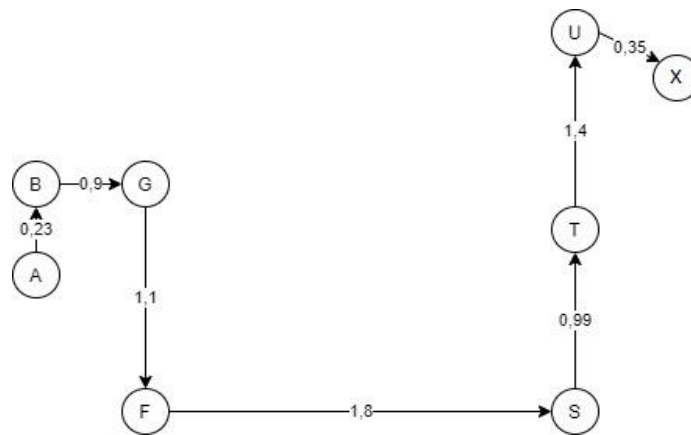
Source: Research Results (2020)

Figure 4. Second Iteration

Table 2. Second Iteration Results

No	Route	Weight (KM)
1	{A}	0
2	{A,B}	0.23
3	{A,B,G}	1.13
4	{A,B,G,F}	2.23
5	{A,B,G,F,S}	4.03
6	{A,B,G,F,S,T}	5.02
7	{A,B,G,F,S,T,U}	6.42
8	{A,B,G,F,S,T,U,X}	6.77

Source: Research Results (2020)
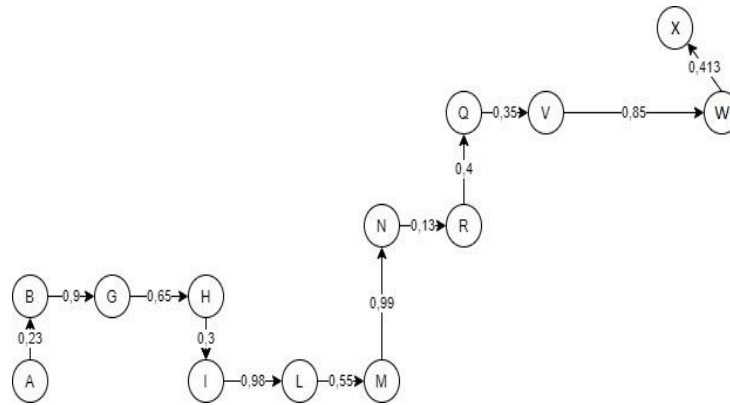
Source: Research Results (2020)

Figure 5. Third Iteration

Table 3. Third iteration Results

No	Route	Weight (KM)
1	{A}	0
2	{A,B}	0.23
3	{A,B,G}	1.13
4	{A,B,G,H}	1.98
5	{A,B,G,H,I}	2.28
6	{A,B,G,H,I,L}	2.378
7	{A,B,G,H,I,L,M}	2.928
8	{A,B,G,H,I,L,M,N}	3.918
9	{A,B,G,H,I,L,M,N,R}	4.048
10	{A,B,G,H,I,L,M,N,R,Q}	4.448
11	{A,B,G,H,I,L,M,N,R,Q,V}	4.798
12	{A,B,G,H,I,L,M,N,R,Q,V,W}	5.648
13	{A,B,G,H,I,L,M,N,R,Q,V,W,X}	6.061

Source: Research Results (2020)
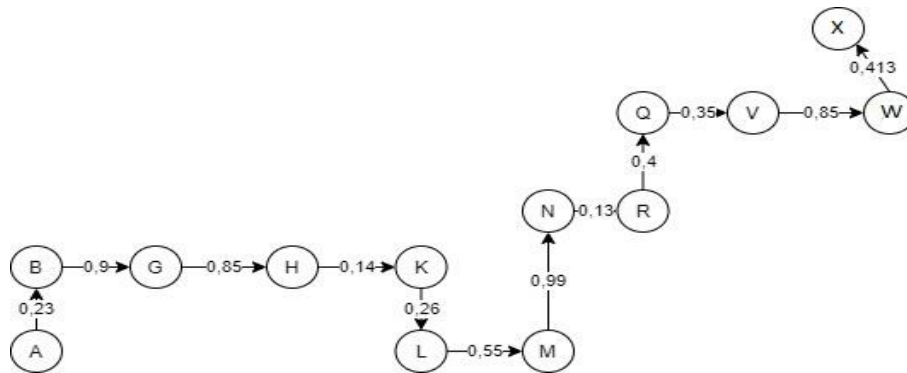
Source: Research Results (2020)

Figure 6. Fourth Iteration

Table 4. Fourth Iteration Results

No	Route	Weight (KM)
1	{A}	0
2	{A,B}	0.23
3	{A,B,G}	1.13
4	{A,B,G,H}	1.98
5	{A,B,G,H,K}	2.12
6	{A,B,G,H,K,L}	2.38
7	{A,B,G,H,K,L,M}	2.93
8	{A,B,G,H,K,L,M,N}	3.92
9	{A,B,G,H,K,L,M,N,R}	4.05
10	{A,B,G,H,K,L,M,N,R,Q}	4.45
11	{A,B,G,H,K,L,M,N,R,Q,V}	4.8
12	{A,B,G,H,K,L,M,N,R,Q,V,W}	5.65
13	{A,B,G,H,K,L,M,N,R,Q,V,W,X}	6.063

Source: Research Results (2020)
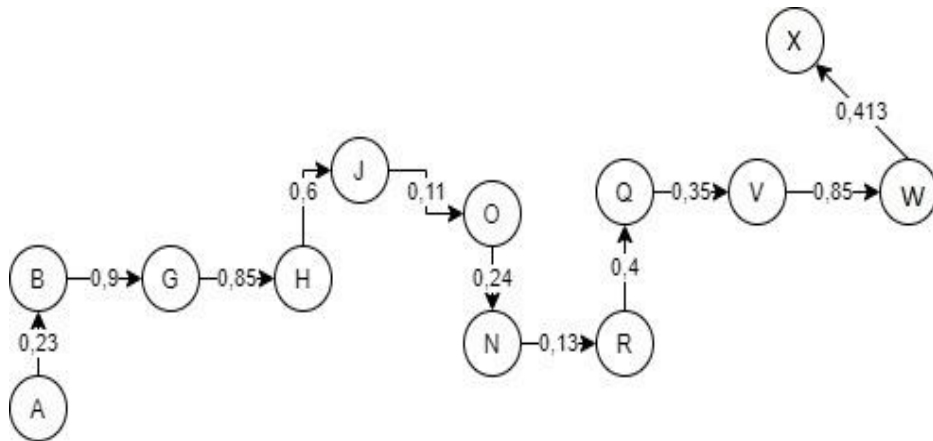
Source: Research Results (2020)

Figure 7. Fifth Iteration

Table 5. Fifth Iteration Results

No	Route	Weight (KM)
1	{A}	0
2	{A,B}	0.23
3	{A,B,G}	1.13
4	{A,B,G,H}	1.98
5	{A,B,G,H,J}	2.58
6	{A,B,G,H,J,O}	2.69
7	{A,B,G,H,J,O,N}	2.93

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No	Route	Weight (KM)
8	{A,B,G,H,J,O,N,R}	3.06
9	{A,B,G,H,J,O,N,R,Q}	3.46
10	{A,B,G,H,J,O,N,R,Q,V}	3.81
11	{A,B,G,H,J,O,N,R,Q,V,W}	4.66
12	{A,B,G,H,J,O,N,R,Q,V,W,X}	5.073

Source: Research Results (2020)
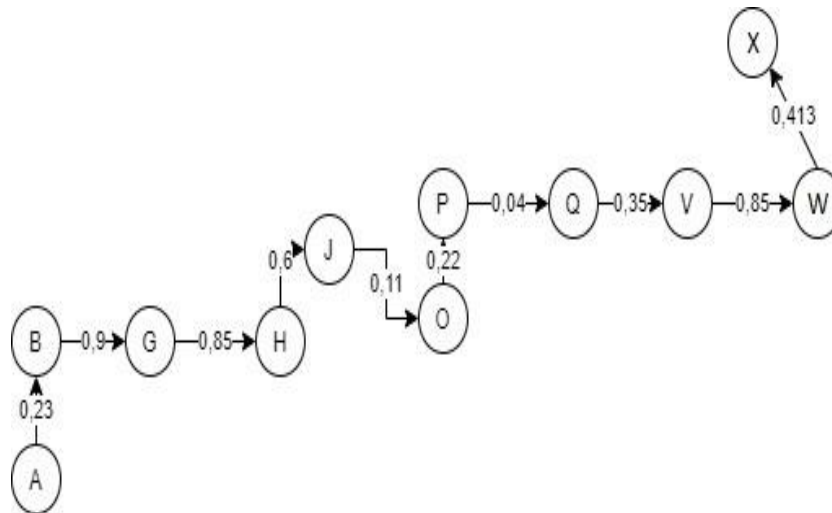
Source: Research Results (2020)

Figure 8. Sixth Iterasi

Table 6.Results of iteration 6

No	Route	Weight (KM)
1	{A}	0
2	{A,B}	0.23
3	{A,B,G}	1.13
4	{A,B,G,H}	1.98
5	{A,B,G,H,J}	2.58
6	{A,B,G,H,J,O}	2.69
7	{A,B,G,H,J,O,P}	2.91
8	{A,B,G,H,J,O,P,Q}	2.95
9	{A,B,G,H,J,O,P,Q,V}	3.3
10	{A,B,G,H,J,O,P,Q,V,W}	4.15
11	{A,B,G,H,J,O,P,Q,V,W,X}	4.563

Source: Research Results (2020)
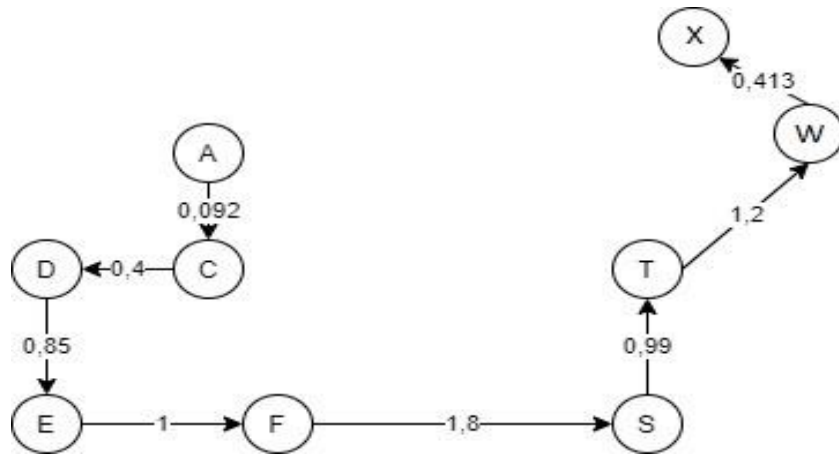
Source: Research Results (2020)

Figure 9. 7th Iteration

Table 7. 7th Iteration Results

No	Route	Weight (KM)
1	{A}	0
2	{A,C}	0.092
3	{A,C,D}	0.492
4	{A,C,D,E}	1.342
5	{A,C,D,E,F}	2.342
6	{A,C,D,E,F,S}	4.142
7	{A,C,D,E,F,S,T}	5.132
8	{A,C,D,E,F,S,T,W}	6.332
9	{A,C,D,E,F,S,T,W,X}	6.745

Source: Research Results (2020)
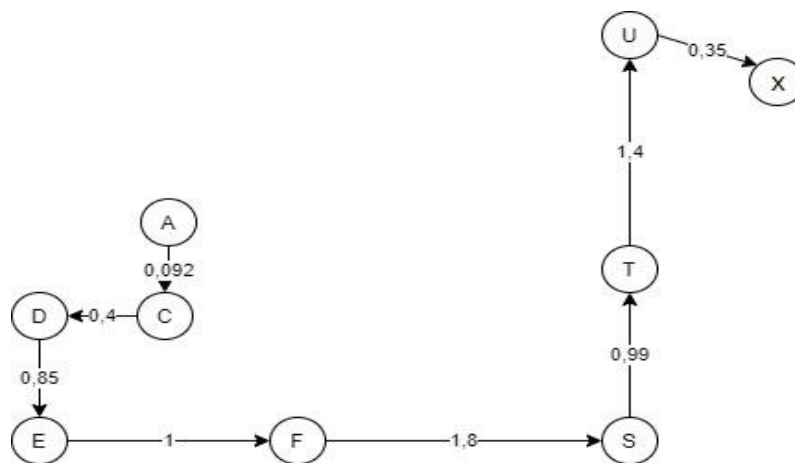
Source: Research Results (2020)

Figure 10. 8th Iteration

Table 8. 8th Iteration Results

No	Route	Weight (KM)
1	{A}	0
2	{A,C}	0.092
3	{A,C,D}	0.492
4	{A,C,D,E}	1.342
5	{A,C,D,E,F}	2.342
6	{A,C,D,E,F,S}	4.142
7	{A,C,D,E,F,S,T}	5.132
8	{A,C,D,E,F,S,T,U}	6.532
9	{A,C,D,E,F,S,T,U,X}	6.882

Source: Research Results (2020)

Table 9. List of Tracks from Initial Point to SMP Negeri 6 Samarinda

No	Route	Distance
1	1-2-8-7-6-23-24-25-26-27-28-22-30	6.633
2	1-2-8-7-6-23-24-25-26-27-29-30	6.77
3	1-2-8-9-13-14-15-12-18-19-20-21-22-30	6.061
4	1-2-8-9-16-14-15-12-18-19-20-21-22-30	5.901
5	1-2-8-9-10-11-12-18-19-20-21-22-30	5.073
6	1-2-8-9-10-11-17-19-20-21-22-30	4.583
7	1-3-4-5-6-23-24-25-26-27-28-22-30	6.386
8	1-3-4-5-6-23-24-25-26-27-29-30	6.522

Source: Research Results (2020)

Table 9 shows that of the 8 paths that I often take to get to Urip Sumoharjo road to SMP Negeri 6 Samarinda, there is one route which is considered to have the shortest distance, namely from 1-2-8-9-10-11-17-19-20-21-22-30 with a total distance of 4.583 km . In figure 11 is the form of the neighbor matrix, where the matrix is a form of representation of the graph that the author has made, so that when creating the program, the computer does not have difficulty reading the existing graph.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
A	0	0.2	0.1	∞	∞	∞	∞	∞	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥
B	0.2	0	¥	¥	¥	¥	1	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥
C	0.1	¥	0	0,4	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥
D	¥	¥	0,4	0	0.9	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥
E	¥	¥	¥	0.9	0	1	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥
F	¥	¥	¥	¥	1	0	1.1	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	2	¥	¥	¥	¥	¥
G	¥	1	¥	¥	¥	1.1	0	0.9	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥
H	¥	¥	¥	¥	¥	¥	0.9	0	0.3	0.6	0.1	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥
I	¥	¥	¥	¥	¥	¥	¥	0.3	0	¥	¥	1	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥
J	¥	¥	¥	¥	¥	¥	¥	0.6	¥	0	¥	¥	¥	¥	¥	0.1	¥	¥	¥	¥	¥	¥	¥	¥
K	¥	¥	¥	¥	¥	¥	¥	0.1	¥	¥	0	0.3	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥
L	¥	¥	¥	¥	¥	¥	¥	¥	1	¥	0.3	0	0.6	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥
M	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	0.6	0	1	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥
N	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	1	0	0.2	¥	¥	0.1	¥	¥	¥	¥	¥	¥
O	¥	¥	¥	¥	¥	¥	¥	¥	¥	0.1	¥	¥	¥	0.2	0	0.2	¥	¥	¥	¥	¥	¥	¥	¥
P	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	0.2	0	0.04	¥	¥	¥	¥	¥	¥	¥
Q	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	0.04	0	0.4	¥	¥	¥	0.4	¥	¥
R	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	0.1	¥	¥	0.4	0	¥	¥	¥	¥	¥	¥
S	¥	¥	¥	¥	¥	2	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	0	1	¥	¥	¥	¥
T	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	1	0	1.4	¥	1.2	¥
U	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	1.4	0	¥	¥	0.4
V	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	0.4	¥	¥	¥	¥	0	0.9	¥
W	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	1.2	¥	0.9	0	0.4
X	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	¥	0.4	¥	0.4	0

Source: Research Results (2020)

Figure 11. Neighbors Matrix

4. Conclusion

From the research that has been done by the author, it can be concluded that Dijkstra's Algorithm is one of the algorithms that can be applied in the process of determining the shortest route in this study. How to find it is by making a graph that contains input in the form of an intersection of origin and destination and a node as an intersection and a node or path as a path that connects it. Factors that must be taken into account in finding the shortest path are road conditions, the length of the path to be traversed, the volume of vehicles, the presence of markets, schools, or other public spaces, traffic lights. For real conditions, the application of Dijkstra's algorithm must be accompanied by other algorithms so that what is measured can be even more complex. For further research, we will extend the research objects such as access distances to other public spaces and add the weight of time as an addition so that it can be applied to the real situation

Author Contributions

Fitri Yani Nurhasanah the topic; Fitri Yani Nurhasanah, Windu Gata, Dwiza Riana, Muh.Jamil, and Surya Fajar Saputra conceived models and designed the

experiments; Fitri Yani Nurhasanah, Windu Gata, Dwiza Riana, Muh.Jamil, and Surya Fajar Saputra the algorithms; Fitri Yani Nurhasanah, Windu Gata, Dwiza Riana, Muh.Jamil, and Surya Fajar Saputra analysed the result.

Conflicts of Interest

The author declare no conflict of interest.

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