INTENSIF, Vol.6 No.1 February 2022
ISSN: 2580-409X (Print) / 2549-6824 (Online)
DOI: https://doi.org/10.29407/intensif.v6i1.15816

Implementation of Dijkstra's Algorithm to Find a School Shortest Distance Based on The Zoning System in South Tangerang

Received:
2 April 2021
Accepted:
28 January 2022
Published:
11 February 2022

[1]*Maulana Muhamad Sulaiman, [2]Sahlan
[1,2]Teknik Informatika, Universitas Pamulang
[1,2]Tangerang Selatan, Indonesia
E-mail: [1]dosen02363@unpam.ac.id, [2]dosen02403@ unpam.ac.id

*Corresponding Author

Abstract— School is an essential thing for education quality. This time, the South Tangerang government is implementing a new student admission process using a zoning system; all prospective students must choose a school that has the shortest distance from their residence. However, many parents and prospective students do not understand this zoning system. The limited access to information is a problem for them, so they do not know where the schools are included in their zoning area. For this reason, the need to efforts the problem-solve to use Dijkstra's algorithm as a consideration to find the results more accurate for the shortest distance. So the exact solution that should implement the information technology this time is "Implementation of Dijkstra's Algorithm to Find a School Shortest Distance Based on The Zoning System In South Tangerang." It is a solution for parents and prospective students to get information about school choices included in their zoning.

Keyword— *Dijkstra's Algorithm, Zoning System, School, Shortest Distance, South Tangerang*

INTENSIF, Vol.6 No.1 February 2022
ISSN: 2580-409X (Print) / 2549-6824 (Online)
DOI: https://doi.org/10.29407/intensif.v6i1.15816

I. INTRODUCTION

School is an essential thing for education quality. The children will get good knowledge and skills with a good education for their future. So, the parents and the children must choose the right school according to the children's passion and abilities. However, this time the admission process of prospective new students uses a zoning system, where all prospective students must choose a school that has the shortest distance from their residence. The South Tangerang government decides the zoning distance for elementary school is a maximum of 3 kilometers, junior high school zoning is between 5 to 7 kilometers, and senior high school or vocational high school zoning is between 9 to 10 kilometers [1].

At the first time, the zoning system was made to provide access to education quality and realize an education center in school, family, and society to go to school in the neighborhood. All schools run by local governments must accept prospective new students who live in the zone shortest to the school, at least 90% of the total student accepted. And 10% of the total students are divided into two criteria, that is 5% for outside admission a school shortest zoning, and another 5% for students who change residence or for student get disaster occurs [2]. The local government must accept free education fees for the new student's low-income families that live in one zoning area. This zoning system rule applies to all regions in Indonesia except for sites where the number of schools available doesn't allow for this system [3].

This time, the South Tangerang government was also implemented a school zoning system. Many parents and prospective students do not understand this zoning system. The limited access to information is a problem for them, so they do not know where the schools are included in their zoning area. And they don't know about the school profile, the school majors available, the school status is a public school or private school, and the quality of these schools. Many parents and prospective new students only rely on information from relatives and neighbors to get about school information that they will do it or go schools to get information. If they come to school to get information, the South Tangerang area implements Large-Scale Social Restrictions during the Covid-19 pandemic. It is made complex and risky for them to get information.

So the exact solution that should implement the information technology this time is "Implementation of Dijkstra's Algorithm to Find a School Shortest Distance Based on The Zoning System In South Tangerang." It is a solution for parents and prospective students to get information about school choices included in their zoning. This research uses Dijkstra's algorithm method. It's used consideration to find the shortest distance, and the result is more accurate. Dijkstra's algorithm needs parameters like starting point and destination point [4]. Dijkstra's algorithm is suitable for this research because it's easy for users and if used only to determine the starting point and the destination point [21]. This research is to find out the information on the

ISSN: 2580-409X (Print) / 2549-6824 (Online)
DOI: https://doi.org/10.29407/intensif.v6i1.15816

school shortest distance. The first determines the location of the starting point based on GPS (Global Positioning System) current location and the end location point displayed on the application. This end location point chooses the shortest school distance from the user's starting point. This research is hoped the application to determine a school shortest distance based on GPS will be a solution for parents and prospective new students to get school information included in their zoning and help get more school information.

II. RESEARCH METHOD

This research starts with data collection and mapping school locations in the South Tangerang area. Then, filter or select the distribution of public and private schools in each sub-district. South Tangerang region has seven sub-districts :

1. Serpong
2. Serpong Utara
3. Pamulang
4. Ciputat
5. Ciputat Timur
6. Pondok Aren
7. Setu

The following figure is a map of the South Tangerang region from (education and training personnel agency South Tangerang) [5].

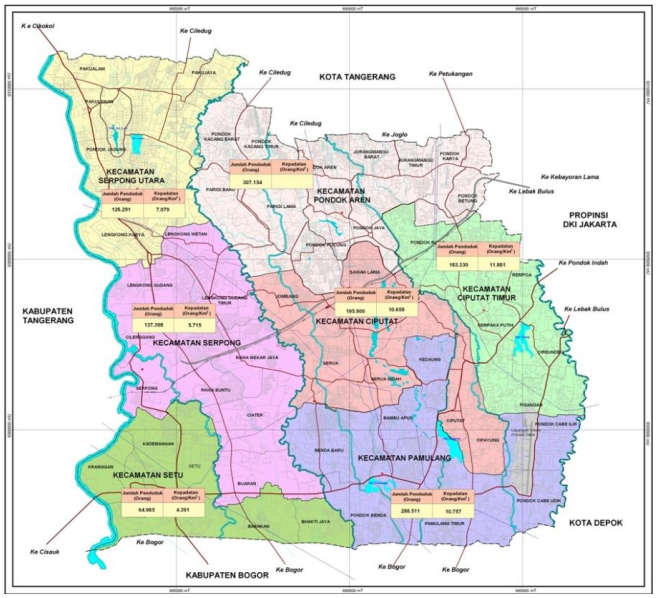

Figure 1. MAP OF SOUTH TANGERANG

INTENSIF, Vol.6 No.1 February 2022
ISSN: 2580-409X (Print) / 2549-6824 (Online)
DOI: https://doi.org/10.29407/intensif.v6i1.15816

After the mapping process, the schools for each sub-district, then determine longitude and latitude for each school use the tracking method so need GPS (Global Positioning System)[6]. There are 355 schools in the South Tangerang region which are the research objects, starting from SD, SMP, and SMK or SMA. Below is a table of some school data. The contents table are the name of schools, addresses, and locations based on latitude and longitude.

Table 1. A PART OF SCHOOL DATA IN SOUTH TANGERANG

School	Address	Latitude	Longitude
SD Negeri Ciputat 01	Jl. Kihajar Dewantoro No.6 Ciputat	-6,309973	106,747249
SD Negeri Ciputat 02	Jl. Pemuda No.7 Ciputat	-6,309705	106,746808
SD Negeri Ciputat 03	Jl. Pendidikan No. 7 Ciputat	-6,308747	106,746541
SMP Negeri 23 Tangerang Selatan	Jl. Sukamulya Raya Rt. 007/001 Tangerang Selatan	-6,306587	106,708025
SMP Negeri 24 Tangerang Selatan	Jl. H. Hasan Rt. 003/007 Tangerang Selatan	-6,301176	106,741317
SMP Negeri 6 Tangerang Selatan	Jl. Halmahera Blok D Komplek Villa Bintaro Indah	-6,297511	106,706941
SMP Negeri 10 Tangerang Selatan	Jl. Yaktapena raya No.8 Kelurahan Pondok Ranji-Ciputat	-6,286727	106,747875
SMA Negeri 1 Tangerang Selatan	JL. PENDIDIKAN NO. 49 Ciputat	-6,308636	106,745531
SMA Negeri 9 Tangerang Selatan	Jl. Hidup Baru No. 31 Tangerang Selatan	-6,313754	106,717151
SMA Negeri 10 Tangerang Selatan	Jl. Tegal Rotan Bintaro Sektor 9 Sawah Baru, Ciputat	-6,282129	106,722708
SMA Negeri 11 Tangerang Selatan	JL.SUMATERA I RT. 002 / 06 RAWA LELE Tangsel	-6,294825	106,696083
SMK Negeri 4 Tangerang Selatan	JL. SUMATRA - TIDORE Tangerang selatan	-6,283544	106,777960
SMK Negeri 7 Tangerang Selatan	Jl. Cempaka 3 RT.002/003 Tangerang selatan	-6,282545	106,775675
SMK Negeri 5 Tangerang Selatan	Jl. Benda Barat 7 No.31 RT.01 RW.07 Tangerang selatan	-6,333577	106,737819
SMK Negeri 2 Tangerang Selatan	RAYA PONDOK AREN NO. 52 Tangerang selatan	-6,266527	106,762574

Then the next step is to use the method Dijkstra's algorithm in this research. Dijkstra's algorithm as a consideration that to find for the shortest distance the results more accurate [7]. As an illustration of Dijkstra's algorithm, so will calculate the shortest distance from K1 to K6 by testing all paths.

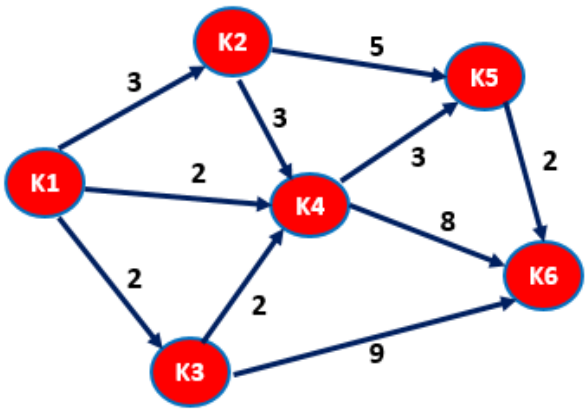

Figure 2. ILLUSTRATION OF DIJKSTRA'S ALGORITHM

INTENSIF, Vol.6 No.1 February 2022
ISSN: 2580-409X (Print) / 2549-6824 (Online)
DOI: https://doi.org/10.29407/intensif.v6i1.15816

From the illustration, the tested path is :

K1→K2→K5→K6 = 3+5+2 = 10

K1→K2→K4→K6 = 3+3+8 = 14

K1→K2→K4→K5→K6 = 3+3+3+2 = 11

K1→K3→K6 = 2+9 = 11

K1→K3→K4→K6 = 2+2+8 = 12

K1→K3→K4→K5→K6 = 2+2+3+2 = 9

K1→K4→K6 = 2+8 = 10

K1→K4→K5→K6 = 2+3+2 = 7

So the shortest distance from K1 to K6 is 7, the path is K1→K4→K5→K6

Dijkstra's algorithm needs parameters from starting point and destination point [21]. The parameter contains a route like (vertex) or vertices in the plural for comparison. Each side of this route is a pair of vertices (a, b) representing the relationship from vertex a to vertex b.

III. RESULT AND DISCUSSION

This research process analyzes the system's flow based on user needs so the design of this application can be developed. The following flowchart describes determining the shortest distance to the school location using Dijkstra's algorithm.

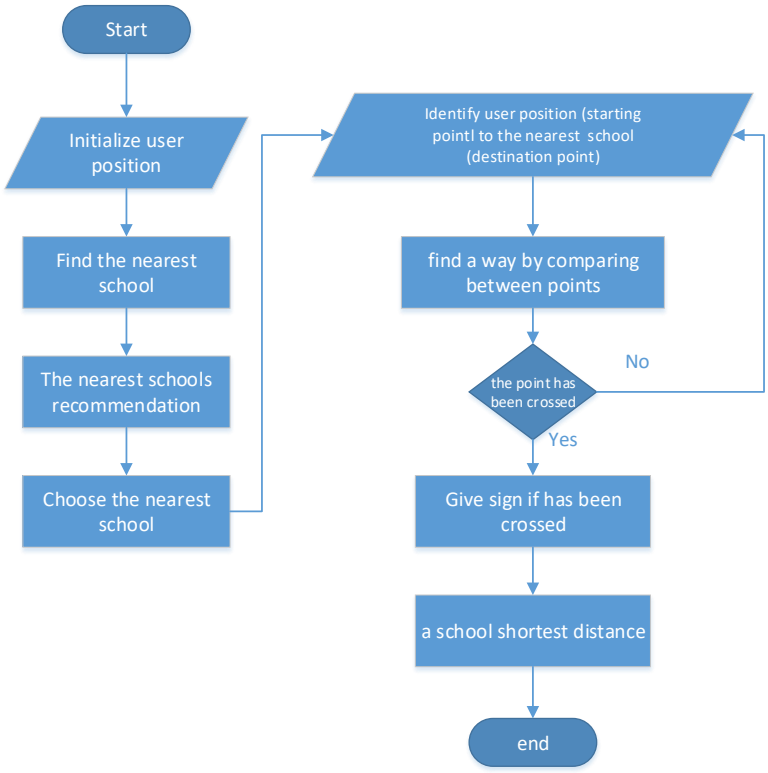

Figure 3. FLOWCHART TO FIND THE SHORTEST DISTANCE

INTENSIF, Vol.6 No.1 February 2022
ISSN: 2580-409X (Print) / 2549-6824 (Online)
DOI: https://doi.org/10.29407/intensif.v6i1.15816

The flowchart determines the shortest distance using Dijkstra's algorithm above the first step system will initialize user position (starting point). Then the system will detect the nearest school. After that, the system recommends the closest schools to display the names of these schools. Afterward, the user selects the destination school, and the system will identify the user position as the starting point to the school designated as the end node. And then, the system determines a path by comparing between vertices. If the vertices have not been passed, the system will find a way back by comparing between vertices [8]. However, if the vertices have been given, the system will sign the path passed. The final step of the system will be to decide or choose the shortest distance to the school.

When the shortest distance has been determined using Dijkstra's algorithm, calculate the spread between coordinates. The Haversine formula starts from the current location of user coordinates to the shortest of school location coordinates. The Haversine formula is used to find the distance between two points on the earth's surface [9]. This research calculates the user distance to each school to see the shortest distance. The system does the distance calculation to select the user position on the map. It then reveals the shortest school recommendation from the user position. This process needs several parameters. The initial coordinate parameter is the user position, and the end coordinate is the nearest school position. These parameters will be calculated to get distance comparisons using the Haversine formula[14].

$$\text{distance} = 2r.\arcsin\left\{\sqrt{sin^2\left(\frac{Lat_2 - Lat_1}{2}\right) + \cos(Lat_1).\cos(Lat_2).sin^2\left(\frac{Long_2 - Long_1}{2}\right)}\right\} \quad (1)$$

r : radius of the earth (6371 km)

Lat : latitude

Long : longitude

As a simulation to calculate distance using the Haversine formula, the first determine current coordinates that are user position and a school coordinates from result to find the shortest distance using Dijkstra's algorithm. Implementation of Dijkstra's Algorithm to find a school shortest distance in South Tangerang based on GPS can be applied to Android-based smartphones. It's created using the Android Studio software as the developer software and Genymotion as the virtual device. The Android Studio software utilizes the Google Maps feature with incompleteness and map detail advantages. Because Google Maps allows users to contribute to mapping development, Google Maps can also be accessed from various platforms [10]. One of them is the android platform using the Google Maps Android API (Application Programming Interface). It allows the developer to integrate Google Maps into the system that has been created [17].

ISSN: 2580-409X (Print) / 2549-6824 (Online)
DOI: https://doi.org/10.29407/intensif.v6i1.15816

The design of this application has school levels from elementary school until senior high school. When the user uses this application for the first time, it will display a red pin symbol as school distribution in the South Tangerang area on the map.

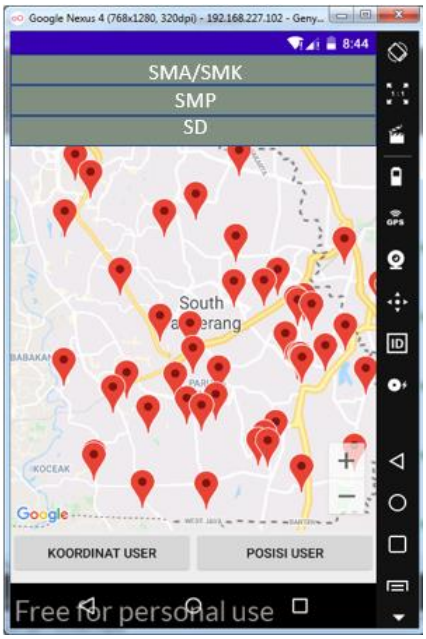

Figure 4. THE DISTRIBUTION OF SCHOOLS IN SOUTH TANGERANG

The next step is geometric user position, and schools are compared according to the distance. They are calculated and be the shortest distance based on the comparison result. This calculation is done by calculating the length of each space, and every crossroads are vertex. Then the user chooses one level school like senior high school (SMA/SMK). So, the application will display some of the nearest senior high schools.

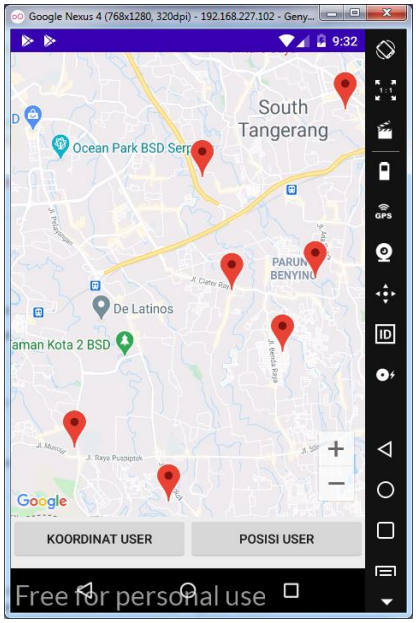

Figure 5. TO DISPLAY POSITION OF SENIOR HIGH SCHOOL NEAREST

INTENSIF, Vol.6 No.1 February 2022
ISSN: 2580-409X (Print) / 2549-6824 (Online)
DOI: https://doi.org/10.29407/intensif.v6i1.15816

Implementation of Dijkstra's Algorithm to find a school the nearest distance is by calculating between geometric user position and school geometric position using Haversine formula. Six schools have under 10 kilometers.

Table 2. THE RESULT OF GEOMETRIC DISTANCE COMPARISON

No	School			User		Distance (km)
	SMA/SMK	Longitude	Lattitude	Longitude	Lattitude	
1	SMA WASKITO	-6,320,550	106,708,249	-6,338,920	106.686612	6,7
2	SMAN 2 TANGERANG SELATAN	-6,345,519	106,672,301	-6,338,920	106.686612	2,9
3	SMAN 3 TANGERANG SELATAN	-6,327,510	106,710,999	-6,338,920	106.686612	6,0
4	SMAN 12 KOTA TANGERANG SELATAN	-6,234,230	106,724,691	-6,338,920	106.686612	6,5
5	SMKS IPTEK TANGERANG SELATAN	-6,343,404	106,663,642	-6,338,920	106.686612	4,0
6	SMKN 3 KOTA TANGERANG SELATAN	-6,355,587	106,689,808	-6,338,920	106.686612	3,1

To determine the nearest school from the user's position, the user must select the school level corresponding and click the user position button. As a result, the system will display the map of the shortest distance from the user's current position to school, and the system will determine one of the schools that has the shortest distance to the user's post based on GPS.

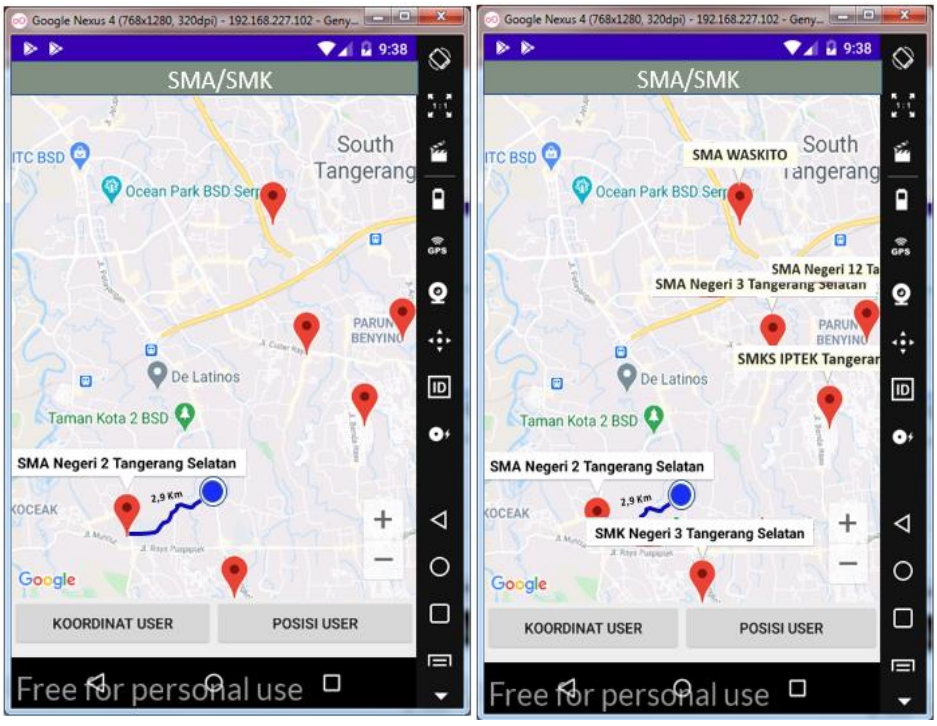

Figure 6. THE USER POSITION AND THE NEAREST SCHOOL POSITION

ISSN: 2580-409X (Print) / 2549-6824 (Online)
DOI: https://doi.org/10.29407/intensif.v6i1.15816

According to government regulation, the zoning distance of the senior high school or vocational high school is 9 to 10 kilometers; six schools have a distance of under 10 kilometers [2]. So the distance between the user position and the nearest school is 2,9 kilometers based on the calculation of the initial coordinates and the final coordinates on the map using the Haversine formula.

IV. CONCLUSION

This research can implement Dijkstra's algorithm to find a school shortest distance in South Tangerang. Parents or prospective new students can use this application to know where the school is included in their zoning. The application can determine the shortest distance between a school with the users' position. There are choices of school levels in the application starting from elementary school until senior high school that can make it easier for the users to determine a school they want.

REFERENCES

[1] Perdana, N. S., "*Implementasi PPDB Zonasi dalam Upaya Pemerataan Akses dan Mutu Pendidikan*," *Jurnal Pendidikan Glasser*,*3*(1), 78-92. doi.org/10.32529/glasser.v3i1.186 2019.

[2] Peraturan Menteri Pendidikan dan Kebudayaan Nomor 14 Tahun 2018 tentang Penerimaan Peserta Didik Baru Pada Taman Kanak- Kanak, Sekolah Dasar, Sekolah Menengah Pertama, Sekolah Menengah Atas, Sekolah Menengah Kejuruan, Atau Bentuk Lain Yang Sederajat

[3] Adiputra, A. R., Karsidi, R., & Haryono, B. (2019). Cultural lag dalam program Penerimaan Peserta Didik Baru (PPDB) online dengan sistem zonasi tahun 2018 di Sekolah Menengah Atas Negeri 2 Sukoharjo. Habitus : Jurnal Pendidikan, Sosiologi, dan Antropologi, 3(1), 1–13. doi.org/10.20961/habitus.v3i1.30906. 2019.

[4] Candra Galih, E., & Andriyat Krisdiawan, R. " *Implementasi Algoritma Dijkstra Pada Aplikasi Wisata Kuningan Berbasis Android*", *Jurnal Nuansa Informatika* 53(95), doi.org/10.1017/CBO9781107415324.004.2018

[5] Kabar Tangsel. "*Peta Kota Tangsel*". https://kabartangsel.com/direktori-tangsel/peta-kota-tangerang-selatan/ (diakses Maret 1, 2021)

[6] Alfeno , Sandro, et al.," *Implementatsi Global Positioning System (GPS) dan Location - Based Service (LSB) Pada Sistem Informasi Kereta Api Untuk Wilayah Jabodetabek*", Jurnal Sisfotek Global Vol 7. No 2, doi.org/10.38101/sisfotek.v7i2.146.2017

[7] Dewi, Ra'idah Naufaliana, W.P., Dwi Atmodjo, dan Purwaningsih, Mardiana," *AplikasiPenentuan Rute dan Waktu Tempuh ke Halte Transjakarta Terdekat dengan Algoritma Dijkstra Berbasis Location Base System*", Jurnal Teknologi Informasi dan Ilmu Komputer , *Perbanas Institute*, Vol 7.No 4. DOI:10.25126/jtiik.202071680,2019.

[8] Aprilianingsih, E. P., Primananda, R., and Suharsono, A." *Analysis Fail Path Pada Arsitektur Software Defined Network Menggunakan Dijkstra Algorithm*". Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer *J-PTIIK Universitas Brawijaya* 1(3), 174–183,2017.

ISSN: 2580-409X (Print) / 2549-6824 (Online)
DOI: https://doi.org/10.29407/intensif.v6i1.15816

[9] Ginting, J. V., Barus, E. S., "*Aplikasi Penentu Rumah Sakit Terdekat Menggunakan Algoritma Dijksra*". Jurnal Mantik Penusa Vol 2, No 2. 2019.

[10] Hairah, Ummul, Budiman, Edy, "*Pemanfaatan Google Maps API Dalam Pengembangan Media Informasi Pasar Malam di Kota Samarinda*". *Jurnal Ilkom*, Vol 9. No 1.2017

[11] Andiany , Fairuz Eka,et al," Implementasi Algoritma Dijkstra Untuk Mencari Rute Terpendek Anara Kantor dan Estimasi Penggunaan Bahan Bakar Kendaraan(Studi Kasus PT. TELKOM INDONESIA Region IV Central Jateng-DIY)", Prosiding *SENDI_U 4. 2018*, Unisbank.2018

[12] Cantona,Aldy, fauziah, winarsih, "*Implementasi Algoritma Dijkstra Untuk Mencari Rute Terpendek ke Museum Jakarta*", Jurnal Manajemen Informatika dan Teknologi, Vol 6. No 1. https://doi.org/10.26905/jtmi.v6i1.3837. 2020

[13] Kumalasari, D. "*Analysis of Comparative to Complexity of Bubble Sort Algorithm, Cocktail Sort and Comb Sort with C ++ Programming*". *Journal Speed*, *9*(2), 1–7.2017

[14] Agung, Halim,"*Sistem Penentuan Jarak Terpendek Berdasarkan Data Coordinate Menggunakan Algoritma Djikstra Dalam Kasus Pengantaran Barang se-Jabodetabek*" Jurnal SISFOKOM,, Universitas Bunda Mulia, Vol 8, No.1. doi.org/10.32736/sisfokom.v8i1.587. 2019

[15] Ojekudo, Nathaniel Akpofure dan Nsikan Paul Akpan."*An Application of Dijkstra's Algorithm To Shortest Route Problem*". IOSR Journal of Mathematics *(IOSR-JM)* Vol 13, Issue 3 Ver. 1, DOI : 10.9770/5728 1303012032, 2017.

[16] Risald, Suyoto, dan Antonio E. Mirino. "Best Routes Selection Using Dijkstra and Floyd-Warshall Algorithm." DOI : 10.1109/ICTS.2017.8265662,2017

[17] Saputra, Kurnia, dkk, "*Google Maps and MAPBOX API Performance Analysis on Android Base Lecture Attendance Application*", Jurnal Natural.Vol.19.No.3. 2019

[18] Setiawan, Kiki, dkk."*Menghitung Rute Terpendek Menggunakan Algoritma A* Dengan Fungsi Euclidean Distance"*. Seminar Nasional Teknologi Informasi dan Komunikasi 2018 (SENTIKA 2018), Yogyakarta. ISSN : 2089-9815.2018.

[19] Somya, Ramos, 2018, "Monitoring System of Real Time Vehicle using CouchDB Technology Based on Android at PT. Pura Barutama",*Technology and Information System National journal, Kristen Satya Wacana University,2018*

[20] Wu, Yu, et al., ," Path Planning for Carrier Aircraft Based On Geometry and Dijkstra's Algorithm.",DOI : 10.1109/CCSSE.2017.8087906, 2017.

[21] Baharudin, I., Purwanto, A. J. ., Budiman, T. R. ., & Fauzi, M. "Implementasi Algoritma Djikstra Untuk Menentukan Jalur Terpendek Dalam Distribusi Barang. *Jurnal Lebesgue : Jurnal Ilmiah Pendidikan Matematika, Matematika Dan Statistika*, *2*(2), 194-203. https://doi.org/10.46306/lb.v2i2.74. 2021