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Abstract

Today, the transmission of information on tourism through internet has been implemented through several systems, among of them are e-Tourism, tourism virtual reality mapping, tourism reservation system, location-based tourism services and tourism recommender system. Of all those varied systems, tourism recommender system plays awfully vital roles because the system is able to provide any tourism information according to the interest and capability of the tourist. However, the development of the tourism recommender system, in fact, faces some problems, among of them are the complexity of the information contained in the tourism objects, and the difficult information extraction related to the existence of the tourism objects themselves.

The information upon tourism objects holds many various aspects in relation to the services which the tourists to be will receive, such as completeness facilities of the tourism objects, easy access to the tourism objects, security guarantee, and so on and so forth. In this study, the methods of weighted sum model (WSM) are implemented to develop recommender system for tourism destination. From analysis result of WSM algorithm obtained characteristic of algorithm to generate tourism object recommendations.

Keywords: Multi-Criteria Decision Making, Weighted Sum Model, Recommender System, Tourism Destination Places

1 INTRODUCTION

Internet is employed as a mean to develop any information systems on tourism with various function, technology, and information package such as e-Tourism, tourism virtual reality mapping, tourism reservation system, location-based tourism services and tourism recommender system (Pease *et al*, 2007). The tourists-to be will receive information upon many tourism objects coming from any system easily and quickly. This makes information overload takes place so that the tourists-to be will be confused to select the information which will support their tourism visit. The application of tourism recommender system will overcome this problem upon information overload (Adomavicius *et al*, 2005), because the system can provide the information needs based on the interest and capability of the tourists'to be (Ponnada *et al*, 2007).

The recommender system improvement has generated several methods such as content-based filtering, collaborative filtering, knowledge-based, the hybrid method, and the multi-criteria approach (Ricci *et al*, 2011). Each of those methods has its own strength and weaknesses. Ganapathy and Arunesh (2010) highlight that some methods have their basic weaknesses; i.e. they are merely able to handle a simple object. In fact, tourism products are not somewhat simple. A tourism product occupies some standards such as the quality of entertaining attraction given, the accessibility level, security guaranty, sufficient facilities provided and many other standards.

Hence, an appropriate approach is needed to develop a tourism object recommender system. That approach must engage some evaluation standards to evaluate tourism objects and can utilize the data on tourism objects stored in the database. This study tries to develop a tourism object recommender system using an approach which can rate a number of tourism objects located in one certain place by using several standards objectively.

The tourist object recommender system which is going to be developed in this study uses two methods of multi attribute decision making (MADM), they are weighted sum model (WSM). The method selection refers to Triantaphyllou's statement (1997) saying that MADM method can overcome an item having many criteria and alternatives and therefore it is right to apply such method for tourism product item. Besides, the system will be developed by using web-based so that the use of WSM method using simple mathematical operation and a little number of computation processes will not cause the server overload.

2 WEIGHTED SUM MODEL

Decision making theory is a study to identify and select alternatives based on the values and preferences of decision makers (Harris, 1998). Decision implies several alternatives to be considered, and decision making not only directed to identify alternatives but also to choose an alternative that is consistent with the objectives, goals, desires, or certain values. Multi-criteria decision making (MCDM) is the theory that discussed the decision making process that considers many criteria.

Weighted Sum Model (WSM) is one of the MCDM methods that seek simple weighted sum of the performance rating of each alternative on all attributes (Triantaphyllou and Sanchez, 1997). The equation used in the method shown in equation 1:

$$A^*_{WSM} = \max_i \sum_{j=1}^{N} a_{ij} w_j, i = 1,2,3,...,M \quad (1)$$

where A^*_{WSM} is the best alternative, N is the number of criterias, a_{ij} is an i alternative to the j criterion, and w_j is the weight of j criterion. In this method, alternative value is the total value of the value multiplied by the weight of each criterion.

3 CASE STUDY

3.1 Tourism Data

The tourism destination used in this study is a tourist attraction in Agam, West Sumatra. Agam has a complete type of attractions ranging from coastal resorts, a valley, mountain areas, and lakes. The natural conditions of Agam has a unique topography that is starting at an altitude of 0 m (in the district of Tanjung Pearls) up to 2.89 km (at Pua River District). Additionally, Agam has historic tourist attractions, culture, arts and crafts. These facts were mentioned at the development report of the national tourism in 1996-1997 which mention that the province of West Sumatra is a potential tourism area by means of land and sea.

A set of tourism destination places that are used include data from the Agam Department of Tourism and Culture and data about tourism attraction in Agam collected from various sources in the Internet. A tourism destination in this study consisted of three group, i.e. group of natural tourism, group of cultural and historical tourism, and sports tourism. Total tourism destinations in this study were 37 places in Agam, West Sumatra.

In this study using eight criterion in the assessment process of tourism destination places. These criterions include distance (C_1), facilities (C_2), accessibility (C_3), attractiveness (C_4), management (C_5), attractions (C_6), safety (C_7), and availability of store (C_8). Each of eight criterions was assigned to different weight levels based on the results of a survey conducted by Pramudia (2008) as shown in Table 1. The assessment process of tourism destination places using Likert scales of 1 (the worst) to 5 (the best). The sample data of assessment scores for each tousrism destination natural tourism group is shown in Table 2.

Aspect	Criterion	Weight Value
Physical	Distance	0.18
	Facilities	0.065
	Accessibility	0.11
	Attractiveness	0.145
Institutional, cultural, social and economic	Management	0.06
	Attractions	0.09
	Safety	0.27
	Availability of store in location	0.08

Table 1. Weight of each criteria (Pramudia, 2008)

No.	Alternatives (Tourism Destination)	Criterion							
		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8
1	Puncak Gunung Merapi	3	1	1	5	1	1	1	1
2	Ngalau Kamang	3	1	1	5	1	1	1	1
3	Air Terjun Malalak	3	1	1	5	1	1	1	1
4	Puncak Singgalang	3	1	1	5	1	1	1	1
5	Linggai	2	1	3	5	1	1	1	1
6	Ngalau Simarasok	4	1	2	5	1	1	1	1
7	Air Terjun Sarasah	4	1	3	5	1	1	1	3
8	Tarusan	4	1	3	5	1	1	1	1
9	Air Terjun Badorai	5	1	3	5	1	1	1	3
10	Ngarai Sianok Anam Suku	5	1	2	5	1	1	1	5
11	Ambun Tanai	4	2	3	5	1	1	1	3
12	Kelok 44	4	1	4	3	1	1	1	3
13	Air Terjun Gadih Rantih	3	2	4	5	1	1	1	5
14	Pulau Tangah	1	1	1	5	5	1	5	3

15	Pulau Ujung	1	1	1	5	5	1	5	3
17	Pantai Bandar Mutiara	1	2	2	5	5	5	5	5
18	Bunga Raflesia	4	1	2	5	5	1	5	3
19	Air Angek	2	2	4	3	1	1	5	3
20	Air Tiga Rasa	2	2	4	3	1	1	5	3
21	Maninjau	3	5	4	4	1	5	1	5
22	Ikan Sakti Sungai Janiah	4	1	3	5	5	3	5	5
23	Ambun Pagi	4	3	4	4	5	5	5	5
24	Muko-Muko (PLTA Maninjau)	2	1	4	5	5	5	5	5
25	Puncak Lawang	3	1	3	4	5	3	5	5

Table 2. Sample data (Pramudia, 2008)

3.2 System Architecture

The proposed recommendation uses a weighted-sum model (WSM) that is one of the multi-criteria decision making (MCDM) approach. This method, supported by Triantaphyllou (1997), is capable of handling an item that has a lot of criterias and alternatives. This it is appropriate to apply this method to tourism data that have a lot of alternatives and criterias. The proposed system was was a web-based system. WSM method uses simple arithmetic operations that load small amount of computation process on the server side.

Figure 2 shows the architecture of the proposed system. The system architecture consists of two main parts, the client side and server side. Client side will be used by users to find information about tourism destination in different areas. Users will input either a keyword, a group or type of tourism attractions or places. On the server side, the web server will filter and rank the alternatives based on the stored data. Web server will give recommendation and information about tourism destination based on user's request. Each criteria of each tourism destination a value score of 1 to 5. Score data was stored in database and would be used to rank the recommended destination. Figure 1 shows the algorithm of the proposed recommender system.

```
WSM Algorithm
Input :
keyword(user input : location and type of leisure places)
arr_destination_places(array data of tourism destination places)
arr_destination_score(array data of scoring value for every tourism destination places)
arr_total_wsm(array data of total value, WSM method result )
Output : Recommendation of Destination Places
get_destination_places(keyword)//query to database system to filtering data of destination places based on user input
if (get_destination_places(keyword))
{
      foreach arr_destination_places do
     {
        get_destination_score()//database query to get score data for every toursim destination places
                add_wsm_total(arr_wsm_total[wsm_total_id][destination_id])//database query to add wsm total value in wsm_total field in wsm table
        totalwsm = 0//initiation value for total_wsm field
        foreach arr_destination_score do
        {
                  get_score_value([criteria_score_id])//database query to get data of score value for every criteria_score_id
                  get_criteria_value([criteria_score_id])// database query to get data of criteria value for every criteria_score_id
                  temp_wsm_value = arr_score_value*arr_criteria_value
                  add_temp_wsm([wsm_total_id])//database query to save temp_wsm_value variable for every wsm_total_id in temp_wsm table
        }
        get_temp_wsm([wsm_total_id])//database query to get temp_wsm_value then add all temp_wsm_value
         update_wsm_total_value([wsm_total_id][ temp_wsm_value])//update and save the new one of wsm total value
}
show_data(keyword)//database query to show recommendation of tourism destination places
}
else
{
"Data not available"
}
```

Figure 1. The recommender algorithm

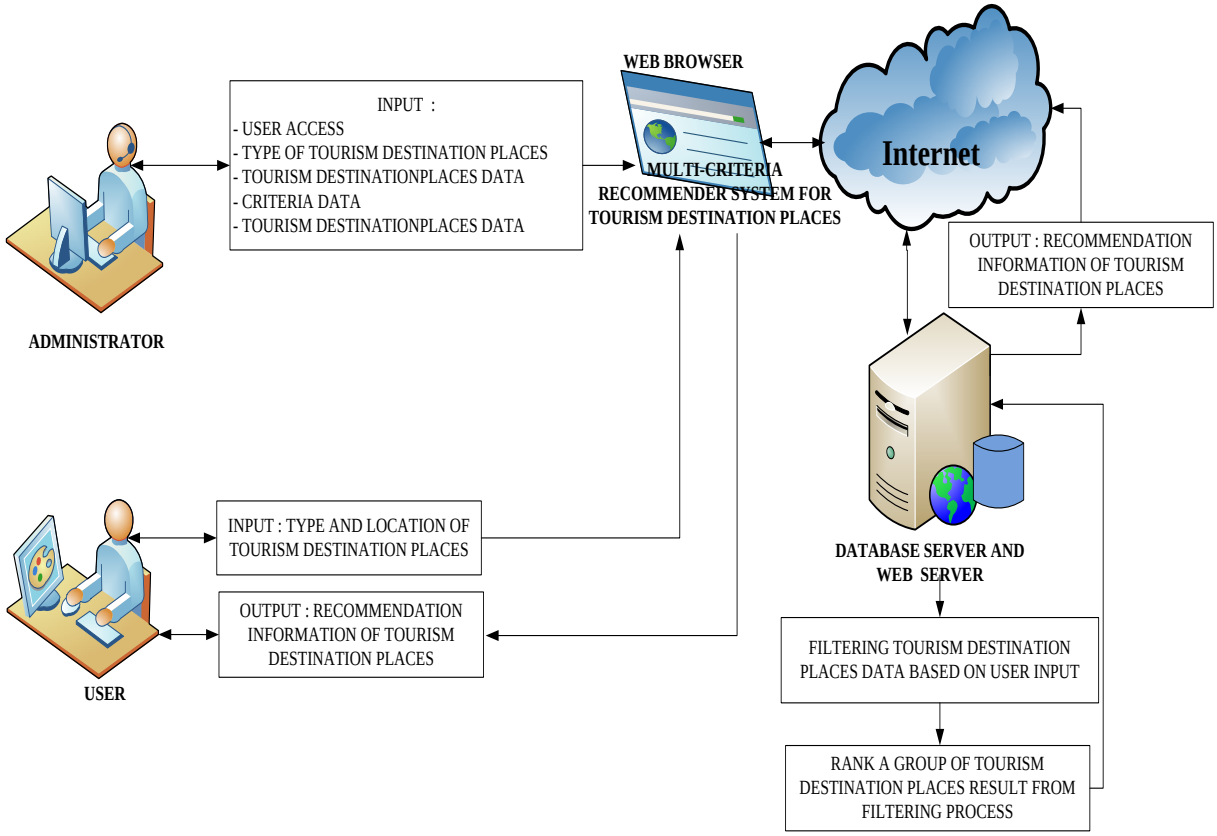

Figure 2. Architecture of multi-criteria recommender system

4 PROTOTYPE

First of all, the user has to insert all his preferences. This includes the name of destination as well as the preferred type of tourism. The user has the possibility to further refine his/her search by specifying additional constraints. The search dialog created for this prototype is shown in Figure 3, Figure 4 and Figure 5.

Figure 3. Search by tourism destination name

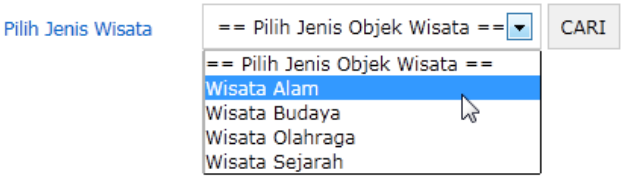

Figure 4. Search by type of tourism destination place

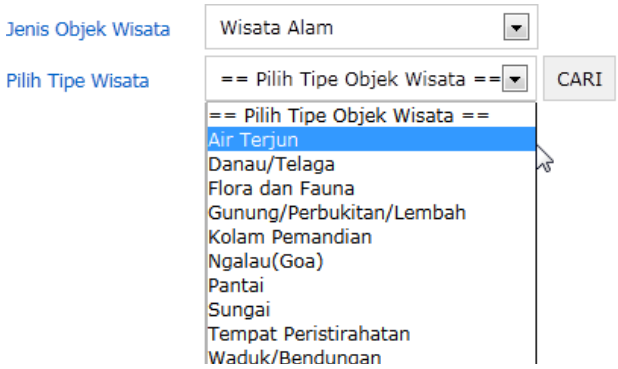

Figure 5. Search by more detail type of tourism destination place

For a test case, it is assumed that there is a user who search for destination by natural tourism group, called "Wisata alam" in Indonesian. The system will rank the recommended destination using the algorithm showd in Figure 2. The recommendation is shown in Table 3. Table 3 only shows a partial list of the recommended destinations which belong to the natural tourism group. The result is almost the same as Pramudia (2008) as shown in Table 4. Pramudia using a modified method of scoring criteria based on MacKinnon et al (1986) and Gunn (1994). The match rate between the proposed system and the one of Pramudia's is 90%.

Ranking #	Nama Objek Wisata	Nilai Metode WSM
1	Ambun Pagi	4.435
2	Ikan Sakti Sungai Janiah	4.16
3	Muko-muko	4.09
4	Puncak Lawang	3.835
5	Pantai Bandar Mutiara	3.755
6	Bunga Raflesia	3.71
7	Air Angek	3.105
8	Air Tiga Rasa	3.105
9	Maninjau	3.065
10	Pulau Tangah	3.06

Table 3. Recommendations produced by the proposed recommender system

Rank	Alternatives
1	Ambun Pagi
2	Ikan Sakti Sungai Janiah
3	Muko-Muko(PLTA Maninjau)
4	Puncak Lawang
5	Pantai Bandar Mutiara
6	Bunga Raflesia
7	Air Tiga Rasa
8	Air Angek
9	Maninjau
10	Pulau Tangah

Table 4. Recommendations produced by Pramudia (2008)

The result produces by WSM method is influenced by the dominant criteria. This can be seen from the difference of the value between the highest value and the lowest value. For an example, for object Ambun Pagi (Figure 6), the difference between the highest and the lowest criteria is 1.15, that is 1.35 for 'safety' and 0.20 for 'facility'. For object Ikan Sakti Sungai Janiah, the difference between the highest and the lowest criteria is 1.28, that is 1.38 for 'safety' and 0.07 for 'facility' alternative shows the difference in value is 1.28. These values show that tourists prefer to go to the safest place for their destination, while facility is not really on their card. Figure 6 also shows that 'safety' and 'distance' were the two most infuential criteria why tourists chose Ambun pagi, while Figure 7 shows that 'safety' and 'attraction' were the two most influential criteria for choosing Ikan Sakti Sungai Janiah.

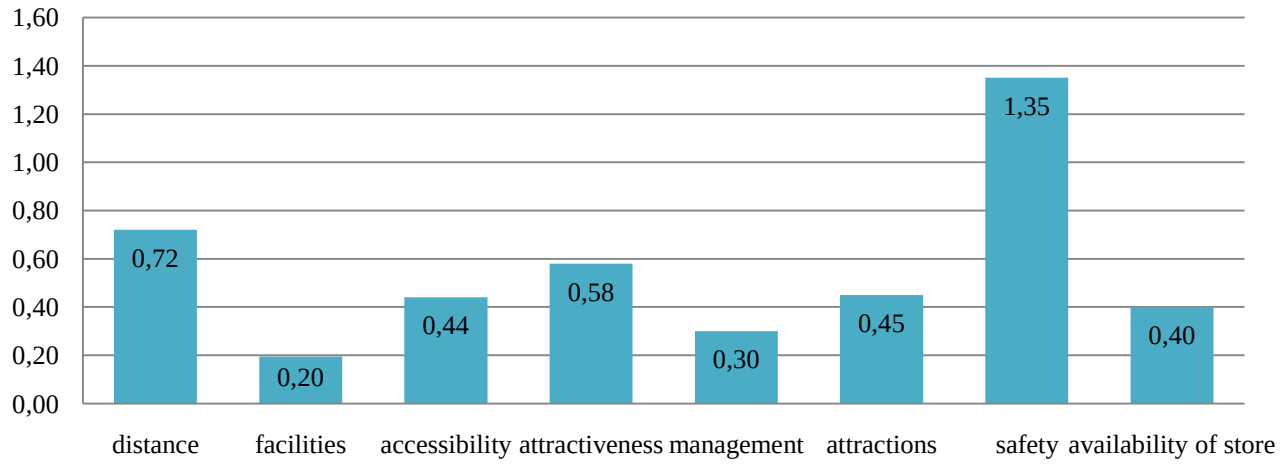

Figure 6. Assessment criteria for Ambun Pagi

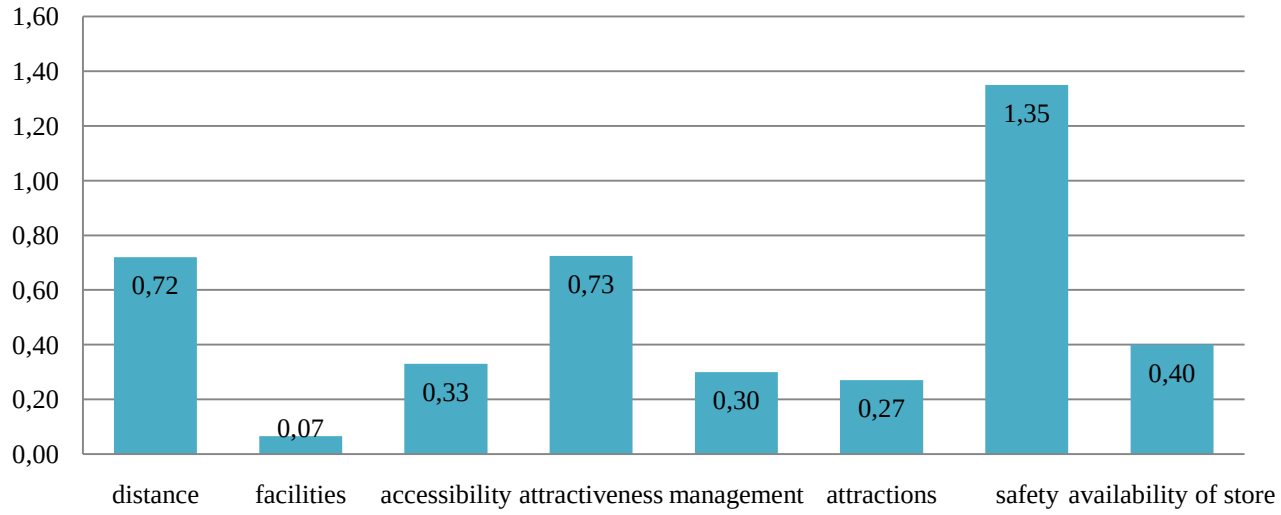

Figure 7. Assessment criteria for Ikan Sakti Sungai Janiah

5 CONCLUSION

The result shows that the recommender algorithm developed using WSM method is able to highlight the most and the least influential criteria to the of the recommendation. The system also provides comparison between the lowest and the highest criterion scores. From the result, it is concluded that WSM method a good method to determine which criteria gives the most influential factor in determining tourism destination. If compare to other system, e.g. Pramudia (2008), this WSM method give a very similar, although the other system was implemented using different method.

This study suggests a future work to compare the performance of WSM model with other methods in generating recommended destinations. The comparison needs to be done with several data set taken from different tourism destinations in several places.

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