



Implementation of the Hill Climbing Method determines the shortest path to the Tanah Datar Regency tourist attraction

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Abstract

Searching is a method in the best search to find a solution. The heuristic search method is the most common and most widely used method in the process of finding the shortest path to find a solution. The process of completing searching using the Hill Climbing method, this method uses a heuristic function. The problem in this case is solving the problem of finding the best path to save costs and time in visiting recreational areas in the Batu Sangkar area, Tanah Datar Regency. The advantage of this algorithm is that all possible solutions will be obtained and then checked from the left side one by one, so that a solution with optimal results will be obtained. In its application, the Hill Climbing method uses Geographic Information Systems as a tool in making decisions, by collecting, examining, and analyzing information related to digital maps. with the combination of the Hill Climbing method and geographic information systems can produce an application that can overcome the problem of finding the shortest path.

Keywords: Searching, Heuristics, Hill Climbing Method

1. Introduction

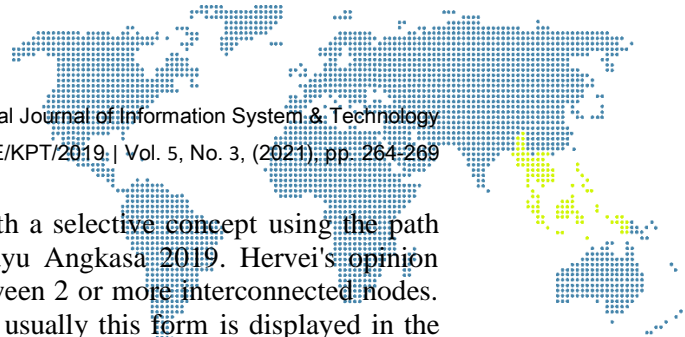
Tanah Datar Regency is a very strategic city and has many tourist attractions, so many tourists want to visit and surround all tourist attractions in Batusangkar City. The problem that often occurs is the lack of path and route information so that visitors find it difficult to find information on the shortest path and experience problems in the form of which recreational areas are visited first so that they are in line and can save time. Searching is the process of tracing a solution to a problem so as to find a goal, with the working principle of doing from the beginning of the state to complete the search for a path to obtain a solution or goal state (Harvei, 2018). According to other experts, Searching is part of a collection of data that is already available, a term we often hear as table look-up or store and retrieval information. In the search process, we often encounter errors, so we need a correct process and produce outputs to serve as a reference. The search method can be divided into 2 parts, namely:

- 1) Blind search / uninformed search (blind / un-informed search)
- 2) Heuristic search / with information (heuristic or informed search)

The discussion in this journal uses the concept of a heuristic search with information so as to make it easier for tourists. In completing a searching method, it has different characteristics, where each method has its own advantages and disadvantages. To get a good searching, there are four things that must be passed including:

- a) Defining the Problem Correctly
- b) Correct definition of the initial state and the resulting solution
- c) Analyze the problem and find the right solution technique.
- d) Selecting knowledge to solve problems and choosing a good technique.

To complete the best search process, we select nodes by using heuristic functions. Marked by the node / node that we use the rules to generate a replacement. A heuristic



function requires a strategy in solving problems with a selective concept using the path concept that has the greatest possible value in Bayu Angkasa 2019. Hervei's opinion (2018) The process of finding the shortest path between 2 or more interconnected nodes. Finding a shortest path is an optimization problem, usually this form is displayed in the form of a graph. shortest path is a graph form that is used to calculate the shortest route, also known as a weighted graph. The terms of this graph are given to the weight or value. The weight of the graph side is called the distance between cities, the process time in sending messages, the cost of shipping costs. Aldisen Juniansyah, Mesterjon 2019. There are 4 criteria in solving searching problems including: :

1. Completeness
2. Time complexity
3. Space complexity
4. Optimal

According to research by Aida and et al in 2017 the resulting method is different from other generation and testing methods. The location of the difference in the method of feedback and procedures in finding solutions by eliminating the melting space. So it can be concluded that the disbursement depends on the form of the rules that have been set so that it can return to the initial step. Sydriani Harahap 2016 research results The hill climbing algorithm can be used to solve case problems because the hill climbing method is part of several types of dept-first-search which can be used as a decision to search for paths with the aim of reducing costs to obtain goals, provided that the heuristic value uses the concept smallest value. There are two slightly different types of Hill Climbing, namely Simple Hill Climbing and Steepest-Ascent Hill Climbing (Hill Climbing by choosing the steepest slope). Simple hill climbing, initially the next state will be determined by comparing the current state with one successor. This comparison process starts from the left. If a new successor is found that is better than the current state, the successor will become the next state. While on the steepest ascent hill climbing in determining the next state, the current state is directly compared with all the successors that are nearby, so that the next state obtained is the best successor and is close to the expected optimization results. In addition, for simple hill climbing the order of operator use is very influential on the solution, while for the steepest ascent hill climbing the order of use of the operator has no effect on the solution. In terms of the advantages of simple hill climbing, efficiency in terms of memory. while the steepest ascent hill climbing requires a lot of memory in its storage.

The simple hill climbing algorithm is as follows: (1) Evaluation of the initial state, if the initial state is the same as the goal, then the process stops. If it is not the same as the goal then continue the process by making the initial state as the current state. (2) Perform the following steps until a solution is found or until no new operators can be used in the current state: a. Find an operator that has never been used in the current state and use that operator to create a new state. b. Evaluate the new state. i. If the new state is the destination, then the process stops. ii. If the new state is not the goal but the new state is better than the current state, then make the new state the current state. iii. If the new state is not better than the current state. TSP or Traveling Salesman Problem with simple hill climbing is a state space that discusses a possibility that occurs on a track. The basic concept used is to replace the position of cities that are close to each other or next to each other. The use of heuristics is to calculate the length of the path that occurs. The function of the operator is to change the position of 2 cities into 1 track.

Below is an explanation of the combination of 4 cities with each combination including:

- 1) Swap1,2 (swap the order of the position of the 1st city with the 2nd city).
- 2) Swap2,3 (swap the order of the position of the 2nd city with the 3rd city).
- 3) Swap3,4 (swap the order of the position of the 3rd city with the 4th city).
- 4) Swap4,1 (swap the order of the 4th city position with the 1st city).



- 5) Swap2,4 (swap the order of the position of the 2nd city with the 4th city).
- 6) Swap1,3 (swap the order of the position of the 1st city with the 3rd city).

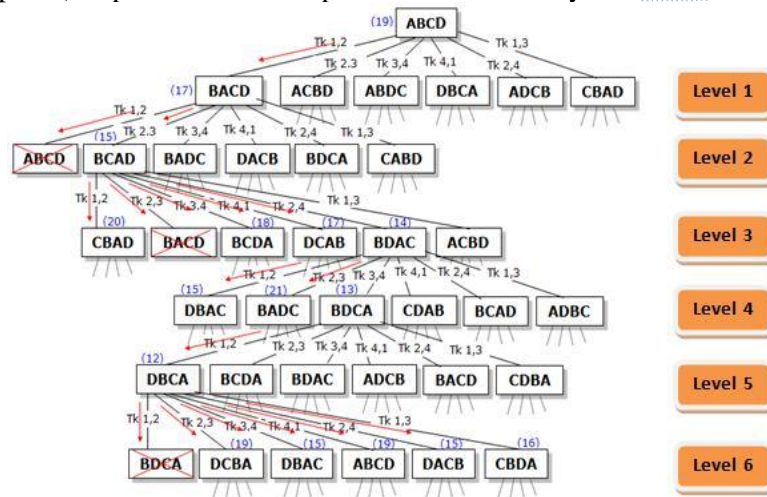


Figure 1. Stages of the 6 simple hill climbing method

The smallest path is a network form with a framework that has vertices, points leading to other vertices with a choice of paths to be traversed. The main purpose of this shortest path is to find the shortest path to the end point or destination. If the path is not known, it can use the concept of coordinates by calculating the smallest path that has been passed. Muchammad Abrori1 , Rike Nur Setiyani 2015. In the field of information technology, it discusses data, facts and various kinds of information such as images, numbers, signals, text analogues and others. Another part of the new data, a new fact and new information needed by the user or user, can be called information Aldisen Juniansyah, Mesterjon 2016. The results of the research by YI Ilwaru1, T. Sumah2, YALesnussa3, ZA Leleury 2017 stated that the shortest path was obtained by counting many travel time based on the distance from the city of origin to the city of destination. If there are many alternative paths, the more complicated the way to find the shortest path. The purpose of calculating this path is to minimize costs and time.

2. Research Methodology

This research is a qualitative research. Qualitative research method is a research method based on post-positivism philosophy used to examine the condition of natural objects where the researcher is the key instrument of data collection techniques carried out in a combined manner, data analysis is inductive or qualitative and the results of qualitative research emphasize meaning rather than generalization (Sugiyono, 2012). The steps in solving geographic information system cases to find the shortest path in this study include.

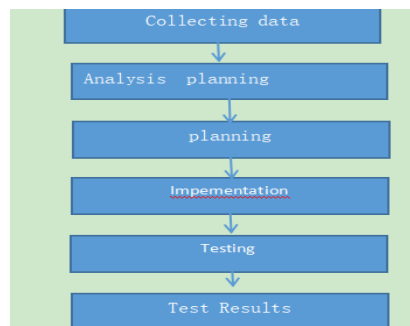
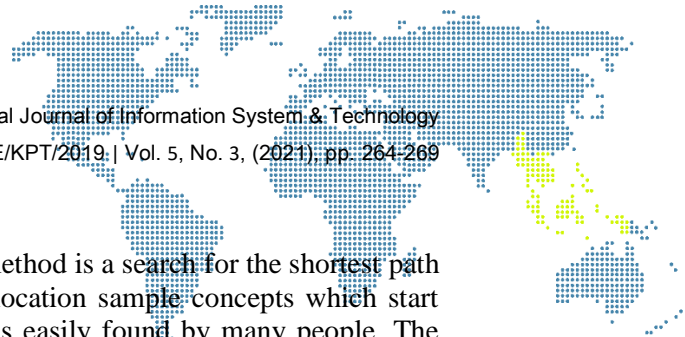


Figure 2. Case resolution steps



3. Result and Discussion

The implementation of the simple hill climbing method is a search for the shortest path in determining the location of tourism by using 6 location sample concepts which start with the initial node with a common location that is easily found by many people. The results displayed are the shortest path starting with the initial node - Benteng Van der Capellen - Cagar budaya batu batikam - Istana Basa Pagaruyung - Rumah gadang kampai nan panjang - Desa Pariangan - The last tourist spot is Danau Singkarak . Below is the itinerary.

Table 1. Itinerary

No.	Travel path	Mileage	Time required	Visiting time
1.	Benteng Van der Capellen-Cagar budaya batu batikam	4.9 km	12 minute	45 minute
2.	Cagar budaya batu batikam - Istana Basa Pagaruyung	8.8 km	17 minute	45 minute
3.	Istana Basa Pagaruyung - Desa Parianga	9.7 km	30 minute	45 minute
4.	Desa Pariangan - Tujuan Terakhir	14.3 km	33 minute	45 minute
	Amount	37,7 km	92 minute	180 minute

In the picture above, it describes the tourist route from the closest distance to the farthest route, the data obtained is in the form of the distance needed for each route to be traversed. The predicted visit time is 45 minutes at each tourist spot, the total distance needed to visit all the wizarding places is 37.7 Km and the time needed to visit all tourist attractions is 92 minutes with a visit time of 180 minutes. To predict the time needed to visit tourist attractions, you can estimate each distance traveled.

Table 2. Time Prediction

No	Travel path	Mileage
1.	2 Travel Path	13,7 km
2.	3 Travel Path	23,4 km
3.	4 Travel Path	37.7 km

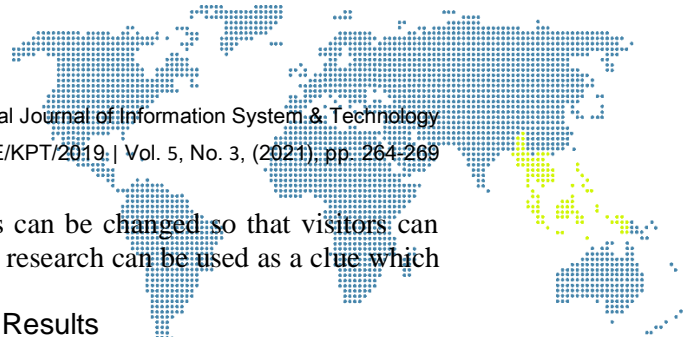
To obtain an accurate value, manual calculations are needed to compare the results of determining the shortest path using a simple hill climbing system. The initial process of manual calculation starts from 1. the initial start of the route and 4 tourist locations using the permutation concept. The process is as below:

$$n \cdot (n-1) \cdot (n-2) \cdot \dots \cdot 1 \tag{1}$$

Where in the testing process has been determined input as many as 6 Route locations to be visited, so that the search results become All the combinations used can be seen in the image below:



Figure 3. Combination



The results of the combination of 4 recreation areas can be changed so that visitors can access the location with the distance traveled, so this research can be used as a clue which way is the closest route.

Table 3. Permutation Results

No	The Resulting	Permutations
1	1234	53,8
2	1324	46,5
3	1243	52,3
4	1342	70,8
5	1423	60,8
6	1432	51,3



The result of the shortest route obtained is the route taken, namely the initial - Van der Capellen Fort - Batikam stone cultural heritage - Pagaruyung Basa Palace - Pariangan Village - The last tourist spot with the total route with the least value with a total distance of 52.83KM.

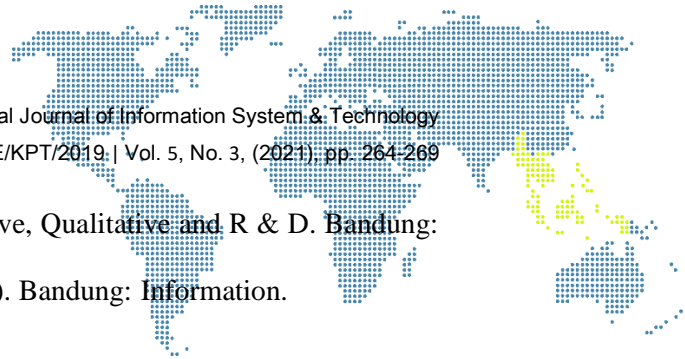
4. Conclusion

Based on the research results obtained, the geographic information system for finding the shortest route using the simple hill climbing method, the conclusions are:

- a) Determining the shortest path in the search for graphic information systems can be used as a digital reference that is very useful for tourists who want to visit a tourist location.
- b) The implementation of the simple hill climbing method is very effective in finding the shortest route for tourists who want to visit tourist attractions.
- c) The simple hill climbing method can be applied in determining the shortest path, so as to be able to solve problems because currently there is still a lack of user understanding in using digital applications.

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