

The Implementation Of Bellman-Ford Algorithm In Rembang Tourism Mobile Application As A Tourism Information Media

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Abstract. Tourism is one of the methods to publish the beauty of nature or the uniqueness of culture in a region that spreads from the coast up to the mountains. The distribution and the access to tourist attractions require mobile application. In creating the application, Bellman – Ford algorithm was used to get the shortest route. The algorithm was the Bellman – Ford algorithm which was used to calculate the shortest distance to the tourist attraction on the weighted graph. Testing the functionality of the application used a black box. The results showed that functions on the mobile application could run well. The compatibility testing showed 100% compatibility with a number of Android devices. In addition, the usability testing showed that the application was appropriate to use with percentage by 82.7% of the 30 respondents. The "Rembang tourism" mobile application can be used by users of information about tourism.

Keywords: Shortest distance, Bellman – Ford, Tourism

Abstrak. Kepariwisata adalah salah satu metode untuk mengenalkan keindahan alam atau keunikan budaya pada suatu daerah yang terbentang dari pesisir pantai hingga ke pegunungan. Pendistribusian dan pengaksesan objek wisata membutuhkan aplikasi mobile. Dalam membuat aplikasi, algoritma Bellman – Ford digunakan untuk mendapatkan rute terpendek. Algoritma Bellman-Ford ini digunakan untuk menghitung jarak terdekat ke objek wisata pada graph berbobot. Pengujian fungsionalitas aplikasi menggunakan black box. Hasilnya menunjukkan fungsi pada aplikasi mobile dapat berjalan dengan baik. Pengujian kompatibilitas menunjukkan kompatibel 100% dengan sejumlah perangkat Android. Selain itu, pengujian kegunaan menunjukkan bahwa aplikasi tersebut sesuai untuk digunakan dengan persentase 82,7% dari 30 responden. Aplikasi mobile "Pariwisata Rembang" dapat digunakan oleh pengguna informasi pariwisata.

Kata Kunci: Jarak terpendek, Bellman-Ford, Pariwisata

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1. Introduction

Tourism is a very important sector for the development of a region, tourism is one means of promotion to introduce the beauty of nature and the uniqueness of the culture in the area.

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Management of tourism attractions could attract many tourists. Therefore, it could become regional income.

Rembang Regency is an area in Central Java Province, which is geographically located in the northeastern of Central Java Province and is passed by the North Java Coastal Road (Pantura) at these following coordinates: $111^{\circ}00'$ – $111^{\circ}30'$ east and $6^{\circ}30'$ – $7^{\circ}6''$ south (<http://rembangkab.go.id/>). Based on its geographical location, Rembang Regency has the potential of various tourism destinations, including natural tourist destinations and beaches. The tourist attractions in Rembang Regency is evenly distributed throughout the region [3]. To reach the location of tourist objects, tourists who come to visit require information on tourist routes to assist their trip plan to the destination and return to the place of origin or their hotels [5].

Determining the shortest route to the tourist destination can uses a number of algorithms, including Dijkstra's algorithm, Bellman – Ford algorithm, and Floyd – Warshall algorithm. Each algorithm resolves the shortest distance with its own their respective criteria.

Based on research conducted by [9] , media used to promote tourism destinations in Rembang Regency are mass media and electronics. However, the promotional media is not sufficient because it only displays conventional maps for tourist destination and does not display specific locations and the closest distance to tourist attractions. Therefore, a web which contains tourism recommendations was created in this study using the Dijkstra algorithm.

According to [4] ,this study compared Dijkstra algorithm and Floyd –Warshall to determine the shortest route from stations / terminals to tourist attractions in Batang. There were 27 shortest routes, 25 same routes and 2 different routes. However, Dijksta's algorithm is more appropriate.

Masyunita (2016) conducted a research to facilitate new students in finding the locations to get to their destination in North Sumatra University. The android application was created by applying the Bellman – Ford algorithm to find the shortest route with a success rate of 84%.

The Bellman-Ford algorithm functions similarly as Dijkstra algorithm. However, its process takes a long time. Although it takes a long time, the Bellman – Ford algorithm can provide more accurate results [7].

The rapid development of technology is not limited to its usage as a medium of communication. It is also used as information media. One of them is an Android-based smartphone [2]. Android is a Linux – based mobile device that includes operating systems, middleware and applications [8]. Based on the brief explanation, the Bellman – Ford Algorithm was used in this study in the Rembang tourism application as a tourism information media.

This study aims to implement the Bellman – Ford algorithm in determining the shortest route to tourism destinations in Rembang Regency and its feasibility based on limited scale test results. The results of the study can be useful for the community to help travelers to find the location of the tourism destinations in Rembang more easily with their location map tourism attractions. In addition, it also helps travelers find the shortest route to save time and tourist expenditures.

2. Method

This study applying for Research and Development design by [10] to create mobile application for tourism and to test its effectiveness. Tourism attractions in Rembang Regency spread throughout the coastal area and the hilly areas (see Figure 1).

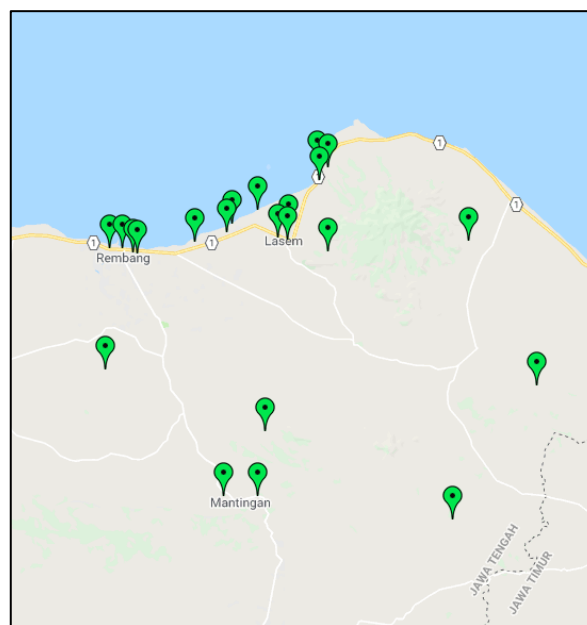


Figure 1 Map of tourist location distribution

We then implement Bellman-Ford algorithm to search the shortest route to tourist attractions in Rembang Regency. First, we determine the starting point and list all vertices and edges (edges), from the starting point marked with (0) to another point, infinity (∞). Then calculate distance of all vertices from the starting point. If the distance V , is smaller than the distance $U + \text{weight } UV$ then the distance V , is filled with a distance $U + \text{weight } UV$ then do it until all vertices are passed path from the ancient boat site of Punjul Harjo (node 6) to the Watu Layar (node 10) tourist attraction using the Bellman-Ford algorithm (see Figure 2).

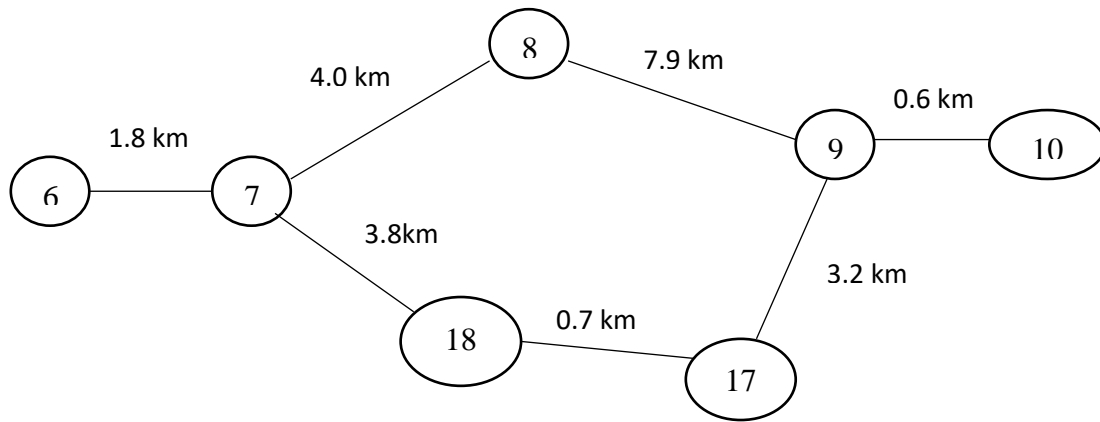


Figure 2 Graph of path from Punjul Harjo to WatuLayar

To start the calculation of the Bellman-Ford algorithm the initial node is given a value of 0 and the other nodes are given a value of ∞ (see Table 1).

Table 1 Initial calculation of the Bellman-Ford algorithm

Iteration	6	7	8	9	10	17	18
0	0	∞	∞	∞	∞	∞	∞
1							
2							
3							
4							

Then apply the Bellman-Ford algorithm (1) to calculate the distance

$$M[i, v] = \min(M[i-1, v], (M[i-1, n] + C_{vn})) \quad (1)$$

where i = iteration, v = vertex / node, n = node neighbor, C = cost.

In the first iteration the value of each node is still ∞ will be added to the cost or weight of the distance traveled from the initial node to the destination node.

$$\begin{aligned}
 M[1, 7] &= \min(M[0, 7], (M[0, 6] + C_{67})) \\
 &= \min(\infty, (0 + 1.8)) \\
 &= \min(\infty, 1.8) \\
 &= 1.8 \text{ km}
 \end{aligned}$$

The result is shown in Table 2.

Table 2 Result on 1st iteration

Iteration	6	7	8	9	10	17	18
0	0	∞	∞	∞	∞	∞	∞
1	0	1,8 / 6	∞	∞	∞	∞	∞
2							
3							
4							
5							

Since the value of the neighbor node is still ∞ (see table 2), then the second iteration calculation is continued.

$$\begin{aligned}
 M[2,8] &= \text{Min}(M[1,8], (M[1,7] + C_{78})) \\
 &= \text{Min}(\infty, (1.8 + 4.0)) \\
 &= \text{Min}(\infty, 5.8) \\
 &= 5.8 \text{ km}
 \end{aligned}$$

$$\begin{aligned}
 M[2,18] &= \text{Min}(M[1,18], (M[1,7] + C_{7,18})) \\
 &= \text{Min}(\infty, (1.8 + 3.8)) \\
 &= \text{Min}(\infty, 5.6)
 \end{aligned}$$

The process continues until the initial distance between nodes = 6 to the destination node = 10 is obtained, as shown in Table 3. The distance from node 6 to node 10 is 10,1 km with route from 6 – 7 – 18 – 17 – 9 – 10 .

Table 3 Complete calculation of all nodes

Iteration	6	7	8	9	10	17	18
0	0	∞	∞	∞	∞	∞	∞
1	0	1,8 / 6	∞	∞	∞	∞	∞
2	0	1,8 / 6	5,8 / 7	∞	∞	∞	5,6 / 7
3	0	1,8 / 6	5,8 / 7	13,7 / 8	∞	6,3 / 18	5,6 / 7
4	0	1,8 / 6	5,8 / 7	9,5 / 17	14,3 / 9	6,3 / 18	5,6 / 7
5	0	1,8 / 6	5,8 / 7	9,5 / 17	10,1 / 9	6,3 / 18	5,6 / 7

3. Results And Discussion

The testing stage was conducted to test the quality of software that has been developed based ISO 25010 standard from the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). Therefore, this application is appropriate for end users.

ISO 25010 specifies these eight following characteristics: functional suitability, reliability, performance, efficiency, usability, maintainability, security, compatibility, and portability. Wagner (2013: 23) used these following characteristics: functional suitability, usability, compatibility, and performance efficiency. The selection of the four characteristics is relevant with David (2011) stating that testing mobile device can use these four characteristics.

The validation of the mobile application was performed by presenting several experts to assess a product to figure out the strengths and weaknesses of the product [10]. In this study, the validation was carried out by a validator from the Rembang Regency Culture and Tourism Office.

In the application revision stage, improvements were made based on the test results and expert input during application validation. To validate user response, a number of respondents were chosen as users to use the application to find out the response of tourists to the application. In this study, the instrument for measuring usability, quality factors were a computer system usability questionnaire which was developed by James R. Lewis. At the final stage, the Tourism Mobile Application as a tourism information media in Rembang Regency was ready to be published and distributed to the public.

Data presented as the results of the study was an android application for tourism, which has a main menu including tourism menus, Rembang regency menus, and route menus. When you first open the application, a splash screen page appears as shown in Figure 3.

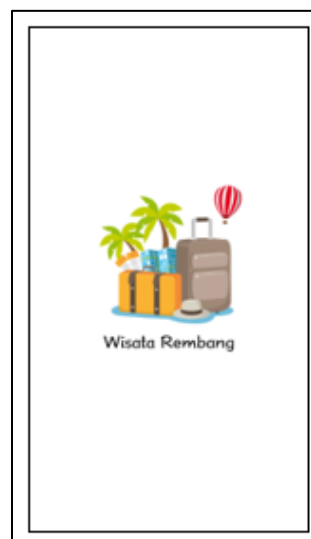


Figure 3 *Splash screen page*

After going through the splash screen page, the application's main menu page is then displayed. The application's main menu includes Rembang regency menu, tourism, routes and application developers. The application's main menu page is shown in figure 4.



Figure 4 Main Menu Page

When the user selects the Rembang regency menu, then application displays short information about Rembang regency in the form of description and image. Rembang menu page is shown in the figure 5.



Figure 5 Rembang Menu Page

If the user selects tourism menu, then application displays a list of travel destination choices in the Rembang regency. Tourism menu page is shown in the figure 6.



Figure 6 Tourism menu

When the user selects one of the tourism destinations on the tourism menu, then application displays the description and information about the selected destination. It also provided the pictures related to the selected tourism destinations for the tourists. The information page about the selected destination is shown in the Figure 7.



Figure 7 Information on Tourism Destination

On the route menu, the application displays the map of Rembang regency. Then the user is requested to enter the location or starting point and the destination point of the tour, then click "route" then application calculate the process using Bellman-ford algorithm to display the shortest route to the destination tour selected by the user. Route menu page is shown in the Figure 8.



Figure 8 The route menu page



Figure 9 The result of the route calculation



Figure 10 The length of route to the destination

The android – based tourism application was tested using ISO 25010 standards which include functional suitability, usability, compatibility and performance efficiency. Functional suitability / black-box testing was performed to find out the application functionality. The results of black-box testing showed percentage of 100 %, which indicated that all functions were going well. The usability testing results / responses of the respondents consisted of 30 respondents showed a percentage of 82.7%. The figure illustrated that the application is very feasible to assist users / tourists to obtain tourism information in Rembang Regency. In addition, the validation test for the mobile application from the Rembang Regency Culture and Tourism Office showed the percentage of 78.57%. It indicated that the application was feasible to be used to help the community to obtain tourism information.

Compatibility testing was conducted by installing applications on five devices with different brands, OS version, and screen size showed a percentage of 100%. In performance efficiency testing which shows the average time of application launch taken from five different devices is 40.47 seconds. With the fastest launch time was 30,89 seconds and the longest one was 30.89 seconds. Calculation using the Bellman – Ford algorithm mathematically on the sample from node 6 (the ancient boat site of Punjulharjo) to node 10 (watulayar) showed a distance of 10.1 Km. In addition, tourism mobile applications showed a distance of 10.5 Km. Therefore, the difference in distance between the results of mathematical calculations and applications was 0.4 Km.

4. Conclusion

Calculation using the Bellman – Ford algorithm mathematically on the sample from node 6 (the ancient boat site of Punjulharjo) to node 10 (Watulayar) showed a distance of 10.1 Km. In

addition, tourism mobile applications showed a distance of 10.5 Km. Therefore, the difference in distance between the results of mathematical calculations and applications was 0.4 Km. Based on the testing using ISO 25010 standards which included functional suitability, usability, compatibility and performance efficiency, It can be concluded that the tourism mobile application of Rembang Regency was very feasible to provide tourism information.

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