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Development of Bandung City Transport Optimization Application with Best-Path Planning Algorithm on Android Platform

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ABSTRACT

City transport is often used by some people who travel without using their private vehicle. Usually, city transportation is empowered by the city government to encourage people to prioritize public transportation as the main choice for traveling. However, there are several problems such as the difficulty in knowing what city transportation routes can be used to reach a destination in the city, especially the city of Bandung. From the problems that arise, it requires information media that can be a virtual guide in optimizing the use of city transportation. This information media is needed to stimulate the public to always return to using city transportation as the primary means of transportation for travel. Smartphones with the Android operating system are one of the information media that can be used because of the very good development and growth of users in society, this can be seen from a survey conducted on one site, namely StatCounter which shows Android users are getting better in 2014. Therefore The development of this application for optimizing the use of city transportation is expected to be able to provide good information in determining the use of public transportation. On the other hand, the Best - Path Planning method is empowered to support the search for city transportation and decision making for the use of city transportation.

1. Introduction

City transportation is a means of public transportation that is often used by some people who travel without using their private vehicles. Usually, city transportation is empowered by the city government to encourage people to prioritize public transportation as the main choice for traveling. Not only as a driving force for society, but public transportation also has quite a positive effect in reducing excessive gasoline consumption and reducing air pollution that is generated when the use of gasoline is too excessive. Thus, the more people who use public transportation, the more effective the use of roads will be. In other words, public transportation is one solution to the congestion problem faced by almost all big cities.

However, there are several problems such as the difficulty in knowing what city transportation routes can be used to reach a destination in the city, especially the city of Bandung. Then the determination of the selection of city transportation, whether involving one or more city transportation. As well as problems that arise when someone uses city transportation more than one transportation. If the point of stopping point for transportation A is at the exact location point on the route of transportation route B, then the transfer of transportation can be carried out immediately, whereas if the point of stopping location for someone using transport A is not on the route of transportation route B then the problem is where someone is must use or take transport B in order to continue the journey to the destination. These things can be an aspect of reducing public interest in using public transportation.

From the problems that arise, it requires information media that can be a virtual guide in optimizing the use of city transportation. This information media is needed to stimulate the public to always return to using city transportation as the primary means of transportation for travel. Now many technologies provide information media that is widely used by the public, one of which is Smartphone technology with the Android operating system. Smartphones are one of the information media that continues to grow and has excellent user growth in society, both among the middle and upper classes. This can be seen from Figure 1.1 of the

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development graph of the Smartphone Os from January to December 2014 issued by the StatCounter site, showing that the use of Android is growing rapidly.

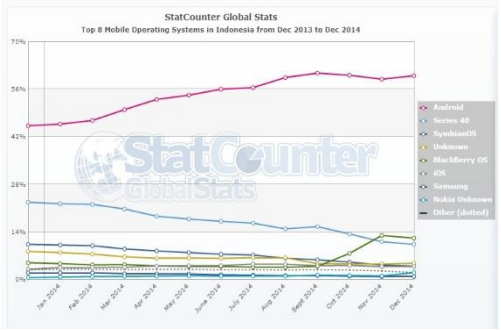

Fig. 1 Graph of Smartphone OS Development January - December 2014

later supported by supporting facilities such as the use of GPS (Global Positioning System) available on smartphones, Google maps, the internet, and data on city transportation routes, especially the city of Bandung. With many and complex route data, this application makes use of a method to determine the use of city transportation, whether it only involves one transportation or more than one transportation. The Best-Path Planning algorithm is a method that is deemed appropriate to support the development of this application. This algorithm is a problem-solving method by providing an optimal solution to calculate the route effectiveness from point A to point B.

It is hoped that the construction of this Android-based application for optimizing the use of city transportation can provide information and suggestions that are effective and optimal. Thus the information provided can be understood by users who are unfamiliar with public transportation in the city of Bandung and public transportation is again one of the main choices in traveling.

2. Literature Review

Best-Path Planning is a problem-solving method by providing an optimal solution to calculate the effectiveness of the route from point A to point B. The Best-Path Planning algorithm is measured by computational complexity, this algorithm functions as a route finder with the best possible number of route transfers. The following is a description of the Best-Path Planning algorithm, which consists of algorithms 1,2, and 3, here is one of the algorithms used in the development of this application:

Algorithm 3 (TPlanning) Let o and d denote the numbers assigned to the origin and destination, respectively.

1) Trivial cases: if o = d, show an appropriate message and return a null plan.
2) Direct: if Qo; d = 1, return any service in DService (o; d).
3) One transfer: if Qo; d = 2, there must be a location m such that Qo; m = 1 and Qm; d = 1. Combine any route in DService (o; m) and any route in DService (m; d) to obtain a one-transfer plan.
4) Two transfers: if Qo; d = 3, there must be different locations m1andm2such that Qo; m1 = 1, Qm1; m2 = 1, and Qm2; d = 1. Combine one route from each of DService (o; m1) , DService (m1; m2), and DService (m2; d) to obtain a two transfer plan.

The description above is a reference in the development of this application later. Best-path planning checks step by step the route of a person using city transportation. By utilizing the graph representation in the matrix, in this case the adjacency matrix, the concept of the greedy path-merging algorithm, is expected to be able to optimize the determination of the connecting point between the starting and the destination locations.

A. Adjacency Matrix

Adjacency Matrix is used to express a graph by expressing the number of lines connecting the points. In the application development, a directed and undirected graph connection matrix is used to represent a graph. Let Q be a directed graph consisting of n points without parallel lines. The matrix that corresponds to the graph Q is a square matrix nxn Q = (Qi, j), if there is a line from point vi to point vj then Qi, j = 1 but if there is no line from point vi to point vj then Qi, j = 0. Below is a graph Q which consists of 5 points (v1… ..v5) so that the matrix is a 5 x square matrix

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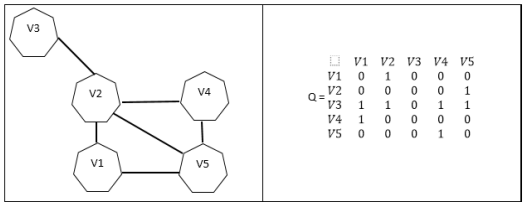

Fig 3. Illustration of the link matrix

B. Greedy Path-Marging Algorithm

Greedy algorithm is an algorithm which follows heuristic problem solving making the optimal choice locally at each stage [9] in the hope of finding the global optimum. In many problems, a greedy strategy does not generally produce optimal solutions, but still the greedy heuristic can produce local optimal solutions that are close to global optimal solutions within a reasonable time.

For example, the greedy strategy for the traveling salesman problem (which is of high computational complexity) is the following heuristic: "At each stage visit the closest unvisited city to the current city". These heuristics don't necessarily find the best solution but end up in a sensible number of steps; finding the optimal solution usually takes an unreasonably many steps. In mathematical optimization, the greedy algorithm solves combinatorial problems which have the properties of matroids. Figure 4 will explain how the different route combining algorithms.

C. Greedy Path-Merging

begin
Select all contig edges.

D. For eachmate-edge e in descending order of weight:

if e is not selected:
Let v, w denote the two nodes connected by e
Let P1be the selected path incident to v
Let P2be the selected path incident to w
if P16 = P2and we can merge P1and P2 (guided by e) to obtain P:
if H (P) - (H (P1) + H (P2)) ≥U (P) - (U (P1) + U (P2)):
ReplaceP1and P2by P
End

3. Research Methodology

A. Problem Analysis

Problem analysis is the first step in system analysis. This step is needed to identify problems that exist in an existing system. The problem analysis referred to here is how to develop existing information media in the hope that the results of this development can provide facilities that make it easier for users, especially for the people of Bandung who need information about city transportation. Even though there are many media available, they still have shortcomings, both from the delivery of information or the physical side of the media as well as situations and conditions that do not provide information about angkot and the routes it passes.

With the development of smartphones, especially Android, which have advantages in terms of mobility, user friendliness, and practicality, it is hoped that they can help build applications that can cover the shortcomings that exist in today's media. Referring to the existing shortcomings, an application to optimize the use of city transportation was built using the best path-planning algorithm. This application aims to display information in real time in the form of a map that can provide direction in using public transportation optimally. In its development, this application uses the Google Map API to get geographic information on google maps. And for that we need an algorithm to search for city transport routes with data centered on the server, so the best path is obtained. This Best Path-Planning function is to display effective information for optimizing the selection of city transportation on smartphones, especially those with an android operating system.

B. How the Best-Path Planning Algorithm Works

Algortima Best-Path Planning looks for all possible uses of angkot in the city of Bandung either using one angkot or more than one angkot. This method works with approximate decision making taking into account the selection of the closest route. There are three ways to search, namely:

a. Angkot Routes Without Transfer

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This angkot route without transfer means determining a direct route using one transportation. A direct route is obtained if the starting point and end point are on the same angkot route. The following is the strategy for the angkot route planning algorithm without transfer:

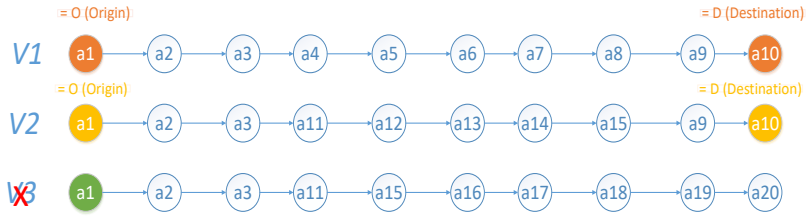

Fig. 4 Transit search without transfer

b. One Transfer Angkot Route (Merge Two Route)

This one-transfer angkot route means determining a direct route using two transports. One transfer route is obtained if the starting point and end point are not on the same angkot route. The following is the strategy for the one-transfer angkot route planning algorithm:

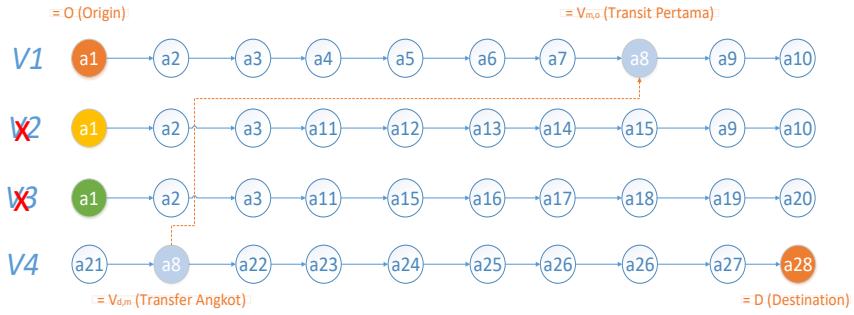

Fig. 5 Search for a single transfer transport route

c. Best Angkot Route - Path Transfer (Greedy path-merging Algorithm)

Two transfer angkot routes are determining the use of more than two angkot. Two transfer routes are obtained if the starting point and ending point are not on the same angkot route and have more than one connection point. The following is the strategy for the angkot route planning algorithm without transfer with the concept of greedy path-merging:

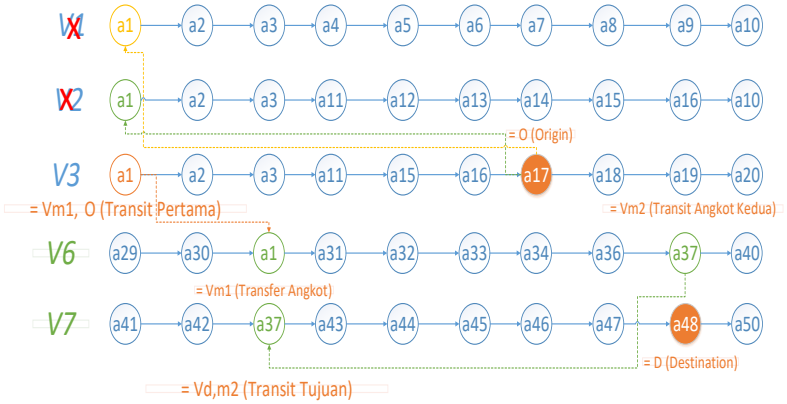

Fig. 6 Route search using greedy ptah_merging

d. Use Case Diagram

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Use Case diagrams are the highest part of the functionality of the system which will describe how someone or actor will use and utilize the system. The objectives of use case modeling include defining the functional and operational requirements of the system by defining the system usage scenario to be built. From the analysis of existing applications, the use case diagram for this can be seen in Figure 7:

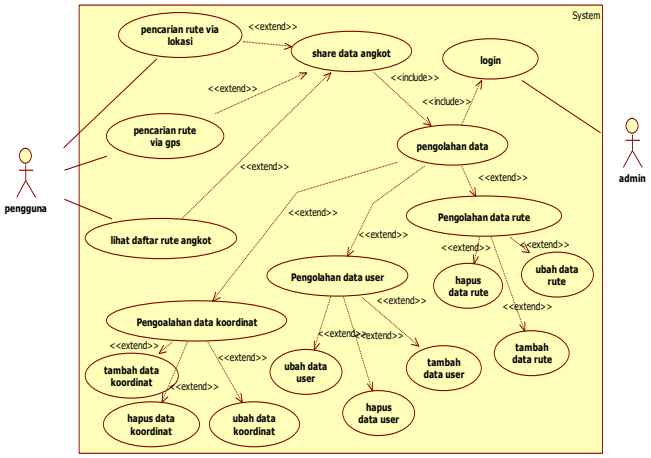

Fig. 7 Route search using greedy ptah_merging

e. Use Case Diagram

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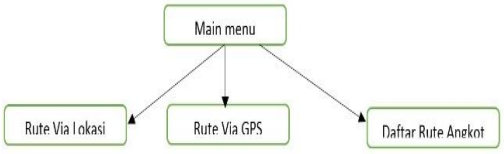

Fig 8. Frontend Application Menu Structure

f. Semantic Network

To find out the connectedness of each view made can use semantic networks. Here is a semantic network for the frontend application.

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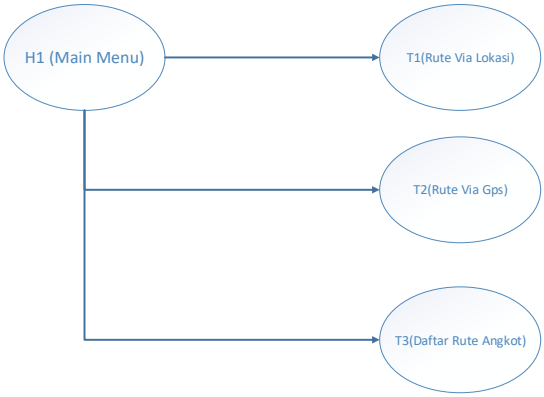

Fig 9. Semantic Network

4. Results And Discussion

A. Implementation

The system implementation stage is the design translation stage based on the results of the analysis into a certain programming language and the application of software built in the real environment. The implementation discussion consists of software development, hardware development and interface implementation.

B. Hardware Implementation

The minimum hardware requirements needed to implement the application program that are built are a PC or notebook computer and a cell phone. The better the hardware specifications that build the computer used, the better the application can be processed. The minimum requirements for builder hardware specifications include:

Table 1.
Hardware Specifications Table

Aplikasi FrontEnd / User	Aplikasi Backend / Admin
1. Telepon seluler (OS Android 4.0 Ice Cream Sendwich)	1. PC / Laptop dengan spesifikasi a. Ram 2GM b. *Harddisk* 250 GB c. *Processor :* dengan kecepatan minimum 2.0 Ghz d. *VGA :* minimum kecepatan 32MB
2. Memiliki koneksi internet HSDPA, 2G dan 3G	2. Memiliki koneksi internet, seperti LAN Wifi, modem.

C. Interface Implementation

Interface implementation is done with every page created on a mobile device. Here are some of the interfaces that have been implemented

a) Main Menu Page

The main page interface is the main display of applications used on Android mobile devices, in the menu there is functionality that can be accessed by users, namely the menu select location via location, select location via GPS and list of public transportation routes.

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Fig. 10 The main front end menu

b) Route Menu Display Via Location

In the route via location menu, there are several steps to take, namely: pressing the starting location (red) and the destination (green) and pressing the route button to get the route that must be used. Route view via GPS can be seen in Figure 11:

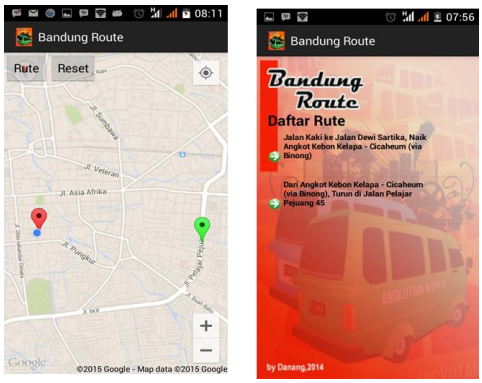

Fig. 11 Search for city transport via location

c) Display Route Menu Via GPS

In the route menu display via GPS, there are several steps that are carried out, namely: running the GPS found on the smartphone device after active the application will automatically be at the starting point based on the coordinates of the mobile phone, press the destination location and press the route button to get the route that should be used. Route view via GPS can be seen in

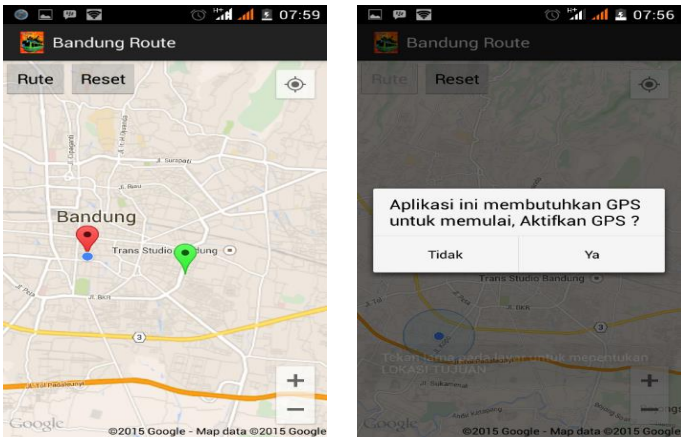

Fig. 12 City transit search via GPS

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d) Display of Angkot Route List Menu

In the public transportation list menu display there is information about the route data of the angkot routes and the roads they pass.

Fig. 13 List of city transport routes

e) System Testing

In testing the application of optimizing the use of mobile-based city transportation, two types of techniques are used, namely black box testing techniques and white box testing techniques. As for black box testing, it focuses on finding program errors, while white box testing focuses on the internal structure (source code) of the program to find out whether there are still errors. Testing is done through beta testing

f) Application Testing Scenarios

The test scenario describes the test of the existing system in the city transportation usage optimization application. The test scenario will be described in the following table:

g) System Testing

In testing the application of optimizing the use of mobile-based city transportation, two techniques are used, namely black box testing techniques and white box testing techniques. As for black box testing, it focuses on finding program errors, while white box testing focuses on the internal structure (source code) of the program to find out whether there are still errors. Testing is done through beta testing

h) Beta Testing

Beta testing is a test that is carried out objectively, where direct testing involves public transportation users directly using a questionnaire regarding user satisfaction with the angkot user application that was built.

Questionnaire

The questionnaire was given to several potential users of the software built with the respondents aged 17 years and over. The sample taken by each prospective user is 30 people, from the results of the questionnaire will be calculated so that a conclusion can be drawn from the respondents' assessment. The percentage results of each questionnaire answer value were tested on each respondent by being given 5 scales using the Likert scale. To find the percentage value of each questionnaire answer, the linkert scale formula is used as follows:

$$P = \frac{s}{skor\ ideal}\ x\ 100$$

5. Conclusions

Based on the trials that have been done, it can be said that this application is running quite well even though there are some shortcomings. This City Transport User Optimization application for Android-based phones is basically a means of disseminating information about city transportation, especially the city of Bandung.This application has advantages in terms of mobility, because this application is based on cell phones, the dissemination of information can be received directly and certainly does not interfere with the mobility of its users. The application is also equipped with Google Maps to view the routes that are city transportation.This

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application also has a drawback, namely this application can only run well if there is an internet connection, and the method used is still not optimal for determining city accounting for more than two uses.

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