

Geographic Information System For Mapping Place Of Health Care Using Algorithm A*

Pandapotan Siagian *, Erick Fernando **, Sindak Hutauruk ***

* Department of Computer System, STIKOM DB Jambi

** Department of informatics Engineering, STIKOM DB Jambi

*** Department of Electro Engineering, Faculty of Faculty Engineering, Universitas HKBP Nommensen Medan

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ABSTRACT

Facility search for clinical information, place of health care, doctor schedule, etc. is not available in the information system, so people cannot figure out the schedule and the doctor availability quickly. Development of mobile-based information system will provide location and useful information, such as the position of the clinic and the alternative road route in Jambi map and positioning and route alternatives by using A* algorithm. Geographic information system (GIS) has emerged over the past decade as widely used as software systems for inputting, storing, manipulating, and outputting the geographical referenced. A* algorithm is a search algorithm graph / tree which will seek the path from the starting point to the destination point that has been determined. A* algorithm uses heuristic approach $h(x)$ which gives the rank of each point x by estimating the best way that can be passed from that point. With this application, people can take advantage to manage their time, and in the future, this application is expected to help the search and to provide of more detailed information about the place of health care in Jambi.

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Corresponding Author:

Pandapotan Siagian,
Department of Computer System, STIKOM DB Jambi
Jalan Jendral Sudirman Thehok, Jambi, Indonesia.
Email: siagian.p@gmail.com

1. INTRODUCTION

There are nearly 700 million cell phones sold each year compared to PCs sold, which are fewer than 200 million PCs, and the gap is getting widening. Increasingly, phones are the way people wanted to connect with each other and with everything else. Phones are going to replace PCs as the main gateway to the Internet, and they are going to be there soon. The cell phones run on different software, has less memory, and slightly different in operation.

Under the constraints of pay-per-byte wireless networks; the mobile Web is a stripped-down, mimeographed version of the real thing. To avoid this, Android had the solution. Android is a free, open source mobile platform that any coder could write for and any handset maker could install. It would be a global, open operating system for the wireless future. Android is a software stack for mobile devices that includes operating system, middleware and key applications [5], [6]. Android is an Open Platform for Mobile development.

The system is develop to enable people searching for the shortest route from/to the hospitals or Public Health Centers in Jambi, and this system will give some accesses ,such as clinic service, facilities, and doctors' schedule in each hospital. This system will be very valuable for the public, especially for the visitors who come from out of town. This informative system development based on mobile system will share more about the location, the position, and the alternative ways in the map of Jambi, and the alternative route by using A* algorithm.

1.1. Geographic Information System

Geographic Information Systems (GIS) or commonly known as the Geographic Information System (GIS) is an information management tool that is closely related to mapping and analyzing system for everything to the various events that occur on earth. Definition of GIS is always evolving, growing and varying. It is seen from many definitions that GIS has been circulating. In addition, GIS is also a study of science and technology that relatively new, which is used by various disciplines, and it develops rapidly [3].

GIS is a research and an application area that utilizes the internet to facilitate the access, processing, and distribution of geographic data and spatial analysis knowledge. The Internet is affecting GIS in three major areas: GIS data access, spatial information dissemination and GIS modeling/processing. It has increasingly been recognized that the future developments in GIS will be centered on the Internet GIS. Most GIS vendors have developed their own Internet GIS Software, including ESRI's ArcIMS and ArcGIS Server, Intergraph's Geomedia Web[2], [4] :

1. APIs give web developers an access to the map functionalities.
2. Traditional GIS here refers to comprehensive desktop systems that generally acquired through licensing agreements.

Map, Autodesk's MapGuide, MapInfo's MapXtreme and GE SmallWorld Internet GIS Application Server are some Internet GIS providers that proprietary ways to allow the users to access, display and query spatial data over the web but it can be expensive in charging.

1.2. A* algorithm

It is based on a greedy best-first search algorithm. A*algorithm uses a heuristic function to evaluate from the starting location to the destination location. The heuristic function is divided into two functions: the path-cost function and the heuristic estimate function [4]. The path-cost function is the cost from starting location to the current location and the heuristic estimate function is the estimation cost from current location to destination location.

A* is probably one of the most well known Artificial Intelligence Algorithms. Its objective is to find the shortest path in a graph from a node x-start to a node x-goal. It combines the features of uniform - cost search and pure heuristic search to efficiently compute the optimal solutions. As the best-first heuristic search, it employs a function f that guides the selection of the next node that will be expanded. The order in which nodes are expanded is determined by the node evaluation function $f(n) = g(n) + h(n)$, where $g(n)$ is the cost of the best path currently known from the start node to node, and $h(n)$ is a heuristic estimated cost to reach from this current node to the goal node. The estimation of the cost is determined by using the problem specific information about the environment that the A* algorithm owned. The behavior of A* depends on the large part of the heuristic $h(n)$ that guides the search. If $h(n)$ is admissible, that is, if it never overestimates $h^*(n)$, and if nodes are expanded in order of $f(n)$, then the first goal node selected for expansion is guaranteed to be optimal.

A heuristic is said to be consistent if $h(n) \leq c(n,n') + h(n')$ for all n and n' where $c(n,n')$ is the cost of an edge from node n to node n' . If $h(n)$ is consistent and nodes are expanded in order of $f(n)$, the g -cost of a node is guaranteed to be optimal when the node is selected for expansion. A node never expanded more than once. If $h(n)$ is not consistent, it is possible for A* to find a better path to a node after the node is expanded.

To prove that A*algorithm is optimal when using admissible heuristic, let us assume sG as a suboptimal goal node and $g(sG)$ as the exact cost of reaching from the root node to the current sub-optimal goal node sG . Also consider $h(sG)$ as zero because for every goal node the estimated cost is always zero and let C^* is the cost of the optimal path from the root node to the real goal node then.

$$f(sG) = g(sG) + h(sG) = g(sG) > C^* \quad (i)$$

The cost of the optimal path from root node to the suboptimal goal node sG is larger than the cost of the optimal path from root node to the real node[14,20]. Thus the suboptimal goal node sG will never be taken in as a goal. Also assume that node n as a node on the optimal path and if heuristic function $h(n)$ is admissible, then we know:

$$f(n) = g(n) + h(n) \leq C^* \quad (ii)$$

A* Algorithm will never select sG as a goal node because if f -cost is greater than the cost of the real goal node rather A* algorithm, it will select node n [4].

1.3. Google Maps

Google Maps is an online map application service provided by Google for free. Map services in Google Maps can be accessed via the official website <http://maps.google.com>. The site can be seen on the geographical information on almost any surface of the earth, except the polar regions, north and south [1]. This service is made very interactive, because the map can be shifted as the user desires, change the zoom

level, and change the type of map displayed. Google Maps has a lot of facilities that can be used as the search location by entering a keyword. The keyword is meant as a place name, city, or street, and other facilities to calculate the route from one place to another[2].

Google Maps made by using a combination of image maps, database, and interactive objects which are created with programming languages HTML, Javascript and AJAX, as well as several other programming languages. The images that appear on the map are the result of communication with Google's database on a web server to display a combination of pieces requested images [3]. The entire image has been integrated into the database on Google servers, which will be called when need demands. Parts of the image map is a combination of pieces of type PNG images called tiles measuring 256 x 256 pixels as shown below.

2. ANALYSIS SYSTEM

The quest to solve the problems, regarding to the Public Health Centers in Jambi City , the author tries to make an analysis of the object to be constructed. In this system, the authors use the A* algorithm. This algorithm is the result of the development of the basic algorithm Best First Search. Authors apply the A* algorithm to determine the shortest route attractions and hotels in the city of Jambi. The A* algorithm flowchart is shown in Figure 1.

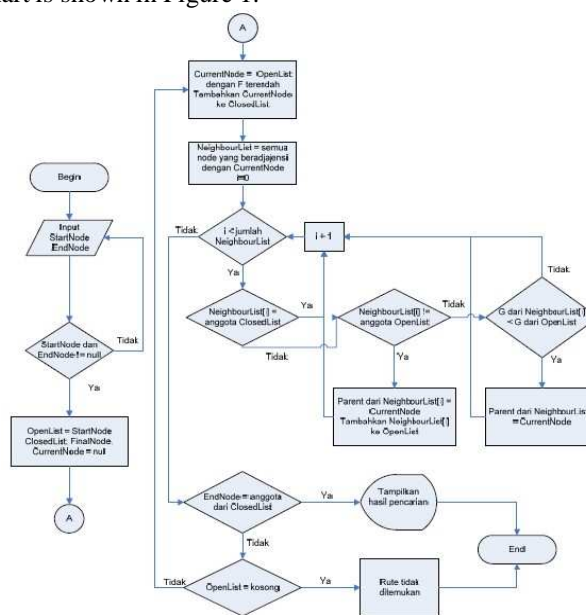


Figure 1. A * algorithm Application

A description to the shortest route search algorithms used as follows:

- Start Node and End Node which are the starting location and destination location obtained from a given user input. Initialized if the program exists, to check whether the Start Node and End Node is inputted available or not. If not, the user is asked to re-inputting.
- Start Node is inserted into the Open list, Closed list, Final List, and the Current Node initialized.
- Node on the Open list with the lowest F values serve is known as the Current Node.
- Neighbour List is filled with nodes adjusted with the Current Node.
- For each node in the neighbor list, do the following checks:
 - If the node is already a member of the Closed list, then proceed to point F.
 - If the node is not a member of Closed list and Open list, then add the node to the open list and Parent node of the node is filled with Current Node. If not, then ignore.
 - If the node is not a member of Closed list but is a member of the Open list, check whether the G value of the node is smaller than the value of the node members of the Open list. If true, then change the Parent Node of the node to be the member of the Open list to Current Node. If not, then ignore.
- If the End Node has become one of the members of the Closed list, then the route is basically found.

Performing backward method for the identification of the End Node to Node Started by looking at the parent node of each node in the Closed list. The search results are displayed, and the search process is completed. If not, then go to point G.

- g. If the open list is empty, then the route is not found and the search process is completed. If not, then go back to step C.

2.1. How A * Algorithm Works

A * algorithm is a result of the development of algorithm Best First Search. This algorithm evaluates every point by combining $g(n)$, the value for the point n from the starting point, and $h(n)$, the estimated value to achieve the objectives of the n points. The formula is: $F(n) = g(n) + h(n)$. This algorithm uses a heuristic function. Heuristic function is a function for approximation, which is used to calculate the distance from the current node to the end node $h(n)$. With calculations in Figure 2.

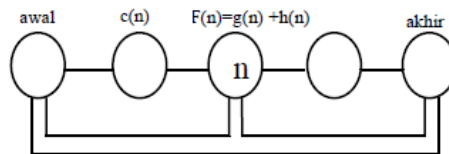


Figure 2. A* Algoritma function

In its application, to represent nodes in the graph, the application used two sets, namely the Open list and the Close List. Whenever users explore a new node, the node will be compared to other nodes that are in the Open and Close List, to check whether the node has been traced or not. Open list contains nodes that have been traced and have been calculated the value of heuristic function, but have not been examined. While the Closed list contains the nodes of the Open list, it has been checked. The working steps of the A * algorithm can be seen as follow:

- a) Start from the beginning of the start node then start node is added to an open list of nodes to be examined. The list contains some nodes that may be passed on the path to search, or may not, so the list contains the nodes that are needed to be examined.
- b) See all nodes that can be passed if they are connected to the start node, avoid nodes that are having a barrier. Add to the open list for each initial node. Initial node is a parental node, the node is useful when you want to follow the path.
- c) Discard the initial node of the open list, then add the start node to the closed list. On this list you do not need to check the previous node.

3. IMPLEMENTATION RESULT

The implementation of the system using Android versi 2.3 (Gingerbread). Implementation results of this study showed the main menu, health information and health shortest path of the application. Those can be seen in Figure 3 and Figure 4.

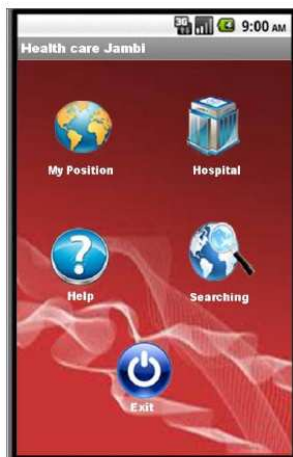


Figure 3. Main Menu

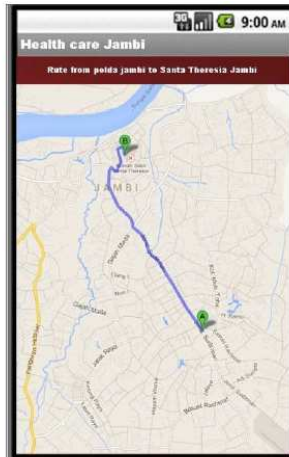


Figure 4. Shortest path from Polda jambi to Rs Theresia



Figure 5. Service Health Care

Informations for governance, facilities and physician practice's schedule in every hospital in the province of Jambi is in one's hand nowadays. Currently, the access to the hospital information in Theresia Hospital can be easily found in people's phone devices. The visitors will be able to see the information services for each clinic, every disease specialist clinic service contained in Figure 5 and room rental information in Figure 7. Physician practice schedule can be overviewed at the menu of data services, see Figure 6.

Dokter	Hari	Jam	No
1. Dr. Bambang Sutopo, Sp.PD	Senin	12.00-14.00	
	Selasa	08.30-12.00	
	Rabu	09.30-12.00	
	Kamis	09.30-12.00	
	Jumat	09.30-12.00	
	Sabtu	09.30-12.00	
	Minggu		
2. Dr. Susanto, Sp.PD	Senin	12.00-14.00	
	Selasa	09.30-12.00	
	Rabu	09.30-12.00	
	Kamis	09.30-12.00	
	Jumat	09.30-12.00	
	Sabtu	09.30-12.00	
	Minggu		
3. Dr. Guswan, Sp.PD	Senin	09.00-10.00	
	Selasa	09.00-10.00	
	Rabu	09.00-10.00	
	Kamis	09.00-10.00	
	Jumat	09.00-10.00	
	Sabtu	09.00-10.00	
	Minggu		

Figure 6. Doctor Schedule

No.	Jenis Kamar	Biaya Kamar / s
1	SVK	Rp. 750.000,00
2	UP	Rp. 800.000,00
3	UP	Rp. 475.000,00
4	KELAS I (RUMAH 100)	Rp. 175.000,00
5	RUMAH KOLAS I 200	Rp. 175.000,00
6	KELAS I A	Rp. 200.000,00
7	KELAS I	Rp. 185.000,00
8	RUMAH I B	Rp. 150.000,00
9	KELAS I B RUMAH I C	Rp. 180.000,00
10	KELAS I B (RUMAH KEDAPARAN)	Rp. 180.000,00
11	KELAS I B (RUMAH I B)	Rp. 175.000,00
12	KELAS I B (RUMAH KEDAPARAN)	Rp. 150.000,00
13	KELAS I B (RUMAH I B)	Rp. 150.000,00
14	KELAS I	Rp. 175.000,00
15	RUMAH I B (RUMAH I B)	Rp. 175.000,00
16	KELAS I B (RUMAH KEDAPARAN)	Rp. 150.000,00
17	RUMAH I B (RUMAH I B)	Rp. 150.000,00
18	RUMAH I B (RUMAH I B)	Rp. 180.000,00
19	KELAS I B (RUMAH I B)	Rp. 150.000,00
20	KELAS I B (RUMAH I B)	Rp. 150.000,00
21	RUMAH I B (RUMAH I B)	Rp. 175.000,00
22	KELAS I B (RUMAH I B)	Rp. 150.000,00
23	KELAS I B	Rp. 175.000,00
24	KELAS I B (RUMAH I B)	Rp. 150.000,00

Figure 7. List of rent rooms




4. CONCLUSION

The application can display routes using GIS on google map, and can be implemented on mobile devices with Android. Information for governance, service health care, doctor schedule, list of rent rooms, etc in every hospital in the province of Jambi can be easily found in people's phone devices.

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BIBLIOGRAPHY OF AUTHORS

	<p>Pandapotan Siagian was born on March 18 1974 in North Sumatra, Indonesia. He received degree from Nommensen University, Medan in 1999, and master degree in Electrical Engineering from Gajah Mada University of Yogyakarta in 2010. He is Information Technology Consultant in Jambi. He is current research interests include Computer Vision, Web Development, database, computational geometry, medical, computer network, Telecommunication.</p>
	<p>Erick Fernando was born on 29 Nov, 1985 in Jambi, Indonesia. He received degree from STIKOM DB, Jambi in 2007, and master degree in MSI from STIKOM DB of Jambi in 2011. He is current research interests include Web Development, database, computational geometry.</p>
	<p>Sindak Hutauruk was born on August 14 1959 in North Sumatra, Indonesia. He received degree from Trisakti University, Jakarta in 1979, and master degree in Electrical Engineering from Bandung Institute of Technology or Institute of Technology, Bandung in 1994. He is current research interests include Telecommunication, Web Development, computational geometry, computer network.</p>