



Implementation of the Trans Jogja Bus Nearest Route System with the Web-Based Shortest Path Method

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ABSTRACT

Objective: To find out the process of finding the closest route using the Web-based Shortest Path method, where each route consists of 8 routes (1A-1B-2A-2B-3A-3B-4A-4B).

Design/method/approach: Using the Shortest Path Problem with a combination of UML and Black Box testing.

Results: The results of the tests carried out with the Shortest Path are the distances that will be generated from the starting point to the destination, where each route has its own distance. Which will be processed according to the starting point and destination point, and will produce a branch if it has the closest route that can be taken.

Authenticity/state of the art: The difference between this research and previous research lies in the technology used and the research object used. The object of research here is the Trans Jogja Bus. In this study, the system is expected to increase the efficiency of waiting time for the Trans Jogja Bus, which has a very long wait time. The technology itself in this study uses Web services as a communication bridge between users in the form of services.

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1 Introduction

Trans Jogja Bus is a bus that uses the Bus Rapid Transit (BRT) system. With this system, Trans Jogja bus passengers can transfer from one lane to another. The Trans Jogja Bus uses medium-sized buses. Trans Jogja passengers can use cashless e-money services for payment. Trans Jogja serves 18 routes using 129 bus fleets. The routes served include Lines 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, 5A, 5B, 6A, 6B, 7, 8, 9, 10, 11, and spare routes. Trans Jogja has 267 stops surrounding the City of Yogyakarta and its surroundings. Trans Jogja Bus is quite popular with the public because it is comfortable, has good facilities, and is affordable [3].

Trans Jogja services regarding routes and time receive negative perceptions from netizens on social media. Netizens feel that the information provided is not communicative. Netizens who are confused by the Trans Jogja route lanes feel they receive poor service [4]. Netizens consider Trans Jogja routes to be long and circuitous, and the time is inefficient due to the long waiting time for the bus. Many netizens complain about the long distance that must be covered and passed to reach one destination point by going through all Trans Jogja routes one by one. The map regarding the Trans Jogja bus route is only a conventional map [5].

These problems experienced by netizens will be overcome by building a system to find the nearest route for the Trans Jogja bus. In some previous studies that have been conducted, system development has been successfully carried out in finding the nearest route for the distribution of raw materials [6], distribution of cellular card [7] products to mini-markets in Taman District [8], to hospitals in Bogor City [9], and to tourist attractions in Pekan Baru City [10].

The system to be built will use the Shortest Path method to find the shortest route. This method was chosen because it is still rarely used to find the shortest route, and only a few researchers use this method to find the shortest route. This method is also rarely applied to an application or system to find the shortest route. In some of the literature obtained, no description of the advantages and disadvantages of this method was found. The research on shortest route search using Graphs has been carried out previously. Use this method to find the shortest transportation option from Chennai City to Kanyakumari City [11], and use this method to find the shortest route with a network that has limitations [12].

The system for finding the nearest route for the Trans Jogja bus to be created is a web-based application. The web is a collection of site pages and documents from several server computers located all over the world and connected in one network [13]. Web-based applications have the advantage of being light and can be accessed as long as there is a connection to the server via the internet or intranet. Web-based applications can be accessed using a browser without having to install the application that will be used [14]. Web pages can be opened using web browsers, such as Internet Explorer, Google Chrome, Firefox, Opera, and Safari [15].

2 Design Method

The system research and development methodology is a systematic sequence of steps in building the system being created. In this research methodology, there are two types of research methods: data collection and development.

2.1 Problem Identification

The problem analysis stage is carried out by searching for information related to problem identification, which is one of the stages to find and determine what problems can be taken and researched from an object. The object in this study is the Trans Jogja Bus. Then, the nearest route system will look for the best route based on distance, for time efficiency, and for wasted time when waiting for the same route without changing routes. In this research, the service that will be created uses a PHP-based web.

2.2 Literature Study

Literature study is a technique for collecting data and information from previous research. Literature study is carried out by searching and compiling data and library sources that can support the research and provide information to solve the problems in this research. Some of the research that has been conducted and used as a reference in this research can be seen in the following table.

Table 1: State Of The Art

No.	Paper	The Difference
1.	Aplikasi Android Untuk Pencarian Rute Terdekat Mini Market Menggunakan Metode Floyd-Warshall Berbasis GIS [16]	Sistem yang dibangun adalah Mini Market dan menggunakan Metode Floyd Warshall
2.	Transportasi Publik Dan Media Sosial: Persepsi Netizen Terhadap Pelayanan Bus Trans Jogja 2016 - 2018 [17]	Tidak diimplementasikan dalam bentuk rute terdekat
3.	Pendistribusian Produk Kartu Seluler untuk Alternatif Rute Terpendek Menggunakan Metode Branch and Bound di PT. T [18]	Objek yang digunakan adalah Kartu Seluler dan menggunakan metode Branch and Bound
4.	Pencarian Jalur Terdekat Menuju Rumah Sakit Di Kota Bogor Dengan Menggunakan Algoritma A [19]	Sistem berobjek rumah sakit dan menggunakan Algoritma A
5.	Aplikasi Pencarian Rute Terpendek Tempat Wisata Di Kota Pekanbaru Menggunakan Floyd Warshall [20]	Sistem yang dibangun berbasis Wisata dan Metode menggunakan Floyd Warshall
6.	Shortest Route Algorithm Using Fuzzy Graph [21]	Sistem yang dibangun menggunakan metode Algoritma Fuzzy
7.	Pencarian Rute Terpendek pada Distribusi Raw Material Metode Dijkstra di PT. SHP [22]	Sistem yang dibangun menggunakan metode Algoritma Dijkstra dan Objeknya adalah Material
8.	Animasi 3D Rute Jalur Bus Trans Jogja Trayek 1A Dan 3A Berbasis Android [23]	Sistem yang dibangun berbasis Android dan Trayek digunakan hanya 1A dan 3A
9.	Panduan Lengkap Membangun Sistem Monitoring Kinerja Mahasiswa Internship Berbasis Web dan Global Positioning System [24]	Sistem informasi yang dibangun bertujuan untuk informasi monitoring kinerja dan berbasis GIS
10.	Generalized Fuzzy Graph Connectivity Parameters With Application To Human Trafficking [25]	Sistem yang dibangun berdasarkan metode Fuzzy Graph yang diambil data Lalu Lintas

2.3 Data Collection

Data collection in this research was obtained from the DIY Transportation Agency. The route and lane data used in this study are the valid routes established in 2018.

2.4 System Development Method

The system development method that will be used in this research is UML. The UML stages that will be used are the analysis, design, coding, and testing stages.

1. The class diagram in this research describes the main classes in the system. This diagram also describes the relationship between classes. There are 3 types of classes in the system, namely controller, model, and view.
2. The controller class is the class that handles input from user interaction. Controller classes include stops, environments, routes, paths, users, and homepages.
3. The model class is the class that handles data and database management. Model classes include stops, environments, routes, paths, and users.
4. The view class is the class that handles output in the form of a display to the user. View classes include stops, environment, routes, paths, users, and homepages.

The following is a class diagram design (Figure 1).

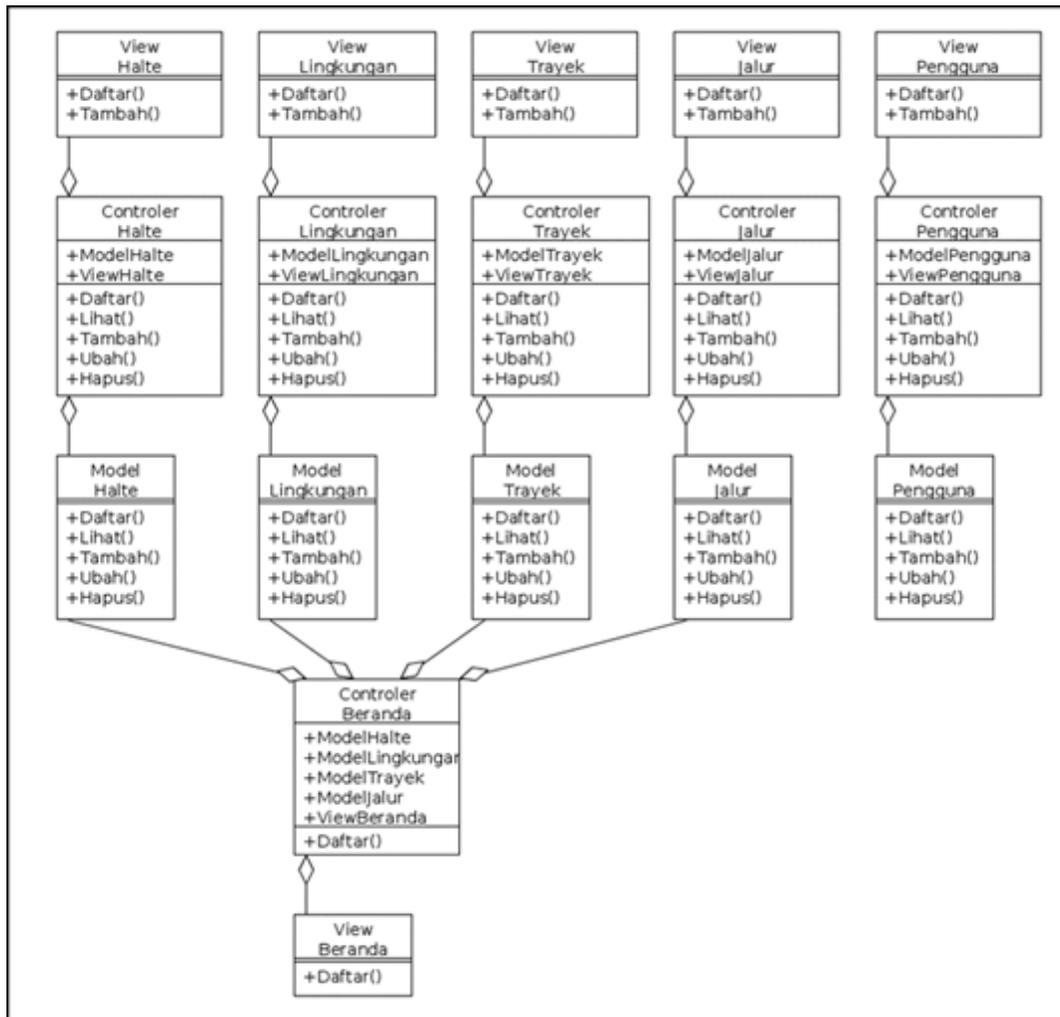


Figure 1: Class Diagram

2.5 Use Case Diagram

The use case diagram in this research describes the use cases by actors in the system. There are 2 actors in the system to be built, namely the administrator and the community. The use case owned by the administrator is managing stop, environment, route, path, and user data. The use case owned by the community is viewing the nearest route. The following is a draft use case diagram (Figure ??).

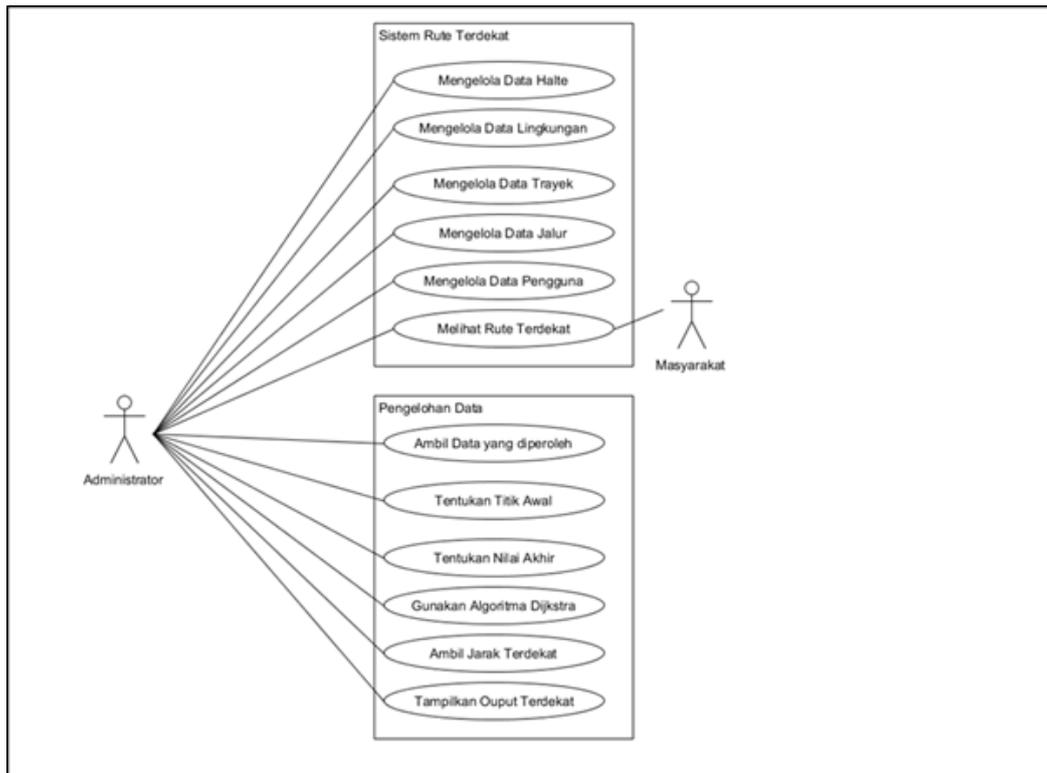


Figure 2: Use Case Diagram

3 Result and Discussion

The web-based Trans Jogja bus nearest route system has been successfully implemented in accordance with the analysis and design that have been made. This application was created using Apache 2 as the web server, PHP 7 as the preprocessor, MySQL 5 as the database management system, OpenStreetMap as the mapping API, CodeIgniter 3 as the backend framework, and Bootstrap 4 as the frontend framework. The operating system used is Windows 10, the server package used is XAMPP 7, the integrated development environment used is Netbeans 11, and the browser used is Mozilla Firefox 75.

3.1 Black Box Testing Results

Testing with the blackbox method needs to be done to find out whether the system can run the predetermined minimal functions correctly. Each function will be tested based on at least its sub-functions. The following are the results of the black box test.

The results of the blackbox test show that the system that has been created can run correctly on all the predetermined minimal functions.

3.2 Shortest Path Calculation Testing

3.2.1 Determining the Start and End Points

In this calculation test, the start point of the Prambanan Terminal environment and the end point of the Adisucipto Airport environment will be used. At this stage, the results of the system's determination of the start and end points are the same as the manual determination results.

3.2.2 Creating a Stop Network from Start to End Point

The Prambanan Terminal environment can use the Prambanan Terminal stop, and the Maguwoharjo environment can use the Maguwoharjo stop. The routes that can be used to get to the Maguwoharjo

Table 2: Blackbox Test Results

No	Fungsi	Sub Fungsi	Hasil
1	Mengelola data halte	Melihat daftar halte	Benar
2		Menambah halte	Benar
3		Mengubah halte	Benar
4		Menghapus halte	Benar
5	Mengelola data lingkungan	Melihat daftar lingkungan	Benar
6		Menambah lingkungan	Benar
7		Mengubah lingkungan	Benar
8		Menghapus lingkungan	Benar
9	Mengelola data trayek	Melihat daftar trayek	Benar
10		Menambah trayek	Benar
11		Mengubah trayek	Benar
12		Menghapus trayek	Benar
13	Mengelola data jalur	Melihat daftar jalur	Benar
14		Menambah jalur	Benar
15		Mengubah jalur	Benar
16		Menghapus jalur	Benar
17	Mengelola pengguna	Melihat daftar pengguna	Benar
18		Menambah pengguna	Benar
19		Melihat pengguna	Benar
20		Mengubah pengguna	Benar
21		Menghapus pengguna	Benar
22	Melihat rute terdekat	Melihat peta jalur saran	Benar
23		Melihat keterangan jalur saran	Benar

Table 3: Initial and Final Environment

No	Lingkungan	Halte	Jarak
1	Terminal Prambanan	Terminal Prambanan	1
2	Maguwoharjo	Maguwoharjo	4

bus stop from Prambanan Terminal are as follows.

Table 4: Bus Stops and Routes from Origin to Destination

No	Halte Asal	Trayek Asal	Halte Tujuan	Trayek Tujuan
1	Terminal Prambanan	1A	Maguwoharjo	1B
2	Terminal Prambanan	1A	Maguwoharjo	3A
3	Terminal Prambanan	1A	Maguwoharjo	1A
4	Terminal Prambanan	1A	Maguwoharjo	3B

The stops used on the next journey are determined based on the bus stop and the route from origin to destination. The following is a list of stops used from Prambanan Terminal using route 1A to Maguwoharjo using route 1B.

The following is a list of stops used from Prambanan Terminal using route 1A to Maguwoharjo using route 3A.

The following is a list of stops used from Prambanan Terminal using route 1A to Maguwoharjo using route 1A (Table 7).

The following is a list of stops used from Prambanan Terminal using route 1A to Maguwoharjo using route 3B (Table 8).

3.2.3 Determine the distance of each stop on the network

The distance of each bus stop on the network is already displayed at the stage of creating the bus stop network from the starting point to the ending point, so it is not displayed again at this stage.

3.2.4 Determining the distance of each travel stage with Shortest Path

The distance of each stage of the journey has been shown at the stage of creating the stop network from the start to the end point, so it is not displayed again at this stage.

Table 5: Bus Stop from Prambanan Terminal Route 1A to Maguwoharjo Route 1B

No	Nama Halte	Trayek	Jarak Ke Halte Berikutnya
1	Terminal Prambanan	1A	4000
2	Kalasan	1A	4400
3	Bandara Adisucipto	1B	4900
4	Maguwoharjo	1B	0

Table 6: Bus Stop from Prambanan Terminal Route 1A to Maguwoharjo Route 3A

No	Nama Halte	Trayek	Jarak Ke Halte Berikutnya
1	Terminal Prambanan	1A	4000
2	Kalasan	1A	4400
3	Bandara Adisucipto	3A	1200
4	Ringroad Utara	3A	6200
5	...		
6	Janti	3A	1700
7	Maguwoharjo	3A	0

3.2.5 Determining the Nearest Distance from Start to End Point

The first step of the Shortest Path method is the environment to determine the first stop taken. In this case, there is only one neighborhood and one bus stop, so the Shortest Path and neighborhood methods result in the Prambanan Terminal bus stop being 1 meter away from the Prambanan Terminal neighborhood. The distance traveled at this stage is 1 meter.

The next step is the Shortest Path method, and to determine the route to be taken based on the closest stop from the initial stop. There is only one bus stop and route option: the Kalasan bus stop on route 1A, 4,000 meters from the Prambanan Terminal bus stop. The initial bus stop will lead to the Kalasan bus stop on route 1A. The next step is to find an interchange bus stop that allows for a route change. Route changes can be made at the Adisucipto Airport bus stop. The distance traveled at this stage is 8,400 meters.

At the intersection bus stop, passengers can change to route 1B to Maguwoharjo bus stop with a distance of 4900 meters, route 3A to Ringroad Utara bus stop with a distance of 1200 meters, route 3B to Maguwoharjo bus stop with a distance of 4900 meters, or continue using route 1A to Janti bus stop with a distance of 1200 meters. Next, the Shortest Path method is used to determine the route to be taken based on the closest bus stop from the intersection bus stop. The following is the distance from the intersection bus stop to the next bus stop.

Based on the table above, the Shortest Path method for the initial intersection will produce route 3A to the North Ringroad bus stop, which is the shortest distance appearing first. The journey then continues to the Maguwoharjo destination bus stop because there is no possibility of changing routes between the intersection and the destination bus stop. The distance traveled at this stage is 47,600 meters.

The journey continues from the Maguwoharjo bus stop to the Maguwoharjo neighborhood, a distance of 4 meters. The total distance traveled from the Prambanan Terminal to the Maguwoharjo neighborhood is 56,005 meters. The calculation that has been done is correct based on the Shortest Path method, but it results in an incorrect path with a long distance. The decision-making error occurs when determining the closest stop from the intersection stop. The Shortest Path method prefers a shorter distance, resulting in being stuck on the wrong path with a long distance.

Based on a comparison of the system's calculations with those of the manual method, it can be seen that the system's calculations are the same as those of the manual method. This indicates that the system can perform calculations correctly.

Table 7: Bus stop from Prambanan Terminal Route 1A to Maguwoharjo Route 1A

No	Nama Halte	Trayek	Jarak Ke Halte Berikutnya
1	Terminal Prambanan	1A	4000
2	Kalasan	1A	4400
3	Bandara Adisucipto	1A	4900
4	Maguwoharjo	1A	0

Table 8: Bus stop from Prambanan Terminal Route 1A to Maguwoharjo Route 3B

No	Nama Halte	Trayek	Jarak Ke Halte Berikutnya
1	Terminal Prambanan	1A	4000
2	Kalasan	1A	4400
3	Bandara Adisucipto	3B	1200
4	Maguwoharjo	3B	0

Table 9: Distance from Intersection Stop to Next Stop

No	Halte Pesimpangan	Trayek Berikutnya	Halte Berikutnya	Jarak Ke Halte Berikutnya
1	Bandara Adisucipto	1B	Maguwoharjo	4900
2	Bandara Adisucipto	3A	Ringroad Utara	1200
3	Bandara Adisucipto	1A	Maguwoharjo	4900
4	Bandara Adisucipto	3B	Janti	1200

3.3 Discussion

The system created has the advantage that users can choose the name of the origin and destination environment, not just choose the name of the origin and destination stop. A stop can have many environment names. This system has facilities to manage environmental data around the stop, along with the distance. The system also calculates the distance of the origin environment to the origin stop, and the destination stop to the destination environment. The calculation process starts from the original environment where the user is. The system will select the nearest stop to the origin environment so that users can reduce walking.

4 Conclusion and Suggestions

4.1 Conclusion

In this study, the web-based Trans Jogja bus nearest route system can be built using the UML method, which includes the analysis, design, coding, and testing stages. The application of the Shortest Path method to the web-based Trans Jogja bus nearest route system uses an Apache web server, the PHP programming language, and the MySQL database management system. The Shortest Path method is suitable for finding the nearest Trans Jogja bus route because it can experience errors in finding the nearest path when choosing the next path that is short, but has a long additional path.

4.2 Suggestions

This research also has many shortcomings that still need to be improved. The shortcomings in this research can be used as a reference and consideration for subsequent research, so there are several suggestions, namely, adding a real map feature that functions to find the path to be taken. For example, if there is road construction, the path will be deactivated, so it is diverted to another path. The application can be developed using operating systems (OS) such as Android and iOS.

References

- [1] Ratminto, Shabrina, F., Yusuf, R. R., Laksana, L. U. A., Wahyuni, S. dan Apriyanti, S. (2017). *Pelayanan Prima: Pedoman Penerapan Momen Kritis Pelayanan Dari A Sampai Z*. Yogyakarta: Gadjah Mada University Press.
- [2] Dinas Perhubungan D.I. Yogyakarta. (2020). *Data Trans Jogja*. <https://dishub.jogjaprovo.go.id/trans-jogja>. Diakses tanggal 19 November 2020.
- [3] Azmi, M. W. *Peran Aktor Dalam Sosiologi Pembangunan: Analisis Pergub D.I. Yogyakarta No. 16 Tahun 2017 tentang Jaringan Trayek Perkotaan Trans Jogja*. *Sosiologi Reflektif*: Vol. 12, No. 2, pp. 267-287, 2018.

- [4] Al Hayati, K. Z. A. dan Al Hamdi, R. Transportasi Publik Dan Media Sosial: Persepsi Netizen Terhadap Pelayanan Bus Trans Jogja 2016 - 2018. *Jurnal Ilmu Pemerintahan Widya Praja*: Vol. 45, No. 2, pp. 127 - 139, 2019.
- [5] Retnowati, N. D. dan Mutropin, H. A. Animasi 3D Rute Jalur Bus Trans Jogja Trayek 1A Dan 3A Berbasis Android. *Seminar Nasional Teknologi Informasi dan Kedirgantaraan (SENATIK)*, Vol. 3, pp. 64-71, 2017.
- [6] Chopra, R. (2016). *Database Management Systems (DBMS): A Practical Approach*. New Delhi: S Chand And Company Limited.
- [7] Nurrizky, M. F., Dwiagnes, D. dan Anggraeni, N. F. Pencarian Rute Terpendek pada Distribusi Raw Material Metode Dijkstra di PT. SHP. *Jurnal Teknik: Media Pengembangan Ilmu dan Aplikasi Teknik*, Vol. 19, No. 1, pp. 34-39, 2020.
- [8] Desparaja, C., Gumelar, R. F. dan Anggraeni, N. F. Pendistribusian Produk Kartu Seluler untuk Alternatif Rute Terpendek Menggunakan Metode Branch and Bound di PT. T. *Jurnal Teknik: Media Pengembangan Ilmu dan Aplikasi Teknik*, Vol. 19, No. 1, pp. 40-45, 2020.
- [9] Dyer, R. J. T. (2015). *Learning MySQL And MariaDB: Heading In the Right Direction With MySQL And MariaDB*. Cambridge: O'Reilly Media.
- [10] Gunawan, F., Fatma, Y. dan Mukhtar, H. Aplikasi Pencarian Rute Terpendek Tempat Wisata Di Kota Pekanbaru Menggunakan Floyd Warshall. *Journal Fasilkom*, Vol. 10, No. 1, 54-60, 2020.
- [11] Nirmala, G., dan Uma, K. Shortest Route Algorithm Using Fuzzy Graph. *International Journal of Scientific and Research Publications*, Vol. 3, No. 11, pp. 1-5, 2013.
- [12] Liao, X., Wang, J. Y. dan Ma. L. An Algorithmic Approach For Finding The Fuzzy Constrained Shortest Paths In a Fuzzy Graph. *Complex & Intelligent Systems*, 2020.
- [13] MacDonald, M. (2015). *Creating a Website: The Missing Manual, 4th Edition*. Sebastopol: O'Reilly Media, Inc.
- [14] Setyawan, M. Y. H., dan Munari, A. P. (2020). *Panduan Lengkap Membangun Sistem Monitoring Kinerja Mahasiswa Internship Berbasis Web dan Global Positioning System*. Bandung: Kreatif Industri Nusantara.
- [15] MacDonald, M. (2015). *Creating a Website: The Missing Manual, 4th Edition*. Sebastopol: O'Reilly Media, Inc.
- [16] Afandi, M. Aplikasi Android Untuk Pencarian Rute Terdekat Mini Market Menggunakan Metode Floyd-Warshall Berbasis GIS (Studi Kasus di Kecamatan Taman). *Ubiquitous: Computers and Their Applications Journal*, Vol. 2, No. 1, pp. 51-56, 2019.
- [17] Al Hayati, K. Z. A. dan Al Hamdi, R. Transportasi Publik Dan Media Sosial: Persepsi Netizen Terhadap Pelayanan Bus Trans Jogja 2016 - 2018. *Jurnal Ilmu Pemerintahan Widya Praja*: Vol. 45, No. 2, pp. 127 - 139, 2019.
- [18] Dinas Perhubungan D.I. Yogyakarta. (2020). Data Trans Jogja. <https://dishub.jogjaprovo.go.id/trans-jogja>. Diakses tanggal 19 November 2020.
- [19] Desparaja, C., Gumelar, R. F. dan Anggraeni, N. F. Pendistribusian Produk Kartu Seluler untuk Alternatif Rute Terpendek Menggunakan Metode Branch and Bound di PT. T. *Jurnal Teknik: Media Pengembangan Ilmu dan Aplikasi Teknik*, Vol. 19, No. 1, pp. 40-45, 2020.
- [20] Gunawan, F., Fatma, Y. dan Mukhtar, H. Aplikasi Pencarian Rute Terpendek Tempat Wisata Di Kota Pekanbaru Menggunakan Floyd Warshall. *Journal Fasilkom*, Vol. 10, No. 1, 54-60, 2020.
- [21] Liao, X., Wang, J. Y. dan Ma. L. An Algorithmic Approach For Finding The Fuzzy Constrained Shortest Paths In a Fuzzy Graph. *Complex & Intelligent Systems*, 2020.
- [22] Utami, F. H. dan Asnawati. (2015). *Rekayasa Perangkat Lunak*. Yogyakarta: Penerbit Deepublish.

- [23] Okti. (2019). PHP Untuk Programmer Pemula. Jakarta: Jubilee Enterprise. Setyawan, M. Y. H., dan Munari, A. P. (2020). Panduan Lengkap Membangun Sistem Monitoring Kinerja Mahasiswa Internship Berbasis Web dan Global Positioning System. Bandung: Kreatif Industri Nusantara.
- [24] Ravindran, A. R. (2016). Operations Research And Management Science Handbook. Boca Raton: CRC Press.
- [25] Setyawan, M. Y. H., dan Munari, A. P. (2020). Panduan Lengkap Membangun Sistem Monitoring Kinerja Mahasiswa Internship Berbasis Web dan Global Positioning System. Bandung: Kreatif Industri Nusantara.