International Journal of Information System & Technology
Akreditasi No. 36/E/KPT/2019 | Vol. 4, No. 1, (2020), pp. 496-501

Penerapan Algoritma *Steepest Ascent Hill Climbing* (SAHC) Untuk Pencarian Rute Terpendek berbasis *Mobile*

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Abstract

This study aim at early to determine the application of algorithms Steepest Ascent Hill Climbing (Sahc) for finding the shortest route-based Mobile in Humbang Hasundutan. Based on the results of application of algorithms Steepest Ascent Hill Climbing (Sahc) To search based Shortest These Mobile in Humbang Hasundutan. So it can be concluded that the search for the shortest route based on Mobile can be solved using the Steepest Ascent Hill Climbing algorithm . In the manual calculation process using the Steepest Ascent Hill Climbing algorithmAt the node from Humbang there is a heuristic value of 0.0896184808, at the node from which the three intersections are originated there is a heuristic value of 0.1693780561, at the node from which there is a heuristic value of 0.367474152, at the node from which the waterfall falls sibabo has a heuristic value of 0.3823982675. Then the result of the shortest route from Sipinsur Geosite (F) to Simolap Waterfall (B) is F ➔D ➔B (Sipinsur GeoSite - intersection 4 - Simolap Waterfall) the total distance is 51 km and the time is 1 hour 34 minutes. So that the test results of the Steepest Ascent Hill Climbing algorithm process with the system in accordance with the manual calculation process of the Steepest Ascent Hill Climbing algorithm .

Keywords: *Algorithm Steepest Ascent Hill Climbing (Sahc) Mobile , Artificial Intelligence*

I. Introduction

In today's era, the application of information technology is very important in everyday life. By applying information technology, work becomes easy and effective. Thus, one of the optimization techniques that can solve life's problems is the *Steepest Ascent Hill Climbing* Algorithm . *Steepest Ascent Hill Climbing* is a method used to find the shortest route in order to reach the destination solution. This method has also been carried out by Lipian Alfha Zemma, Herfina, Arie Qur'ania in a study entitled Application of the *Steepest Ascent Hill Climbing* Method in Searching the Nearest Route to Emergency Service Facilities in the City of Bogor based on Android. In this research, some data is needed, namely the actual distance between the related points/ *nodes* which is the cost between the *nodes* and the coordinates of each point/ *node* . By using this data, the closest route search can be applied. The process of implementing the SAHC (*Steepest Ascent Hill Climbing*) algorithm cannot be directly included in the route search on google maps, because google maps itself does not provide services to enter and run the desired path change function. Therefore, the solution for applying the SAHC (*Steepest Ascent Hill Climbing*) algorithm in this research is done manually using the data that has been obtained and then a line is made according to the results of manual calculations on the google maps route by entering the coordinate points that have been selected. and is the closest route to coding programs in Android Studio. Humbang Hasundutan Regency, which is located in

ISSN : 2580-7250

North Sumatra which has natural beauty and marine tourism as well as historical relics which until now are actively used as tourist objects. Some of the tourist objects that can be visited are, 1) Sibabo Waterfall ; 2) A simolap waterfall; 3) Incitement; 4) Waterfall promises ; 5) Sipinsur Geosite. The natural beauty and existing marine tourism have the potential to be developed. The development of potential tourism objects certainly requires supporting facilities. The shortest route search application is one of the supports when it is designed with the appropriate technology.

2. Reseach Methodology

This research was conducted at the tourist attractions in Humbang Hasundutan Regency, including: 1) Bakkara; 2) Sisingamangaraja Tomb Palace; 3) Aek Sipangolu Waterfall; 4) Sipinsur and; 5) Binanga Janji Waterfall. In the first week of June to the second week of October. Data collection techniques in this study are divided into 2, namely **literature and observation studies.** In this study, one of the data collection techniques used was looking for theoretical references that were relevant to the case with the case or problem found. Searching for information with literature studies in several scientific journals and theses related to the shortest route search system using the *Stepeest Ascent Hill Climbing* algorithm can strengthen problems and as a theoretical basis for conducting research. In this study the authors conducted direct field observations by traveling using motorbike kilometers and a *stopwatch* to find out the distance and time needed to arrive at several tourist sites in Humbang Hasundutan Regency and use the *google maps* application to determine the accuracy of distance, time, route and data accuracy. longitude and Latitude values at each point of the tourist attraction location. The results of the observations are in the form of distance, time and route data to the desired location of the Humbang Hasundutan Regency tourist attraction. Application or use in this study, users can download and install the application into an Android-based *smartphone* , then the user determines the initial location and location that he wants to go to, then the shortest route , distance and travel time appears in the application.

3. Results and Discussion

3.1. Data Analysis

Data analysis in this study takes data in the form of Longitude and Latitude values on *google maps* to calculate and search for heuristic values using the formula:

$$H(n) = \sqrt{(Xorigin - Xdestination)^2 + (Yorigin - Ydestination)^2} \quad (1)$$

This is intended to be able to match some of the data that has been obtained with various literature and other data that has been prepared. Here's how to get the Latitude and Longitude values at each point of Humbang Hasundutan Regency attractions using the help of *GoogleMaps* :

a) Open *GoogleMaps* Web.
b) Input Tourism Object.
c) Then right click on the red icon of the object that has been inputted and select the reading "what's here?".
d) Then the Latitude and Longitude values will appear on the tourist attraction.

3.2. Result of Data Analysis

The results of the data analysis of the Latitude and Longitude values and the results of the heuristic values in this study are:

Table 1. Data Analysis Results

Initial Location	Latitude (x)	Longitude (y)	Destination location	Latitude (x)	Longitude (y)	Heuristic
Down	2.198849	98,572106	Sipinsur	2.329149	98.881393	0.3356136743
Intersection 4	2.256828	98.687397	Sipinsur	2.329149	98.881393	0.2070099884
Simolap waterfall	2.270737	98.518591	Sipinsur	2.329149	98.881393	0.3674741527
The promise waterfall	2.339474	98.815052	Sipinsur	2.329149	98.881393	0.0671396597
Sibabo Waterfall	2.348579	98.426052	Sipinsur	2.329149	98.881393	0.4557553633
Intersection 4	2.256828	98.687397	Down	2.198849	98,572106	0.129048747
Simolap waterfall	2.270737	98.518591	Down	2.198849	98,572106	0.0896199738
The promise waterfall	2.339474	98.815052	Down	2.198849	98,572106	0.5067313538
Sibabo Waterfall	2.348579	98.426052	Down	2.198849	98,572106	0.2091670237
Sipinsur	2.329149	98.881393	Down	2.198849	98,572106	0.5152080632
Down	2.198849	98,572106	Simolap waterfall	2.270737	98.518591	0.0896184808
Intersection 4	2.256828	98.687397	Simolap waterfall	2.270737	98.518591	0.1693780561
Sipinsur	2.329149	98.881393	Simolap waterfall	2.270737	98.518591	0.3674741527
The promise waterfall	2.339474	98.815052	Simolap waterfall	2.270737	98.518591	0.3043253189
Sibabo Waterfall	2.348579	98.426052	Simolap waterfall	2.270737	98.518591	0.3823982675
Down	2.198849	98,572106	The promise waterfall	2.339474	98.815052	0.2807100809
Intersection 4	2.256828	98.687397	The promise waterfall	2.339474	98.815052	0.1520728783
Simolap waterfall	2.270737	98.518591	The promise waterfall	2.339474	98.815052	0.3043253189
Sipinsur	2.329149	98.881393	The promise waterfall	2.339474	98.815052	0.0663410001
Sibabo Waterfall	2.348579	98.426052	The promise waterfall	2.339474	98.815052	0.38910654199
Down	2.198849	98,572106	Sibabo Waterfall	2.348579	98.426052	0.2091670237
Intersection 4	2.256828	98.687397	Sibabo Waterfall	2.348579	98.426052	0.2769755495
Simolap waterfall	2.270737	98.518591	Sibabo Waterfall	2.348579	98.426052	0.0925389999
The promise waterfall	2.339474	98.815052	Sibabo Waterfall	2.348579	98.426052	0.38910654199
Sipinsur	2.329149	98.881393	Sibabo Waterfall	2.348579	98.426052	0.4557553633

3.3 Testing

Testing is an advanced stage after data analysis is carried out. Testing is carried out with the aim of proving that the system being built has been running well. Tests are carried out on the *Steepest Ascent Hill Climbing* algorithm to determine the shortest *mobile* -based route by implementing the results of the shortest distance and processing time in the algorithm. There are 5 origin and destination points provided. in Figure 1

Figure 1. Testing the SAHC Algorithm Process

At this testing stage the user selects the starting location and desired destination then press the process button to search for the shortest route, the total distance, time and the graph / route that will be displayed using the *Steepest Ascent Hill Climbing* Algorithm as shown in Figure 1. Based on Figure 2 it is known that from Sipinsur Geosite (initial location) to Simolap Waterfall (destination location) the result of the shortest route traversed is Sipinsur Geosite ➔intersection 4 ➔Simolap Waterfall, with a total distance of 51 km and a time of 1 hour 34 minutes. In figure 2.

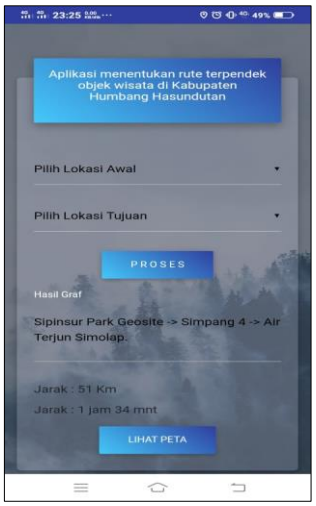

Figure 2. Results of the Shortest Route

Table 2. Name of Tourism Object in Humbang Hasundutan Regency

Point Code	Point Name
A	Incitement
B	Simolap Waterfall
C	Sibabo Waterfall
D	Intersection 4
E	Promise Falls
F	Sipinsur Geosite

3.4. Manual calculation of the Steepest Ascent Hill Climbing Algorithm

In this test, the results of the manual calculation of the *Steepest Ascent Hill Climbing* algorithm will be seen , whether it is in accordance with the System Implementation. The manual calculation of the *Steepest Ascent Hill Climbing* algorithm is as follows:

Stage 1:

The test system to be sought is the closest route with a manual count from *node* F to *node* B in Figure 1.

Stage 2:

Get heuristic values using the coordinates of Longitude and Latitude on *Google Maps* and then calculated using the equation as shown below:

$$H(n) = \sqrt{(Xorigin - Xdestination)^2 + (Yorigin - Ydestination)^2} \quad (2)$$

Following are the results of calculations to get the heuristic value h (n) which can be seen in Table 3 below:

Table 3. Manual Calculation of the *Steepest Ascent Hill Climbing* Algorithm

Node Origin	Latitude x	Longitude y	*Node* destination	Latitude X	Longitude Y	Heuristic Value
Down	2.198849	98,572106	Simolap waterfall	2.270737	98.518591	0.0896184808
3-way junction	2.256828	98.687397	Simolap waterfall	2.270737	98.518591	0.1693780561
Sipinsur	2.329149	98.881393	Simolap waterfall	2.270737	98.518591	0.3674741527
The promise waterfall	2.339474	98.815052	Simolap waterfall	2.270737	98.518591	0.3043253189
Sibabo Waterfall	2.348579	98.426052	Simolap waterfall	2.270737	98.518591	0.3823982675

Stage 3:
Starting from *the* initial *node* F. Select all *nodes* connected to *the* initial *node* F, namely *nodes* E and D as shown in Figure 1, note that the heuristic value of each *node* is :
D : 0.1693780516
E : 0.3043253189
Select the *node* with the smallest heuristic value, namely *node* D. Then h (d) = 0.2769755495 *node* D becomes the *current node* (see Figure 3)

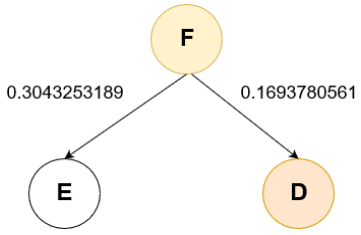

Figure 3. *N ode* D M enjadi *Current Node*

Stage 4:
Starting from the *current node* = D. Select all *nodes* connected to *node* D, namely *nodes* A and B, based on the calculations in table (4) it is known that the heuristic value of each *node* is:
A : 0.2091670237
B : 0
Due to the *current node* B contained heuristic value *Nod* e B = 0 and *node* B is the goal. Then the results of the search process stop looking at Figure (3) (see Figure 4).

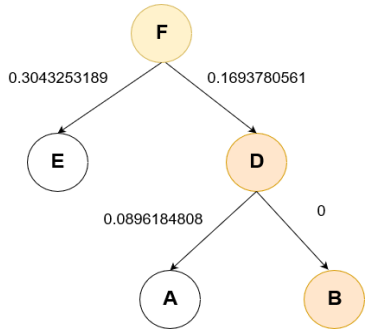

Figure 4. Stop Search Results

Based on the results of testing the manual calculation process using the *Steepest Ascent Hill Climbing* algorithm which is shown in Figure 3, the results of the shortest route from Sipinsur Geosite (F) to Simolap Waterfall (B) is F ➔ D ➔ B (Sipinsur GeoSite - intersection 4 - Simolap waterfall) the total distance is 51 km and the time is 1 hour 34 minutes. So that the test results of the *Steepest Ascent Hill Climbing* algorithm process with the system in accordance with the manual calculation process of the *Steepest Ascent Hill Climbing* algorithm (see Figure 3 and Table 3).

4. Conclusion

Based on the results of application of algorithms *Steepest A scent Hill Climbing* (Sahc) To search based Shortest These *Mobile* in Kabu patent Humbang Hasundutan. So it can be concluded that the search for the shortest route based on *M obile* can be solved using

the *Steepest Ascent Hill Climbing* algorithm . In the manual calculation process using the *Steepest Ascent Hill Climbing* algorithm at the node from Humbang there is a heuristic value of 0.0896184808, at the node from the intersection there is a heuristic value of 0.1693780561, at the origin node of Sipinsur there is a heuristic value of 0.367474152, at the node from which the waterfall promises a heuristic value amounting to 0.3043253189, and the last one at the node from which the sibabo waterfall has a heuristic value of 0.3823982675. Then the result of the shortest route from Sipinsur Geosite (F) to Simolap Waterfall (B) is F ➔D ➔B (Sipinsur GeoSite - intersection 4 - Simolap Waterfall) the total distance is 51 km and the time is 1 hour 34 minutes. So that the test results of the *Steepest Ascent Hill Climbing* algorithm process with the system in accordance with the manual calculation process of the *Steepest Ascent Hill Climbing* (SAHC) algorithm.

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