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An Implementation of A* Algorithm to Tourism Destination

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***Abstract*—The tourist sector contributes significantly to the country's development and has a big potential capital. Therefore, it could as well contribute to innovations of communication and information technology. Development of the tourism sector should be based on technology development. The district of Bantul has a big variety of several important and tourism sights, which are spread all over the District with a wide range of different routes and locations. Therefore, it might be confusing for tourist to locate them. Based on this problem, the writer creates an information system which can be integrated in Google Maps as a visual media map including all sight-seeing spots completed with an application which efficiently recommends the shortest route using A* algorithm. From the result of the research conducted, the result of the browsing system is compared to manual calculation giving the same results.**

Keywords-tourism; shortest route; A* algorithm; google maps; web-based.

I. INTRODUCTION

As technology advances rapidly, technology is now able to adopt processes and ways of thinking like humans, namely artificial intelligence. Artificial intelligence is learning from systems that work specifically that looks smart by users [1]. Intelligent systems have a knowledge base as a place to store data and interface mechanisms to think to produce the proper output [2]. Without having the ability to reason well, humans with a myriad of experiences and knowledge will not be able to solve problems well. These problems can be solved by an application that can solve problems as needed. Thus, an application could act like a human being if it is equipped with knowledge and have the ability to reason.

The important thing in determining the success of an application based on artificial intelligence is success in searching and matching. Basically there are two search and tracking techniques used, namely blind search and guided search. In guided search there are several algorithms that can be used, one of which is the A* (A star) algorithm. This algorithm can solve problems optimally to determine the shortest path to a destination.

Algorithm A * can be used for *pathfinding*, which can solve problems optimally to determine the shortest path to a destination [3]. A* uses a heuristic function which is often also called `f(n)` which is the order in which points are visited first. This heuristic function actually symbolizes how well / possible that point is visited to reach the destination. A* will also minimize the total cost of the track, in the right conditions A* will provide the best solution in the optimal time. A* is a development of best-first search (BFS) that is used to find the shortest path.

Yogyakarta is known as a tourist destination, where various tourist attractions are offered in Yogyakarta. It is including attractions that are in the Bantul Regency region. Bantul is one of regions in Special Region of Yogyakarta province. Information on the way to a tourist spot is needed by tourists. Due to the lack of information on the road, tourists can get lost or the distance traveled further. The available road information is generally in the form of a map, but the map only provides information in the form of roads and street names, while the information needed is information on roads that must be passed to get to the destination with minimal travel distance. The number of tourist attractions in Yogyakarta, especially Bantul Regency can cause difficulties for tourists in choosing tourist attractions and determining the shortest tourist route that must be passed.

Therefore, by utilizing A*, an application will be built that can help tourists in searching for the shortest route to visit Bantul. This application will be made based on the web so that it can be utilized by a wider range of people everywhere at any time as long as it is connected to the internet. Graphical visualization of this application uses Google Maps so that it can better understand the route that it will run effectively. The common name for the system is the Geographic Information System (GIS) [4]. Geographic Information Systems are computer systems that are used to enter, store, examine, integrate, manipulate, analyze, and display data relating to positions on the earth's surface [5].

II. PURPOSE

In accordance with introduction above, the objectives of this study are:

1) Designing a web-based system that can act as an effective and efficient means of promoting the tourism sector.

2) Implement the A * method to determine the shortest route for tourist destinations.

III. METHODOLOGY

A. Preliminary Study

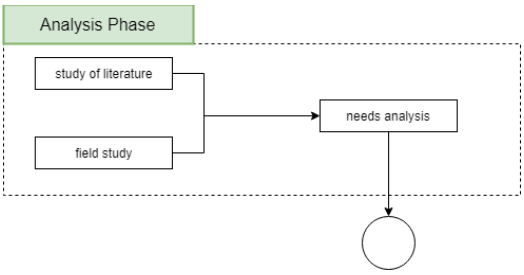
Before developing the system, the author first studied several factors that are potential to be developed in the tourism sector. One of the supporting factors for the development of the tourism sector is tourism travel which is supported by guiding information both information about attractions and trips that will be taken by tourists.

As one of the contributors to the country's foreign exchange, the tourism sector has the potential to continue to grow in line with the development of communication and information technology. The development of the tourism sector must be supported by the use of technologies such as the use of information and communication technology applications. As one example of a system recommendation for Indonesian tourism promotion is by implementing an information system and web-based application.

Information systems and web-based applications are expected to be able to develop marketing and promotion of tourism at home and abroad through increasing the effectiveness of integrated tourism marketing and promotion based on information and communication technology, and responsive to the market, so that in the future the Indonesian tourism sector has high competitiveness and utilization of appropriate technology.

B. Research Design

Research design is a stage or description that will be carried out in conducting research. The stages that will be carried out in this research can be seen in Fig. 3.



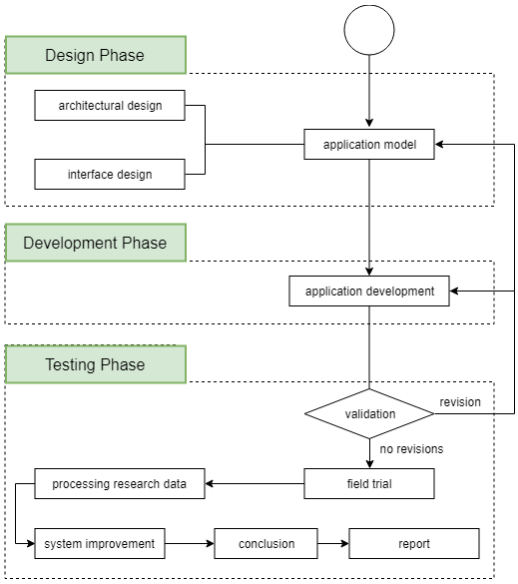


Figure 1. Research Design

C. System Development Requirements

In system development, the author uses a device computers with the following specifications:

1) Intel Corei3-380M 2.53GHz CPU
2) 2GB Memory/RAM
3) Intel Corei3 VGA Graphic.

While the software is:

1) Operating System Windows XP Service Pack 2, Windows Seven
2) Google Maps API
3) XAMPP 1.7.0 (Apache Web Server, PHP)
4) MySQL Database
5) Net Beans 7.0.1
6) Macromedia Dreamweaver 8
7) Mozilla Firefox 22.0 Web Browser.

D. System Development Methods

In general, the purpose of information system development is to provide information storage, reduce costs and save time, improve control, encourage growth, and increase productivity. The system development method used in designing this information system uses the Waterfall Model. The reason the author uses the waterfall method is because this method has steps that are clear, real and practical. Each stage must be completed in advance to avoid repetition in stages so that the system development carried out can obtain the desired results.

Waterfall method is a classic model that is structured in developing software [6]. The phase of the waterfall model is like Fig. 2:

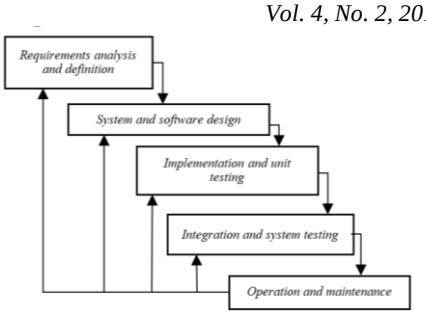


Figure 2. Waterfall Model

- Requirements analysis and definition: collect complete needs and then analyze and define needs that must be met by the program to be built.
- System and software design: design is done after the needs have been completely collected.
- Implementation and unit testing: program design is translated into codes using predetermined programming languages. Programs that are built are directly tested each unit.
- Integration and system testing: uniting program units then testing as a whole (system testing).
- Operation and maintenance: operate programs in their environment and carry out maintenance.

E. Data Collection

1) Primary data sources (interviews, observations)

The interview method is a question and answer that is carried out by the compiler with various parties where the source of the information needed is available. In this technical interview the compiler acts as an interviewer and interviews officials, owners, employees and ranks in the agencies and companies concerned. This method is a technique of collecting data by means of direct survey authors to the place of research, namely to find out which system is running for a reference to making a better system.

2) Secondary data source (documentation)

Documentation methods are applied to collect data and prepare various forms of documents such as data distribution, as well as documentary archives. In this study a descriptive method was used, namely a method that seeks to collect, present, and analyze so that it can provide a fairly clear picture of the object under study. The method used in data collection is the literature method, namely data collection techniques by studying books, notes and other literature that can be used as references relating to data in the form of reports.

IV. Result and Discussion

A. The Test Results Search for the Shortest Route

In the system testing phase, it will be exemplified by finding the shortest route between two objects with each iteration, as follows:

1) Example search route I (Kids Fun to Panggung Krapyak)

The original destination is Kids Fun, and the destination is the Panggung Krapyak. Kids Fun is included in the closed list and Kids Fun as a point now

TABLE I. CLOSED LIST I (KIDS FUN-PANGGUNG KRAPYAK)

Closed list
Kids Fun
Distance = 0 km

Iteration I.

- Generate successors from Kids Fun that are not on the closed list. And the successor of Kids Fun is the Museum Wayang Kekayon, Balong Water Park.
- After knowing the successor, distance comparison can be made by accumulating actual distance with heuristic distance, heuristic distance serves as a determinant of decision-making options besides the actual distance parameter.

TABLE II. COMPARATIVE TABLE FOR F(N) OF SUCCESSOR KIDS FUN

Destination	g(n)	h(n)	f(n)
Museum Wayang Kekayon	3,913	9.8	13,713
Balong Water Park	5,745	8,408	14,153

The next destination chosen was Museum Wayang Kekayon, because it has the smallest `f(n)`.

Distance Kids Fun to Museum Wayang Kekayon = 3,913 km

Total distance = 0 + 3,913 = 3,913 km

Current point = Museum Wayang Kekayon.

- Add Museum Wayang Kekayon to the closed list.

TABLE III. CLOSED LIST II (KIDS FUN-PANGGUNG KRAPYAK)

Closed list
Kids Fun
Museum Wayang Kekayon
Distance = 3.913 km

Because Panggung Krapyak is not yet in the closed list, then proceed to the next iteration.

Figure 3. The results of the iteration I search for the shortest route Kids Fun-Panggung Krapyak

Iteration II.

- Generate successor from Museum Wayang Kekayon that is not on the closed list. The successor of Museum Wayang Kekayon is Makam Dinasti Mataram Kotagede, Balong Water Park, Ngoto Air Force Monument, Panggung Krapyak, Goa Payaman.
- Calculate f(n)

TABLE IV. COMPARATIVE TABLE FOR F(N) OF SUCCESSOR MUSEUM WAYANG KEKAYON

Destination	g(n)	h(n)	f(n)
Makam Dinasti Mataram Kotagede	8.02	4,364	12,384
Balong Water Park	8,889	8,408	17,297
Ngoto Air Force Monument	10,519	4,353	14,872
Panggung Krapyak	13,713	0	13,713
Goa Payaman	27.09	14,121	41,211

The next destination chosen is Makam Dinasti Mataram Kotagede, because it has the smallest f(n).

Distance Museum Wayang Kekayon to Makam Dinasti Mataram Kotagede = 4,107 km

Total distance = 3.913 + 4,107 = 8,02 km

Current point = Makam Dinasti Mataram Kotagede.

- Add Makam Dinasti Mataram Kotagede to the closed list.

TABLE V. CLOSED LIST III (KIDS FUN-PANGGUNG KRAPYAK)

Closed list
Kids Fun
Museum Wayang Kekayon
Makam Dinasti Mataram Kotagede
Distance = 8,02 km

Because Panggung Krapyak is not yet in the closed list, then proceed to the next iteration.

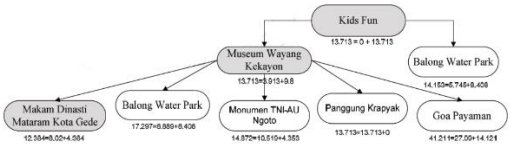


Figure 4. The results of the iteration II search for the shortest route Kids Fun-Panggung Krapyak

Iteration III.

- Generate successor from Makam Dinasti Mataram Kotagede that is not in the closed list. The successor of Makam Dinasti Mataram Kotagede is Culinary Center of Sate Klathak, Ngoto Air Force Monument, Panggung Krapyak.
- Calculate f(n)

TABLE VI. COMPARATIVE TABLE FOR F(N) OF SUCCESSOR MAKAM DINASTI MATARAM KOTAGEDE

Destination	g(n)	h(n)	f(n)
Culinary Center of Sate Klathak	13,601	8.565	22,166
Ngoto Air Force Monument	11,423	4,353	15,776
Krapyak stage	12,384	0	12,384

Panggung Krapyak was chosen as the next point because it has the smallest f(n).

Distance Makam Dinasti Mataram Kotagede to Panggung Krapyak = 4,364 km

Total distance = 8,02 + 4,364 = 12,384 km

Current point = Panggung Krapyak.

- Add Panggung Krapyak to the closed list.

TABLE VII. CLOSED LIST IV (KIDS FUN-PANGGUNG KRAPYAK)

Closed list
Kids Fun
Museum Wayang Kekayon
Makam Dinasti Mataram Kotagede
Panggung Krapyak
Distance = 12,384 km

Because Panggung Krapyak is already on the closed list, the search is stopped.

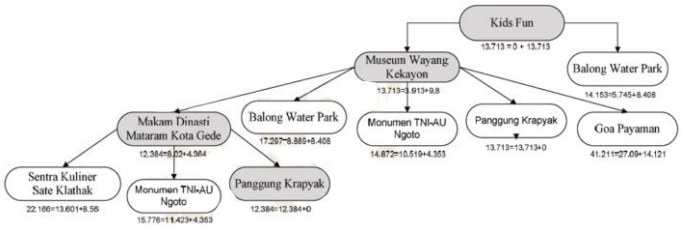


Figure 5. The results of the iteration III search for the shortest route Kids Fun-Panggung Krapyak

Thus the route is obtained as follows: Kids Fun -> Museum Wayang Kekayon -> Makam Dinasti Mataram Kotagede -> Panggung Krapyak, with a total distance traveled as far as 12,384 km.

2) Example search route II (Samas Beach to Pandansimo Beach)

The original destination is Samas Beach, and the destination is Pandansimo Beach. Samas Beach is on the closed list and Samas beach is the point now

TABLE VIII. CLOSED LIST I (SAMAS BEACH – PANDANSIMO BEACH)

Closed list
Samas Beach
Distance = 0 km

Iteration I.

- Generate successors from Samas beach which is not in the closed list. The successors of Samas Beach are Goa Japan, Gereja Hati Kudus Ganjuran, Selo Gilang Site, Goa Cemara Beach, Mangrove Forest of the Opak River.
- After knowing the successor, distance comparison can be made by accumulating actual distance with heuristic distance.

TABLE IX. COMPARATIVE TABLE FOR F(N) OF SUCCESSOR SAMAS BEACH

Destination	g(n)	h(n)	f(n)
Goa Japan	12,875	18,598	31,473
Gereja Hati Kudus Ganjuran	12,261	16,604	28,865
Selo Gilang site	13.7	16.01	29.71
Goa Cemara Beach	0.885	7,349	8,234
Opak River Mangrove Forest	3.41	10,326	13,736

The next destination chosen was Goa Cemara beach, because it has the smallest `f(n)`.

The distance from Samas beach to Goa Cemara beach = 0,885 km

Total distance = 0 + 0,885 = 0,885 km

Current point = Goa Cemara beach.

- Add Goa Cemara Beach to the closed list.

TABLE X. CLOSED LIST II (SAMAS BEACH – PANDANSIMO BEACH)

Closed list
Samas Beach
Goa Cemara Beach
Distance = 0,885 km

Because Pandansimo Beach is not yet in the closed list, then proceed to the next iteration.

Figure 6. The results of the iteration I search for the shortest route Samas Beach-Pandansimo Beach

Iteration II.

- Generate successor from Goa Cemara Beach that is not on the closed list. The successor of Goa Cemara Beach is Kuwaru Beach, Mangrove River of the Opak River.
- Calculate `f(n)`

TABLE XI. COMPARATIVE TABLE FOR F(N) OF SUCCESSOR GOA CEMARA BEACH

Destination	g(n)	h(n)	f(n)
Kuwaru Beach	6,924	2,412	9,336
Opak River Mangrove Forest	5,089	10,326	15,415

The next destination chosen was Kuwaru Beach, because it has the smallest `f(n)`.

Distance Goa Cemara Beach to Kuwaru Beach = 6,039 km

Total distance = 0,885 + 6,039 = 6,924 km

Current point = Kuwaru Beach.

- Add Kuwaru Beach to the closed list.

TABLE XII. CLOSED LIST III (SAMAS BEACH – PANDANSIMO BEACH)

Closed list
Samas Beach
Goa Cemara Beach
Kuwaru Beach
Distance = 6,924 km

Because Pandansimo Beach not yet in the closed list, then proceed to the next iteration.

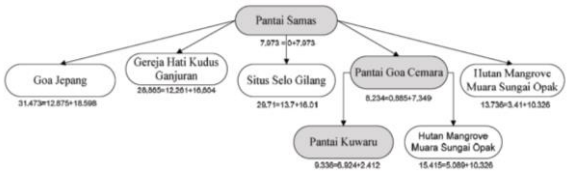


Figure 7. The results of the iteration I search for the shortest route Samas Beach-Pandansimo Beach

Iteration III.

- Generate successor from Kuwaru Beach that is not on the closed list. The successor of Kuwaru Beach is Baru Beach and Sate Nggeci.
- Calculate f(n)

TABLE XIII. COMPARATIVE TABLE FOR F(N) OF SUCCESSOR KUWARU BEACH

Destination	g(n)	h(n)	f(n)
Baru Beach	9,081	0,276	9,357
Sate Nggeci	20,435	13,7	34,135

Baru Beach was chosen as the next point because it has the smallest f(n).

Distance Kuwaru Beach to Baru beach = 2,157 km

Total distance = 6,924 + 2,157 = 9,081 km

Current point = Baru Beach.

- Add Baru Beach to the closed list.

TABLE XIV. CLOSED LIST IV (SAMAS BEACH – PANDANSIMO BEACH)

Closed list
Samas Beach
Goa Cemara Beach
Kuwaru Beach
Baru Beach
Distance = 9,081 km

Because Pandansimo Beach is not yet in the closed list, then proceed to the next iteration.

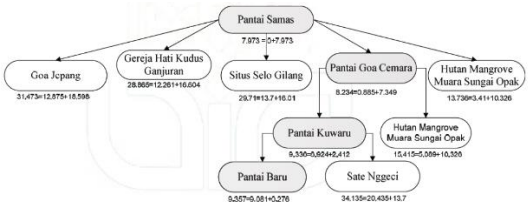


Figure 8. The results of the iteration I search for the shortest route Samas Beach-Pandansimo Beach

Iteration IV.

- Generate successor from Baru Beach that is not on the closed list. The successor of Baru Beach is Pandansimo Beach.
- Calculate f(n)

TABLE XV. COMPARATIVE TABLE FOR F(N) OF SUCCESSOR BARU BEACH

Destination	g(n)	h(n)	f(n)
Pandansimo Beach	9,357	0	9,357

Pandansimo Beach was chosen as the next point because there was no other successor.

Distance Baru Beach to Pandansimo Beach = 0,276 km

Total distance = 9,081 + 0,276 = 9,357 km

Current point = Pandansimo Beach.

- Add Pandansimo beach to the closed list.

TABLE XVI. CLOSED LIST V (SAMAS BEACH – PANDANSIMO BEACH)

Closed list
Samas Beach
Goa Cemara Beach
Kuwaru Beach
Baru Beach
Pandansimo Beach
Distance = 9,357 km

Because Pandansimo Beach is already in the closed list, the iteration is stopped

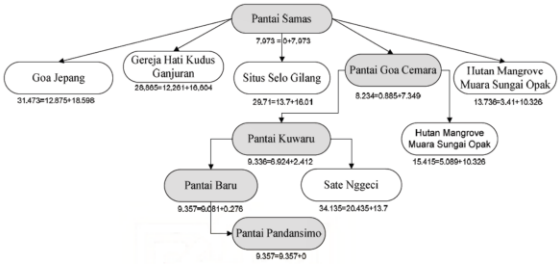


Figure 9. The results of the iteration I search for the shortest route Samas Beach - Pandansimo Beach

Thus the following routes are obtained: Samas Beach -> Goa Cemara Beach -> Kuwaru Beach -> Baru Beach -> Pandasimo Beach, with a total distance traveled as far as 9,357 kilometer.

B. System Test Result

This system testing involved 15 respondents from competent circles in the tourism sector. Testing is done on the interface and system access in Table XVII, while the functional test results are in Table XVIII, and real time testing can be seen in Table XIX.

TABLE XVII. RESULTS OF TESTING INTERFACES AND ACCESSING

No.	Statement	SS	S	TS	STS
1.	The content on the system is quite simple and easy to understand, making it easier for users	7	8	-	-
2.	The menu on the system is easy to understand and familiar with users	5	10	-	-
3.	Navigation on the system is functioning properly	10	5	-	-
4.	Error messages make it easy to use the system	6	9	-	-
5.	Time is relatively fast loading	7	8	-	-
Total		35	40	-	-

Information:
SS : Strongly Agree **TS** : Disagree
S : Agree **STS** : Strongly Disagree

TABLE XVIII. RESULTS OF TESTING SYSTEM FUNCTIONALITY

No.	Statement	Yes	Not
1.	The system can display a map preview clearly	14	1
2.	The system is able to provide information about the tourism sector	15	-
3.	The system is able to find the shortest route and display route details	15	-
4.	The system is able to provide search results according to the keywords entered	15	-
5.	The system is able to interact and provide feedback to users	14	1
Total		73	2

TABLE XIX. REAL TIME TEST RESULTS

No.	Statement	Yes	Not
1.	Is the shortest route produced by the system an efficient route?	12	2

C. Discussion

The results of testing interfaces and accesses in Table XVII show that 46.7% stated strongly agree, 53.3% agreed, and no one expressed disagree or strongly disagreed. The results of testing the system functionality in Table XVIII show that 97.3% stated yes, and 2.7% stated no. The real time test results in Table XIX show that 80% stated yes and 13.3% no.

From the results of testing the interface and accessing it can be concluded that most users state the interface and access according to the application. Whereas from the results of testing the system based on the functional system, it was concluded that most users stated that the functional function was good.

From real time results, 13.3% stated that the route generated by the system was not yet an efficient route, because there were several routes that had not represented that the recommended route was the shortest route, 6.7% decided not to carry out trials, this because the respondents have not succeeded in testing according to the criteria stated in the test questionnaire, so that respondents feel they do not have the authority to assess the questionnaire points that are not in the business process of the institution.

Based on the description that has been explained, it can be concluded that the application of determining the shortest route of tourism deviation that is integrated with the tourism information system is feasible to use, but further development is needed in order to obtain more optimal results so that it is more effective and provides an applicable knowledge treasure especially in tourism sector.

V. CONCLUSION

Based on the research that has been done by the author regarding the design and implementation of the system to provide recommendations for the shortest route of travel and information about the tourism sector in Bantul Regency, the following conclusions can be drawn:

1) Successfully designed a web-based information system application that is able to present data relating to the tourism sector.

2) The A * algorithm was successfully implemented in the process of calculating distances to obtain the shortest route from an object to another object, and to display route details.

3) Successfully visualize the distribution map of attractions with Google Maps.

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