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Using A*Algorithm and Google Maps API for Web-Based Path Optimisation Public Vehicles Routes in Medan City

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Abstract: Public transport optimum route search is a problem to find a route between two points with the minimum number of weights. The research method that can be used to solve the problem of finding the optimum route is divided into two stages, namely first designing a model device using the A* algorithm and Google Maps API, second designing an android-based application. The purpose of this research is to develop an android-based system that can contain information on the optimum route of public transport in Medan City. The A* algorithm is a computer algorithm that uses distance estimation using the search for the closest path to reach the destination and has a heuristic function that is used as a basis for consideration to determine the choice of a number of alternatives to achieve the target effectively. The output of this research is the application of optimum route information for Medan city public transport based on android. The level of readiness of this research technology is of the Software type at the subsystem module validation status in a laboratory environment with indicators of integrated basic software components working together.

Keywords: Algorithm; Google map; Public; Web

Introduction

The city acts as the centre of the activities of its population, which is very diverse. Therefore, transport is an important component for the sustainability of city activities and productivity. The transport system has a very close relationship with the human socio-economic activity system where the transport system from time to time will develop in line with the development and changes in the human socio-economic activity system. Changes in the transport system (supply) must still be able to keep pace with transport demand (Nikitas et al., 2020).

Medan City is currently transforming into a metropolitan city and becoming the centre of government, trade, education, services and others. Activities in various sectors attract population mobility from the Medan city area itself, and other cities, such as Binjai and Deli Serdang. The high mobility of the population makes the transport system very important (Hörcher et al., 2022). Public transport is the choice of the community, in addition to the large number of fleets, public transport fares are cheaper than other public transport. In addition, public transport has a flexible departure time.

Based on data from the dishub. Pemko medan.go.id page, Medan City has 15 public transport companies, namely: PT Rahayu Medan Ceria, KPUM, PTU Morina, CV. Wampu Mini, CV. Mitra transport, CV. Desa maju, PT Mars, PT National Medan Transport, PT Povri, CV Hikma, CV Kobun, CV. Laju Deli Sejahtera, CV. Medan Bus, FA. Mekar Jaya, PU. Gajah Mada, where each of these public transport companies has a different number of public transport and different routes. Calculation of the shortest route plays an important role in everyday life because it must be done in a short time and at that time so that it can immediately know which route is the most optimal to pass.

Along with the development of science and technology, a technological development emerged,

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namely GPS (Global Positioning System) (Ramtohul & Khedo, 2020; Zekavat et al., 2021). Aiming to know the location of the destination and knowing where the user is with the help of two satellite signals, GPS itself can provide precise and accurate information about position, speed, direction and time (Hamid, 2020; Lukmana et al., 2014). This GPS itself is embedded in sophisticated smartphones with the Android operating system, so that every user can know where the user's position is without fear of getting lost somewhere he doesn't know (Harahap & Rakhmadi, 2023). Shortest route search, is an attempt to find the shortest route from the starting location to the destination location with the fastest travel time compared to other routes. So it was inspired to develop the closest route search application using a smartphone.

This is supported by the development of Smartphone technology and the growth of its use so that this will make it very easy for many people, especially people who are new to living in Medan or who are still unfamiliar with public transport in Medan City. There are several algorithms that can search for shortest routes, one of which is the A* Algorithm (A-Star). The A* algorithm is an improved algorithm of the Best First Search algorithm that combines Uniform Cost Search and Greedy Best First Search, with a modified heuristic function (Pramudhita et al., 2018; Widodo & Ahmad, 2017). The A* algorithm has a heuristic function where heuristics are assessors that can give a price to each node so that it can provide the desired solution (Nuryoso et al., 2020). The A* algorithm is one of the best graph search algorithms that has optimal and complete capabilities in solving a problem related to finding or determining the route with the closest distance (Budiman et al., 2018; Purnama et al., 2018).

According to data from Statcounter (2021) Android users in Indonesia are 91.42%, consisting of 8.39% iOS users and 0.04% Windows Operating System users. In the era of technology, there are many ways to get information based on geographic location with the help of technological devices (Marcelina & Yulianti, 2020). The development of information technology about locations and places makes it easy for everyone to get several locations, one of which is developing graphical data-based information that uses latitude and longitude as location coordinates (Mohamad et al., 2017).

Based on the above background, the researcher is interested in analysing the shortest path from the starting point and the specified end point of several sub-districts in Medan city with the title "Analysis of Meedan City Public Transport Routes Using A* Algorithm and WEB-based Google Maps API".

Method

The Waterfall method is one of the Softwarw Model Development Life Cycle (SDLC) which consists of: stages of needs analysis, design, implementation, testing and maintenance (Mariana, 2021). In Figure 1 System development from the needs analysis stage includes hardware and software. The design stage is carried out designing a data flow diagram which aims to facilitate understanding of the system being built. Implementation stage activities to implement all designs that have been made. At this stage the programming process of the A* algorithm is carried out using the Android Application. The A* algorithm compares all possible paths on the graph for each edge of all vertices for an estimate of the optimal route selection decision at each stage between two vertices, until the estimate is known as the optimal value. To find the optimal route is done at the testing stage.

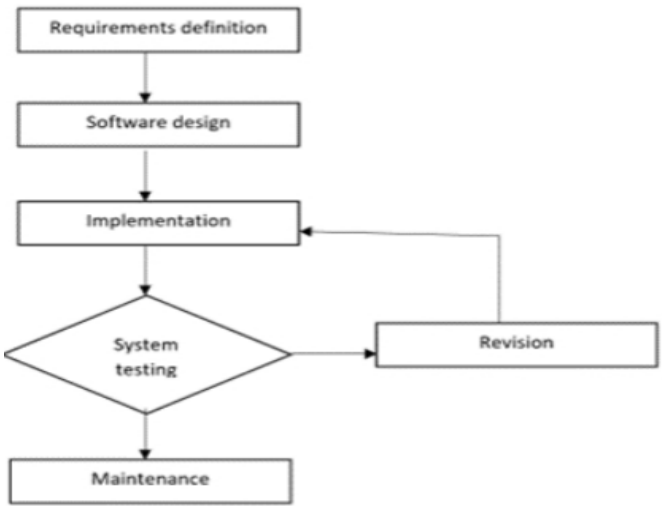

Figure 1. Flowchart of logic

Black Box testing, this test is in the fundamental aspects of the system without paying attention to the internal logic structure of the software. Black Box testing tends to be concerned with whether the system provides output as expected by the system or not, without knowing the working system of the software being tested. Testing the correctness of the results of the optimum route and mileage generated by the system, done by passing and observing the Medan city public transport route and comparing the route of the system calculation results.

Result and Discussion

The A algorithm*

The A* (A Star) algorithm was first introduced in 1968 by Peter Hart, Nils Nilsson, and Bertran Raphael

(Trisnawan et al., 2021). It is a graph search algorithm used to find a path with the least cost. The least expenditure from the starting point to the expected destination point. This algorithm is the best first search with the smallest estimated cost solution with distance and heuristic value (criteria for specified alternatives) as a basis for consideration (Yuliani & Agus, 2016).

Google Maps API is a technology development from Google that is used to embed Google Maps in an application that is not made by Google (Sharon, 2021). Google Maps API is a javascript library that is useful for modifying maps on Google Maps as needed (Yazdeen & Zeebaree, 2022). In its development, Google Maps API is given the ability to take static map images. Perform geocoding, and provide directions. Google Maps API is free to the public. The use of the Google Maps API in Android application development using Eclipse and computers using the Windows operating system. The disadvantage of the Google Maps API is that if you want to access there must be internet service on the device used. While the advantages of the Google Maps API are: full support by Google so that it is guaranteed and varied features in the Google Maps API; and many developers use the Google Maps API so it is easy to find references for application development (Li & Hecht, 2021; Qi et al., 2022).

Data Analysis Using the A algorithm*

This research conducts a research study on a system that is run which aims to see the effectiveness of the system being used. The field studies through Google Maps and Google Earth by looking for sources of information by collecting data from the object to be studied (Tamiminia et al., 2020; Zhao et al., 2021). The data used for analysis are many public transport routes in Medan city and the path of each public transport in Medan city.

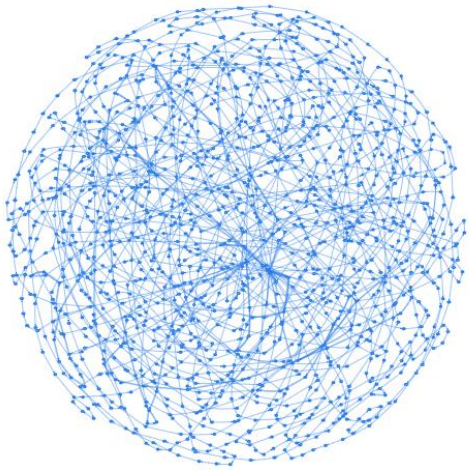

Figure 2. Public transport routes of Medan city in graph form with 1392 nodes

Data analysis using the A Star algorithm with several stages. Collecting data in the form of distance data based on grids and points obtained from Google Maps. Determine the coordinates of each public transport lane and road intersection point determined by taking the longitude and latitude points on Google Maps. Arrange the grid by illustrating all the data that has been obtained, starting from the points and sides that connect one point to another. Calculating the Heuristic value using Algorithm A Star (Wang et al., 2023; Zhang et al., 2021). Conduct experiments to determine the optimum public transport route.

A Star Algorithm Programming

Programming of the Floyd Warshall algorithm using HTML Web Applications, supported by PHP and Javascript programming languages using the MySQL Database obtained a display like this. Through the system built, it can find out the optimum public transport route taken from the starting point to the destination point.

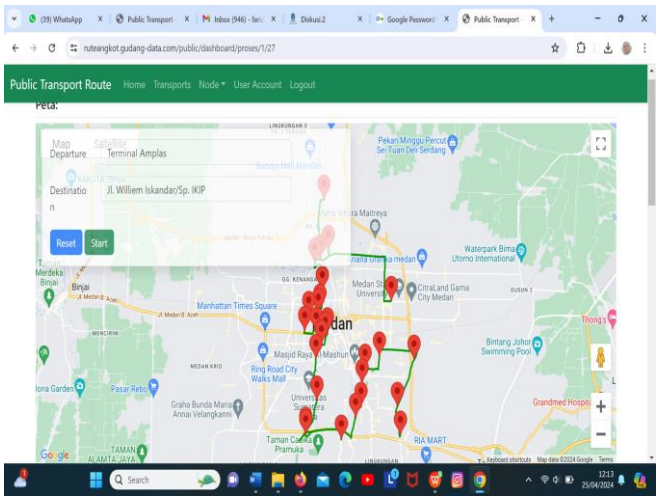

Figure 3. Destination point

The results obtained from the calculation of the A* algorithm provide an optimum choice of public transport routes in terms of distance. The results of testing with the Black Box method show 100% system functionality runs well. And the last stage of testing is done to test the reliability of the system that has been made, the results of the system reliability test show the truth works well and can be accepted and there is no deviation of the route, so the expected results are in accordance with the expected.

Conclusion

From the analysis result of this research, the optimum route finding application using A* algorithm can be used in Medan City. The optimum route search

from the starting position to the destination position starts from transforming the road coordinate data obtained from Google Map into a road network. Then the network that has been formed is made a neighbourhood matrix and calculated using the A* algorithm until the optimum route choice is obtained. From the results of the transport network research to find the optimum public transport route in Medan city can be recommended as an alternative that can shorten the distance travelled.

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Author Contributions
This study was conducted by me personally, so the content presented is my full responsibility. The single author provides a space for free expression so that the satisfaction of pouring thoughts can be accommodated.

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Conflicts of Interest
There is no interest conflict in this research. This research is conducted for scientific studies that are widely disseminated through this journal. Writings that are free of conflicts of interest will be disseminated without fear of the author, so that they can be free to continue working.

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