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# Tourism recommender system using Case Based Reasoning Approach (Case Study: Bandung Raya Area)

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**Abstract.** Getting the expert advice to specify a reliable tourist attraction quickly and consistent to the requirements of each tourists was difficult, and the amount of experienced experts who can advise for tourism issues was insufficient. Providing an effective service in tourism sector, such as using the technology of computer system, can be the right solution and very necessary to attract foreign and local tourist to visit the tourist attractions in Bandung. In this paper, we develop the recommender system in tourism using Case Based Reasoning (CBR) method. The CBR system provides recommendations based on solutions from previously solved cases, and suitability between user requirements and features available. Recommendations are given by calculating the similarity values of previously solved cases with new cases. The solutions from previously solved cases with the greatest similarity value will be recommended. Thus, visitors can get recommendations suits to their requirements. In this observation, the given recommendations have an average level of accuracy 91% and 92% with Minimum Similarity Value 80-99%.

## 1. Introduction

In daily life, we often got many offers or suggestions from various sources, such as dining recommendations with various menu options, or destinations to visit during the holidays. Recommendations help us to decide which thing is good to use, buy or consume. Information about tourism attractions at Bandung Raya which available in printed form or web based was very diverse, and still requires deciding destinations suit to their requirements and preferences. In situations where the amount of choices is increasing, the best recommendations are also increasingly important. Using technology of computer system to build the recommender system has many advantages. Recommender Systems is technique to provide suggestions for items to be used. The suggestions provided are aimed in decision-making processes. RS focuses on a particular type of item to indicate the recommender system, therefore the design until the recommendation technique used to make recommendations are adjusted to provide useful and effective advice on specific problems [1].

Watson and Marir [2] stated that in Artificial Intelligence (AI) research, Knowledge-Based Systems (KBS) is one of the best methods to develop the Recommender system. KBS provides items suit to user requirements and preferences [3]. However, the KBS was success in many sectors, but there are some problems founded, such as when implementing model-based KBS, the process is slow



and difficult to implement. According to the problems, the Case-Based Reasoning (CBR) method is interesting to use. CBR usually used to develop the expert system in diagnose disease [4].

Therefore, we purpose to develop a recommender system in tourism using CBR method. CBR means adapting old similar solved problems to solve new problems [5]. A similarity function is needed to compare between data which to be used by searching in the data to objects from new data or testing data [6]. If the data consists of various kinds and categories, it's better to use min-max normalization [7], [8]. Calculation result from this formula is the distance (closeness) of the new case and the old case [9]. To calculate the case similarity, we use the formula of Similarity [10]:

$$\text{Similarity} = \frac{\sum_{i=1}^n f(p_i, q_i) \times w_i}{\sum_{i=1}^n w_i} \quad (1)$$

$p$  = New cases

$q$  = Cases in case repository

$n$  = Number of attributes in each case

$i$  = Individual attributes among 1 to  $n$

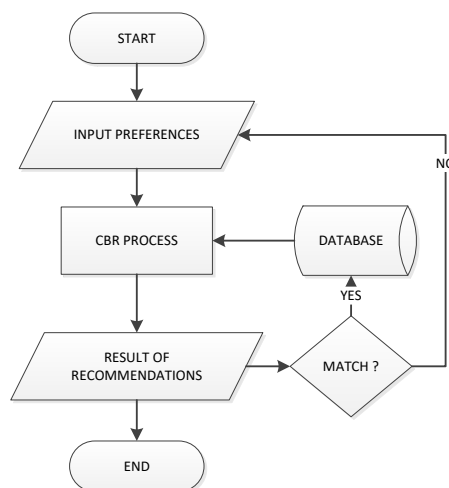
$w$  = Weight of attribute  $i$

$f$  = Similarity function attribute  $i$  among case  $p$  and case  $q$

In this paper will be divided into 5 sections. Section 1 explains the problems of this observation. System planning which to be main idea to solve the problem described in section 1 will be explained in section 2. Section 3 explains the implementation of Recommender System built. Test analysis of the observation will be explained in Section 4. Section 5 contains the Conclusion of the observation.

## 2. System Planning

Based on problems described in section 1, it takes a web based recommender system which is able to provide recommendations or destinations to visit. The recommender system proposed is Case Based Reasoning (CBR) method. Figures 1 bellow shows that system input includes the tourism category, price option, location and facilities available on tourist attractions. While the system output are recommended tourist attractions or destinations according to each tourists requirements.



**Figure 1.** System process design.

## 3. Methodology

### 3.1. Data Analysis

This phase is collecting the necessary information such as existing tourism data and cases data in Bandung Raya. The data obtained and validated by the Department of Tourism and Culture of West Java Province Year 2017. It's required for existing data to be valid and tested so as its quality is acceptable.

### 3.2. System Implementation

#### 3.2.1. Defining the Features

Defining the features used to calculating similarities of cases in case repository [11]. In this tourism recommender system, there are 7 features to consider. Table 1 shows the features used to consider the recommendations. Each feature has its own index which useful for calculating the similarity process.

**Table 1.** Define the features.

No	Feature	Description	Index
1	Tourism Category	Natural tourism	Cat01
		Culture tour	Cat02
		Recreation areas	Cat03
		Shopping tour	Cat04
		Artificial natural tourism	Cat05
		Special Interest	Cat06
2	Price	Free	Prc01
		Cheap	Prc02
		Medium	Prc03
		Expensive	Prc04
3	Location	West Bandung	Reg01
		Cimahi City	Reg02
		Bandung District	Reg03
		Bandung City	Reg04
4	Musholla		Yes/no
5	Lodge		Yes/no
6	Food court		Yes/no
7	Gift shop		Yes/no

#### 3.2.2. Weighting and Priority Scale Mechanism

This research applies priority scale for features used and the priority weighting obtained from the survey to 55 respondents. In the Similarity equation used, there is a function  $f(p_i, q_i)$  returns a value of 0 until 1 (normalized). Where the value of 0 can be interpreted there is no similarity between the new case and the base case compared, so do the opposite [8].

**Table 2.** Priority weight.

Index	Priority weight
Tourism Category	41.9
Price	27.9
Location	21.4
Musholla	2.14
Lodge	2.14
Food court	2.14
Gift shop	2.14
<b>Total Priority Weight</b>	<b>99,76</b>

**Table 3.** Similarity value of tourism category.

	Natural tourism	Culture tour	Recreation areas	Shopping tour	Artificial natural tourism	Special Interest
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Natural tourism	1	0	0	0	0.8	0
Culture tour	0	1	0	0	0	0
Recreation areas	0	0	1	0	0	0
Shopping tour	0	0	0	1	0	0
Artificial natural tourism	0.8	0	0	0	1	0
Special Interest	0	0	0	0	0	1

**Table 4.** Similarity value of price.

	Free	Cheap	Medium	Expensive
Free	1	0.66	0.33	0
Cheap	0.66	1	0.66	0.33
Medium	0.33	0.66	1	0.66
Expensive	0	0.33	0.66	1

**Table 5.** Similarity value of other facility.

No	Index Name	Equal	Diverse
1	Musholla	1	0
2	Lodge	1	0
3	Food court	1	0
4	Gift shop	1	0

Based on table 3, 4 and 5, can be concluded that the value of 1(normalized) is only obtained when the feature on the new case is the same as the existing feature in the old case. It's useful if someone wants to travel to the West Bandung area, but did not find a tourist spot suits to their requirements, then the system will search the nearest alternative area according to the requirements of tourists. We used the Euclidean Distance [11], [12] function and normalized to calculate the similarity value of location from each region.

$$Distance = \sqrt{(Lat_1 - Lat_2)^2 + (Long_1 - Long_2)^2} \quad (2)$$

$Lat_1$  = Latitude of object 1     $Long_1$  = Longitude of object 1

$Lat_2$  = Latitude of object 2     $Long_1$  = Longitude of object 2

### 3.2.3. Case Representation

Case representation is carried out at the beginning of the process used as problem mapping. The following table will explain the similarity calculation process performed to calculate the value of proximity between new cases with some old cases. Each old case will be calculated for its proximity to the new case given. Old cases that have a large value of similarity will be used as a recommendation.

**Table 6.** Old case.

Features	Feature Selected
Tourism Category	Recreation areas
Price	Cheap
Location	West Bandung
Musholla	Yes
Lodge	Yes
Food court	Yes
Gift shop	Yes
Solution	Tangkuban Perahu

**Table 7.** New case.

Features	Feature Selected
Tourism Category	Recreation areas
Price	Cheap
Location	West Bandung
Musholla	No
Lodge	Yes
Food court	Yes
Gift shop	Yes
Solution	TBD

$$\begin{aligned} \text{Similarity} &= ((1 \times 41.9 + 1 \times 27.9 + 1 \times 21.4 + 0 \times 2.14 + 1 \times 2.14 + 1 \times 2.14 + 1 \times 2.14) / 99.76) \\ &= (41.9 + 27.9 + 21.4 + 0 + 2.14 + 2.14 + 2.14) / 99.76 \\ &= 0.978 \end{aligned}$$

**Table 8.** Similarity result.

CaseID	Tourism Object	Category	Price	Location	Musholla	Lodge	Food court	Gift Shop	Total Similarity Value
Case013	Floating Market Lembang	1	1	1	1	0	1	1	0.98
Case044	Trans Studio Bandung	1	0.33	0.546	1	0	1	1	0.69

Case004	Situ Ciburuy	0	1	1	1	0	1	1	0.56
Case029	Lereng Anteng Panoramic Coffee	0	1	1	1	0	1	0	0.54
Case033	Taman Lalu Lintas	0	1	0.546	0	0	1	0	0.42

**Recommender System**

Choose Destination Category  
Culture tour

Choose Price  
Free

Choose Location  
Bandung City

Other Facility :

Mushola  
☒ Yes ☐ No

Lodge  
☒ Yes ☐ No

Food Court  
☒ Yes ☐ No

Gift Shop  
☒ Yes ☐ No

**Recommend**

**Figure 2.** Features used.

**Result**

**Pos Indonesia Museum**  
Bandung City  
Culture tour  
Similarity : 100%

**Asia-Africa Museum**  
Bandung City  
Culture tour  
Similarity : 90.5%

**Figure 3.** Result of CBR process in tourism recommender system.

Figure 3 and figure 4 are the screen shoot from application built. User input their requirements to system, and system will display the recommendations suits to their requirements. Object with the highest similarity value will be recommended.

## 4. Evaluation and Testing

### 4.1. System Performance Testing

The purpose of this test is to measure the recommender system built using the CBR method can provide recommendations of tourist attractions in Bandung Raya. Total data used in this research is 60 rows of data. The system performance testing uses Minimum Similarity Value [4]. Testing data will be divided into 2 scenarios:

Scenario A = 60 data and 40 testing data and

Scenario B = 40 data and 40 testing data

The size of the amount will affect the performance of the system. From the results of observations made, obtained the 5 MSV best values of each scenario as shown in table 9 and table 10:

**Table 9.** Result of scenario A.

MSV	True	False	SV<MSV	Accuracy
99	3	0	37	1
95	10	0	30	1
90	15	0	25	1
85	27	7	6	0.794
80	30	7	3	0.81
<b>Total</b>	<b>85</b>	<b>14</b>	<b>101</b>	<b>4.604</b>
<b>Average of Accuracy</b>				<b>0.92</b>

**Table 10.** Result of scenario B.

MSV	True	False	SV<MSV	Accuracy
99	3	0	37	1
95	10	0	30	1
90	14	0	26	1
85	24	7	9	0.774
80	27	7	6	0.749
<b>Total</b>	<b>78</b>	<b>14</b>	<b>108</b>	<b>4.523</b>

<b>Average of Accuracy</b>	<b>0.913</b>
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SV = Similarity Value

MSV = Minimum Similarity Value

From the observation using 2 scenarios, it can be concluded that the more data stored, it will produce recommendations with a higher level of accuracy. The data are helpful in the recommendation processes.

#### 4.2. User Acceptance Testing

The purpose of this test is to find out the system from the user side [13]. From the level of accuracy, the quality of the system can be known from the user side. According to 35 respondents stated that the recommendations given were in suits to their respective needs, with a value of 4.25 from a scale of 1 to 5.

**Table 11.** User acceptance testing result.

Criteria	Value (scale 1 to 5)					Total	Average (scale 1 to 5)
	1	2	3	4	5		
Easy to use	0	0	2	17	16	154	4.4
Efficient in time	0	0	2	24	9	147	4.2
The user interface is interactive	0	0	5	23	7	142	4.057143
Help determine the destination	0	0	1	20	14	153	4.371429

## 5. Conclusion

Based on system planning, implementation and system testing, we can build a tourism recommender system using the Case Based Reasoning approach with value of accuracy of 91% and 92 % (MSV value of 80-99%) also from 35 respondents stated that the recommendations given was in accordance with their respective needs, with a value of 4.25 from a scale of 1 to 5. The weighting mechanism applied to calculate the similarity value is very effecting to the final results given.

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