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Geographical Information System of Bus and Travel Counter in Padang City Using BFS Method Based on Mobile Web

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Abstract.
Purpose: One of the main objectives of the research is the BFS (Breadth-First Search) algorithm method in the search for nearby bus and travel counters using GPS found on each device used in the search process. Each smartphone produces a different coordinate point with an average distance difference of 30.2 meters to the hardware coordinate point. Each GPS embedded in the smartphone will process the data according to the location conditions of the user's point of existence. The methodology for system development is a standard process for a team of developers to connect all the steps needed in analyzing, designing, implementing, and maintaining information systems.
Methods: The methodology becomes a guideline in system development activities in SDLC. The SDLC model used in this study is the WaterFall Model.
Result: The results of this study are expected to facilitate the public in booking tickets and to find the nearest location from the bus and travel counters.
Novelty: The novelty of this research is the development of GIS as a search for the location of bus and travel counters using the breadth-first search algorithm. This research can help the community find the location of the nearest bus and tourist counter in the city of Padang.

Keywords: BFS, GIS, Coordinates, GPS, Route, Transportation

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INTRODUCTION

Transportation using buses and travel is still widely used by the people of Padang city. The location of the counter position and ticket booking process is a problem for customers. Many customers do not know the location of the counter and have difficulties booking bus and travel tickets. Sometimes prospective passengers who have the wrong address in finding the location or bus and travel counters that move to other places and make it difficult for prospective passengers to find the latest location.

A Geographic Information System (GIS) is an organized collection of computer hardware, software, geographic data, and personnel designed efficiently to obtain, store, update, manipulate, analyze and display all forms of geographically undifferentiated information. In a simple sense, geographic information systems can be summed up as a combination of cartography, statistical analysis, and database system technology. The use of GIS, makes it easier for the public to know disaster-prone points and evacuation routes that can provide benefits for the community to be swift in the face of natural disasters. The use of GIS can be applied using the android system or website to be accessed by many people. Android is a Linux-based operating system modified for mobile devices consisting of operating systems, middleware, and major applications. Mobile GIS integrates the workings of software/hardware for the access of data and geospatial services through mobile devices via wired or wireless networks [3]. A website is a collection of pages used to display text information, still or moving images, animations, sounds, and a combination of all of them, both static and sweetened, that form a series of interrelated buildings, each of which is connected to a network of pages[4]. The following are some previous studies that use mobile [4] do research with the title Mobile

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Application Development for Spectral Signature of Weed Species in Rice Farming [5]. [6] do research with the title Presenting New Framework For Semi-automatic Composition Of Web Services. [7] do research with the title A Rough Set Based Approach To Classify Node Behavior In Mobile Ad Hoc Networks.

The use of Geographic Information System (GIS) has been done in previous research such as that conducted by [8] for Mapping of Coastal Vulnerability. Furthermore, the results of research by Juniati for Estimating Water Availability using the SCS-CN Method based [9]. Abdulkadhem used the Geog RafisInformation System (GIS) for the Construction of Important Landmarks [10]. [11] use GIS for the suitability of PLTMH locations in Ogan Komering Ulu Sela tan Regency, South Sumatra, Indonesia. Further research was conducted by [12][13] using the GeogRafis Information System (GIS) for Transportation Planning.

The research was done by [14] with the title GIS-based multicriteria decision analysis: a survey of the literature. The research was done by [15] with the title Integration of GIS and video surveillance. [16] do research with the title Constructing and implementing an agent-based model of residential segregation through vector GIS. [17] do research with the title Visualizing and quantifying the movement of vegetative drought using remote-sensing data and GIS. [18] do research with the title Nearly Periodic Behavior in the Overloaded G / D / s + GI Queue. [19] do research with the title Visualizing and quantifying the movement of vegetative drought using remote-sensing data and GIS. [20] do research with the title Integration of genetic algorithms and GIS for optimal location search. [21] do research with the title Feminist Visualization: Re-envisioning GIS as a Method in Feminist Geographic Research. [22] do research with the title GridCertLib: A Single Sign-on Solution for Grid Web Applications and Portals. [23] do research with the title Assessing professional benefits of GIS certification. [24] do research with the title Area calculation based on GADM geographic information system database.

One of the main objectives of the research is the BFS (Breadth First Search) algorithm method in the search for nearby bus and travel counters using GPS found on each device used in the search process. Each smartphone produces a different coordinate point with an average distance difference of 30.2 meters to the hardware coordinate point because each GPS embedded in the smartphone will process the data according to the location conditions of the user'spoint of existence. To overcome the ignorance of customers, it is necessary to create an easy and practical information system in order to help bus and travel customers, as well as provide information about bus and travel companies in the city of Padang. Finding the position of the counter and booking tickets using this geographical information system can save time on the trip at the time of location search and ticket booking, because the address is already known. The number of bus and travel counters in the city of Padang makes users confused in determining the nearest location of the place of existence. For that, it is necessary for an application that is able to provide the shortest route to reach the location of the counter. With the Breadth First Search (BFS) algorithm integrated into the app, it can save travel time by knowing the shortest route to reach the bus and travel counters.

The use of the Breadth First Search (BFS) algorithm has also been done in previous research as done by Sularno, namely the implementation of the BFS Algorithm for the search for the shortest route to disaster evacuation shelters [24]. Next Is the Best First Search Algorithm in The Expert System of First Aid In Infants and Children [26]. Breadth first search algorithm used by [27] for native online store checking system or dropship on shopee.

Breadth First Search (BFS) is a wide search algorithm that visits nodes preorder i.e., visits one node and then visits all nodes that neighbor the node first. Breadth First Search (BFS) search will find no dead-end in the solution search process, and if it has more than one solution, this method will find it [28]. Where the search is done by widening to each node at the same level and will later find the best route from the starting point to the destination [29].

METHODS

The SDLC model used in this study is the WaterFall Model. The waterfall method is called Classic LifeCycle. It describes a systematic and sequential approach to software development. It starts with the specification of user needs and then continues through the stages of Planning (Planning), Modeling (Modeling), Construction (Construction), and submission of the system to the customer/user (Deployment), which ends with support on the complete software generated[30].
The following is a system development mechanism using Waterfall.

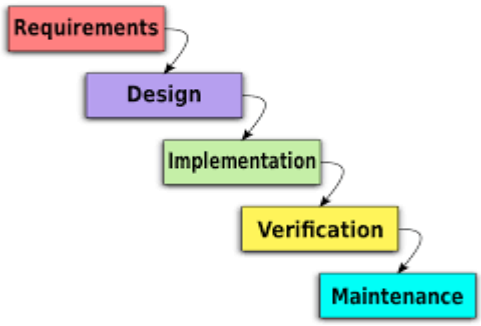

Figure 1. Stage of waterfall method

The stages of the Waterfall Method are as follows [31]:

1. Requirement Analysis

At this stage, developers need communication to specify the software needs of promotional products and the location of bus and travel counters to understand what kind of software the user needs. Proses that is done is to collect data about bus and travel counters located in Padang City. The data collected include the number of bus and travel counters available, each bus's departure destination, and travel. Specifications of bus and travel counter software needs at this stage must be documented so that the needs in the manufacture of bus and travel counter software can be well defined.

2. System design

The requirements specifications of the previous stage will be studied in this phase, and the system design prepared. System Design helps in determining hardware and system requirements and also helps in defining the overall system architecture. Bus and travel counter-marketing activities software design is a multi-step process that focuses on designing bus and travel counter software programs, including data structures, software architectures, interface representations, and coding procedures. This stage translates into design representation to be implemented into a bus and travel counter-marketing program later. The design of bus and travel counter software generated at this stage also needs to be documented.

3. Implementation

The system is first developed in small programs called units, which are integrated into later stages. Each unit is developed and tested for a functionality referred to as Unit Testing.

This stage is the stage in real in working on a system, in the sense that the use of computers will be maximized. The design should be translated into an information system program of bus and travel counter-marketing activities. This stage results in a computer program according to the design created at the design stage, where the program is created using the PHP programming language.

4. Integration &Testing

All units developed in the implementation phase are integrated into the system after testing conducted by each unit. After integration, the entire system is tested to check for any failures or errors. The system is ready to be used by the user. Testing focuses on bus and travel counter-marketing activity software in terms of lodges and functional and ensures that all parts are tested. It is done to minimize errors (errors) and ensure the resulting output under the desired bus counter-marketing program and mobile web-based travel.

5. Operation & Maintenance

The final stage in WaterfallModel. Ready-made software, run and maintained. Do not rule out the possibility of a software marketing activity bus and travel counter changing when sent to users, namely the Transportation Office of West Sumatra Province. Changes can occur due to errors that appear and are not detected during testing or the software has to adapt to the new environment. The supporting or maintenance stage may repeat the development process ranging from specification analysis to changes to existing software, but not to create new bus and travel counter-marketing activity software [32][33].

RESULT AND DISCUSSION

The stage needed in the creation of a program is to analyze existing systems. Analysis of the current system aims to find out more clearly how a system works and know the problems faced by the system to be used as a basis for proposed new system design.

Implementation of Alghoritma BFS (Breadth First Search)

The BFS (Breadth First Search) algorithm is an algorithm that performs a widening search that visits a node and then visits all nodes neighboring the node first.

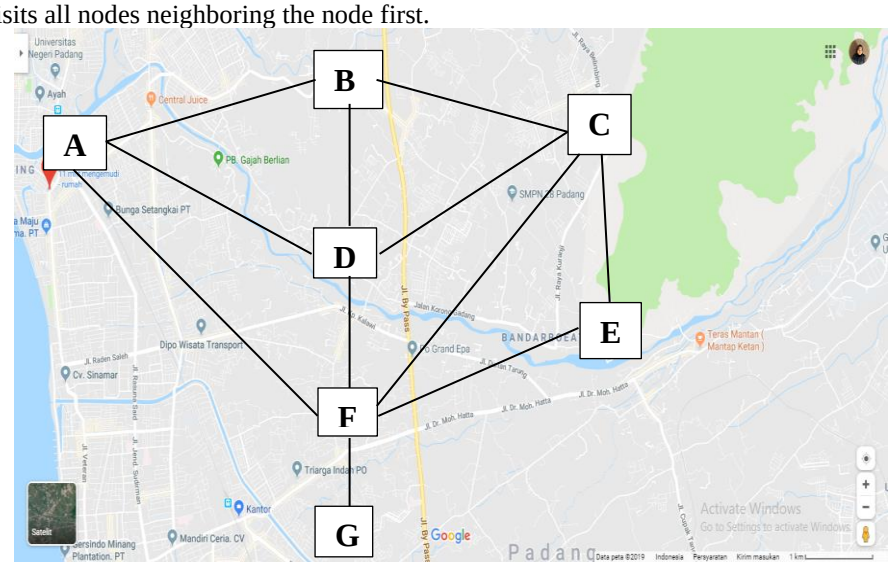

Figure 2. Map of the Area

On this map, the starting point is the user and the endpoint is PT. Kurnia Indah Travel. The starting point is converted to *node* A, and the endpoint becomes *node* E. The Breadth First Search algorithm for each point is performed on a node adjacent to the node (child node), can be seen in figure 2 of the following:

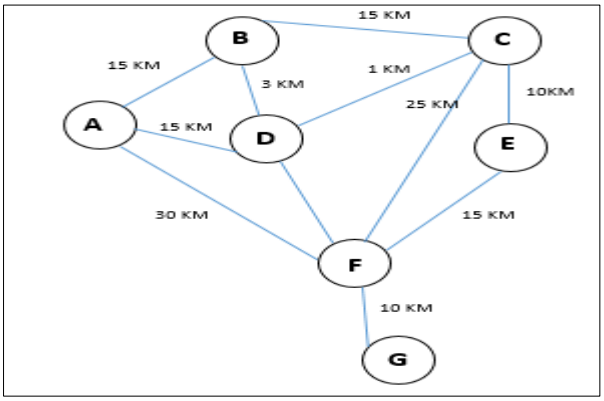

Figure 3. Graph for Breadth First Search

Description of figure 4.2:

Point A = User

A –> B = 15 km	C –> E = 10 km
B –> C = 15 km	D –> F = 10 km
C –> D = 1 km	E –> F = 15 km
B –> D = 3 km	A –> F = 30 km
A –> D = 15 km	F –> G = 10 km

Determining the shortest path with Breadth First Search from A to E, based on the image above, can implement into Breadth First Search to obtain the shortest path with the following steps:

1. Step 1

Take the initial state is A, A has a choice of paths that are to B, D and F so that it can represent the search tree.

2. Step 2

Perform the shortest path search based on the concept of Breadth First Search. The purpose of the search is to find point E. The search begins by tracing the base point that is point A, because point A is the point with the highest level then the search continues by exploring the points at the level below it or nodes that neighbor the node (child node), as seen in figure 4.

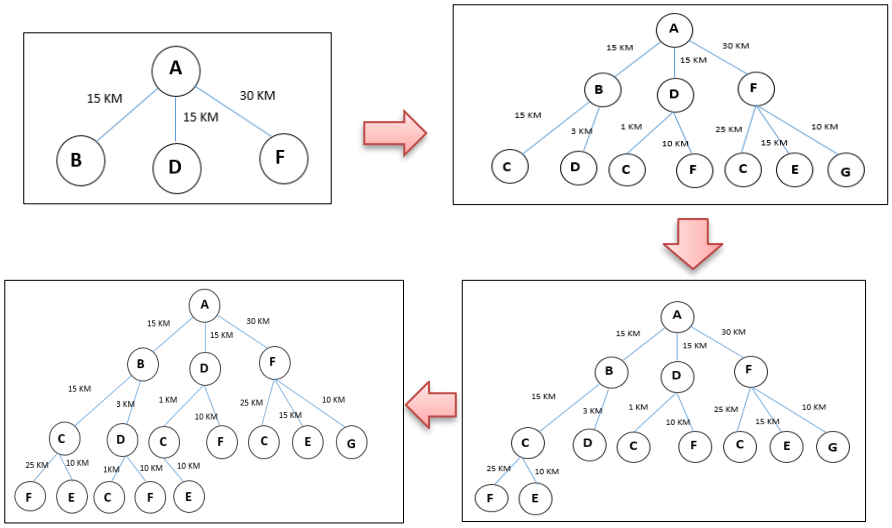

Figure 4. Shortest Path Search Process

In figure 4 see the results of the Shortest Path Search Process with the following final conclusion:

1. (A –> B) + (B –> C) + (C –> E) = 15 + 15 + 10 = 45 km
2. (A –> D) + (D –> C) + (C –> E) = 15 + 1 + 10 = 26 km
3. (A -> F) + (F -> E) = 30 + 15 = 45 km

The solution is found again with a distance of 26 km then this distance is stored and replaces the previous distance, thus the search process stops because the distance to be traversed has exceeded or equal to the previous distance. Based on the search process above with the Breadth First Search method found the shortest path from A to E is A, D, C and E with a distance of 26 km.

Information System Design

In this study, the authors designed a *system* that can help search and book tickets more efficiently. The results of the new system design that the author designed can be seen in the Use case diagram, Activity Diagram, Sequence Diagram, Class Diagram, and Object Diagram.

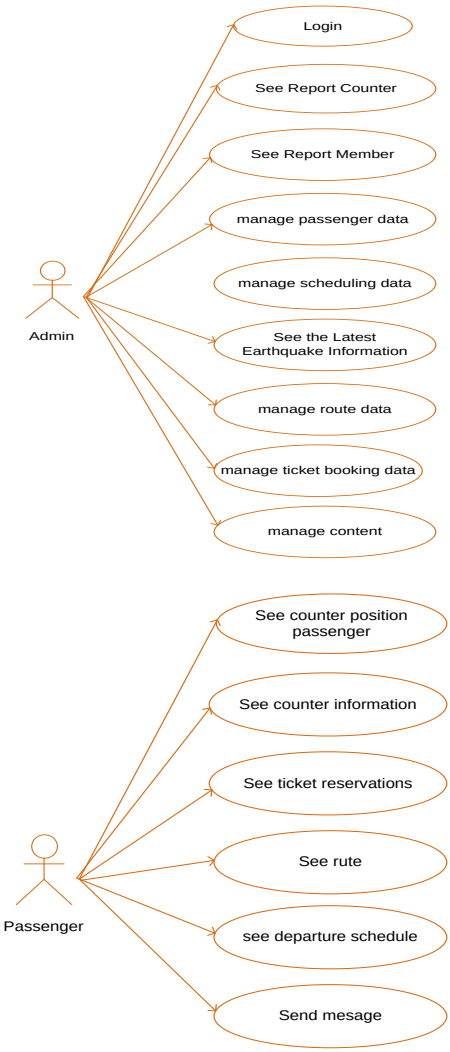

Figure 5. Use Case Diagram

The description in figure 5 is as follows:

1. Admins login, can view counter reports, member reports, manage passenger data, manage route data, manage schedule data, manage booking data, manage page content, and logout.
2. Passengers login can access the home, view counter maps, counter-information, directions with google maps, and ticket reservations.

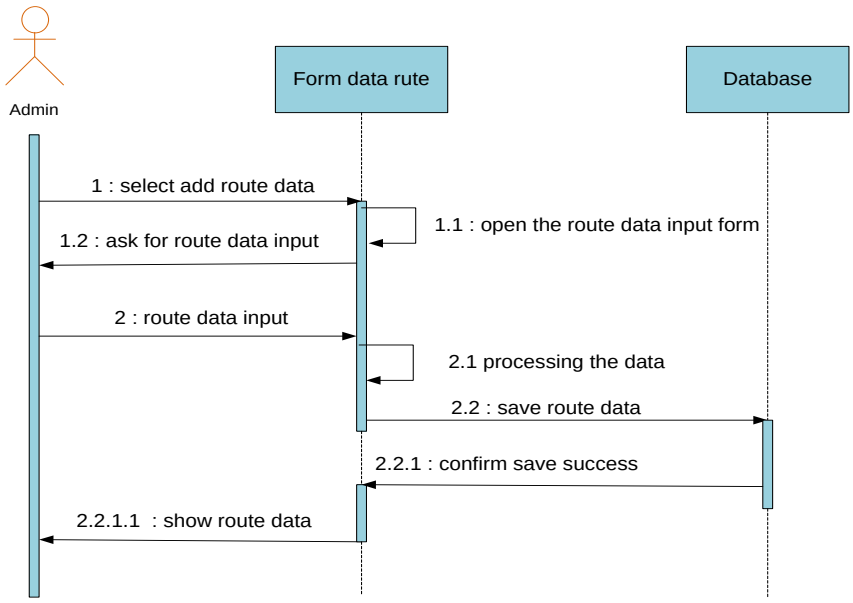

Figure 6. Sequence Route Data Diagram

Admin selects the route data to add the menu, then the system will display the input form plus route data. Admin fills in the latest route data, and the system processes the inputted data and then sends it to the database for storage. The database will conform to the system that the storage is successful in being retrieved and reprocessed. After the newly processed data, the system will confirm the data successfully and display the new data to the admin in the route data table.

Class diagrams are structural diagrams that model the collection of classes, interfaces, constellations, and their relationships.

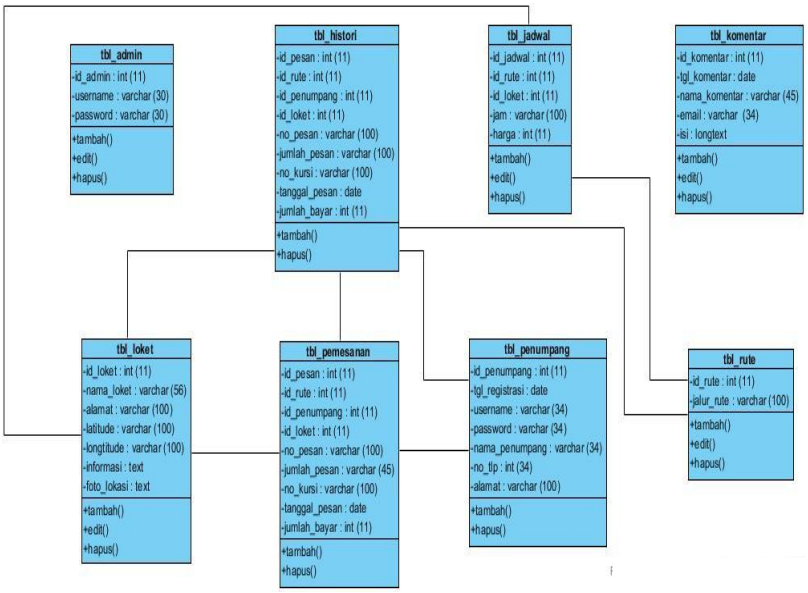

Figure 7. Class Diagram

Object diagrams depict objects in a class diagram.

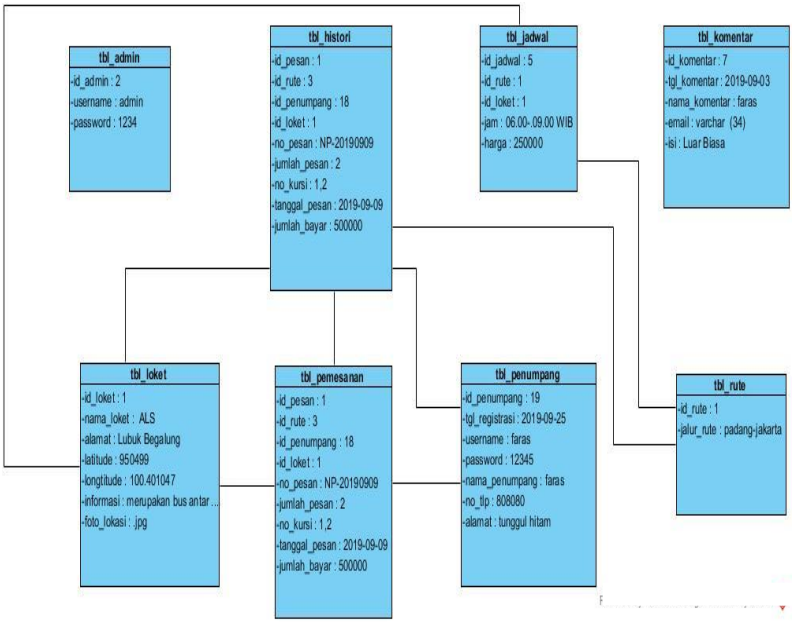

Figure 8. Object Diagram

System Testing and Implementation

System implementation aims to see whether the system is designed following what is desired or not. After done implementation of the system, the quality of a system will be seen.

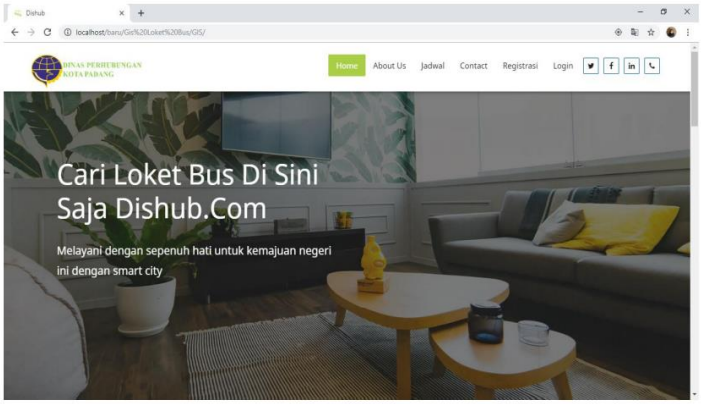

Figure 9. App home page view

The main page view is the basic framework of several sub-programs in it as the main display of the website Padang City Bus and Travel Counter.

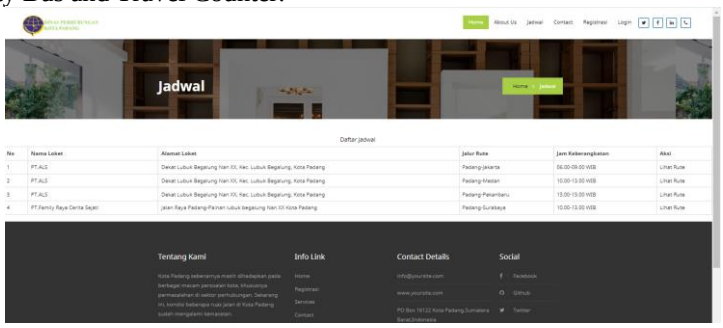

Figure 10. Schedule Page

The schedule page contains page views to display departure schedule for each bus and travel counter.

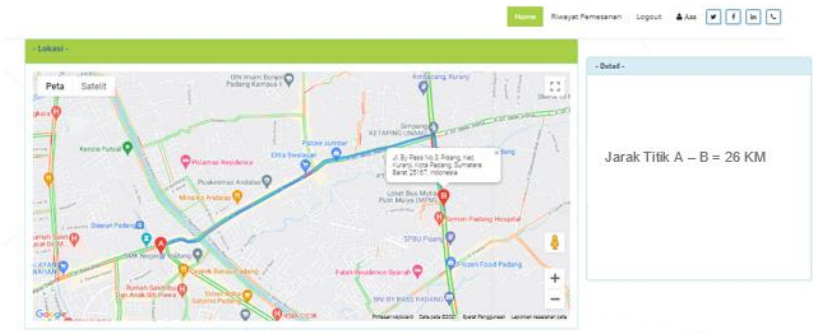

Figure 11. Route Page

Figure 11 is the nearest bus counter route page. On this page, the public can see the route of the nearest bus counter and information about the departure schedule, the distance to point A. It can be seen in Figure 11 that there is more than one route to point B. Based on the search results using the breadth-first search algorithm, the shortest distance route is 26 KM. After testing, it uses an application to track the shortest path, as shown in Figure 11. So it can be said that the system built by implementing the first search algorithm that is right is used to find and determine the shortest path with a larger number. The Breadth-First Search algorithm can not only be implemented in a game or game but this algorithm can also be implemented in the shortest route to the location of the bus counter and travel counter in the city of Padang. The novelty of this research is the development of GIS as a search for the location of bus and travel counters using the breadth-first search algorithm. The function of this research can help the community find the location of the nearest bus and tourist counter in the city of Padang.

CONCLUSION

Based on the research that has been done, it can be concluded that the application of the shortest path search using the Breadth First Search method can be implemented and used in the city of Padang. The simulation program created can show the optimal shortest path. The online bus and travel counter website makes it easier for people in Padang City to book bus and travel tickets. Padang City people also can find out the location points of bus and travel counters in Padang City and can see bus and travel departure schedules.

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