JEEMECS (Journal of Electrical Engineering, Mechatronic and Computer Science) ISSN 2614-4859
Vol. 6, No. 1, February 2023, Pp. xx-xx

Café Selection Recommendation System in Semarang City uses Collaborative Filtering Method with Item Based Filtering Algorithm

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ABSTRACT

The café selection recommendation system in the city of Semarang aims to provide recommendations for users in finding the desired café according to the type of café expected. This recommendation system serves to predict an item that is of interest to the user. Implementation of recommendation system using Collaborative Filtering and Item Based Filtering algorithms. Collaborative filtering is a recommendation system algorithm where recommendations are given based on consideration of data from other users while the Item Based Filtering algorithm to provide recommendations based on similarities between customer tastes and café characteristics.

Keywords
Recommendation System
Collaborative Filtering
Item Based Filtering

1. Introduction

The city of Semarang is one of the tourist destinations that are quite famous in Indonesia because there are many café locations in the city of Semarang that are indeed good and always crowded with buyers. Visitors from outside the city often stop by the café in Semarang to taste drinks and food or just to take pictures and enjoy the atmosphere of the café. Currently, there is still a very minimal application that displays information on the list of cafes in Semarang City. This is quite difficult for coffee lovers from outside the city or in the city of Semarang who want to try cafes in the city of Semarang. Therefore, the problem can be utilized by the author to maximize the application of the café selection recommendation system developed using collaborative filtering and item based filtering algorithm methods. Collaborative filtering algorithm is an algorithm that is able to provide recommendations to users by determining items that are similar to other items liked by those customers. In this method the relationship between items is more static, so it requires fewer calculations but has a high quality [2]. Item based filtering is a concept in which the opinions of other existing users are used to predict items that may be liked / in demand by a user. Therefore, the recommendation system will ask the user's opinion related to for example whether the user likes bitter coffee, whether the user has enough budget to buy expensive coffee, and so on. Item-Based Collaborative Filtering method, this looks for similarity / similarity of items with other items. With this algorithm, the system can search for the rating of each item and calculate similarity values using pearson correlation-based similarity equations. The results of similarity calculations will be used to calculate the predictive value of each product using the weighted average of deviation equation [4].

The implementation of this system-based item-based collaborative filtering method recommends based on items preferred by the user. This method aims to predict specific items for a user based on previous user preferences and opinions from other similar users [6]. Collaborative filtering algorithms use Adjusted-cossine similarity to calculate similarities between users and weighted sum algorithms for prediction calculations, while for content based filtering the algorithm used is tf-idf for search availability of existing content. The result of the execution time required is influenced by the number of items and the content based filtering method has the fastest execution time compared to collaborative filtering and mixed hybrid methods [7]. Implementing a recommendation system in attracting tourists to visit, done with a system of providing recommendations regarding the desired

café. Tourists can determine the object of the café based on information about the café. Based on the conditions and phenomena above, this study will discuss the implementation of a recommendation system that can help, explain, describe, and provide information to tourists and the public who want to taste coffee in cafes in Semarang City. Therefore, the author conducted a study with the title "Café Selection Recommendation System in Semarang City with Collaborative Filtering method using Item Based Filtering algorithm".

2. The Proposed Method

2.1. Recommendation System

A recommendation system can be defined as a program that attempts to recommend the most suitable item (product or service) to a particular user (individual or business) by predicting the user's interest in the item based on related information about the item, the user and the interaction between the item and the user. The purpose of developing a recommendation system is to reduce information overload by retrieving the most relevant information and services from large amounts of data, thereby providing personalized services. The most important feature of a recommendation system is its ability to "guess" a user's preferences and interests by analyzing user behavior and/or other user behavior to generate personalized recommendations [8].

2.2. Collaborative Filtering

Collaborative filtering is the algorithmic application of the effort to imitate how humans exchange recommendations with their friends. In real practice not all friend recommendations match taste, so it can be sorted between which friends have similar tastes and which friends have not similar tastes to get the most appropriate recommendation results [9]. The collaborative filtering method is based on the assumption that similar users prefer similar items or users express similar preferences for similar items. Instead of doing content indexing or content analysis, collaborative filtering systems rely entirely on ratings from participating community members. Collaborative filtering methods are classified into two general classes, namely model-based and memory-based [3].

2.3. Item Based Filtering

Item-based collaborative filtering is the opposite of the userbased method. When on user-based collaborative filtering prediction recommendations are based on similarities between users, in itembased predictions for recommendations are based on similarities between items. The item-based approach looks into the set of items that have been rated by the target user and calculates how similar the target item is to item i and then selects the most similar item k {i1, i2,...,ik}. At the same time, the similar value {si1, si2,..., sik} of each of these items is also calculated. Once the most similar items are found, predictions are calculated by taking the weighted average of the ratings that have been given by the target user on the most similar k items. There are two aspects to the item-based collaborative filtering method: similarity calculation and computational prediction [10].

3. Methods

3.1. System Architecture

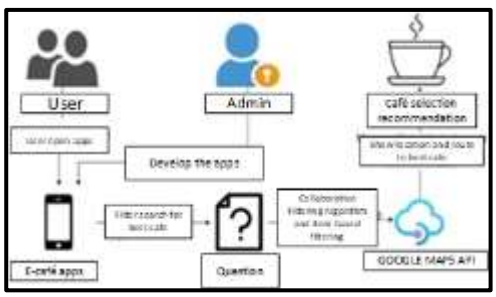

Fig 1. Diagram system

The nearest café selection recommendation system is conducted using collaborative filtering and item based filtering algorithms to determine the best café. The system will call the Google MAP API to display the location and route of travel to that location.

3.2. Activity Diagram Looking for the Best Café

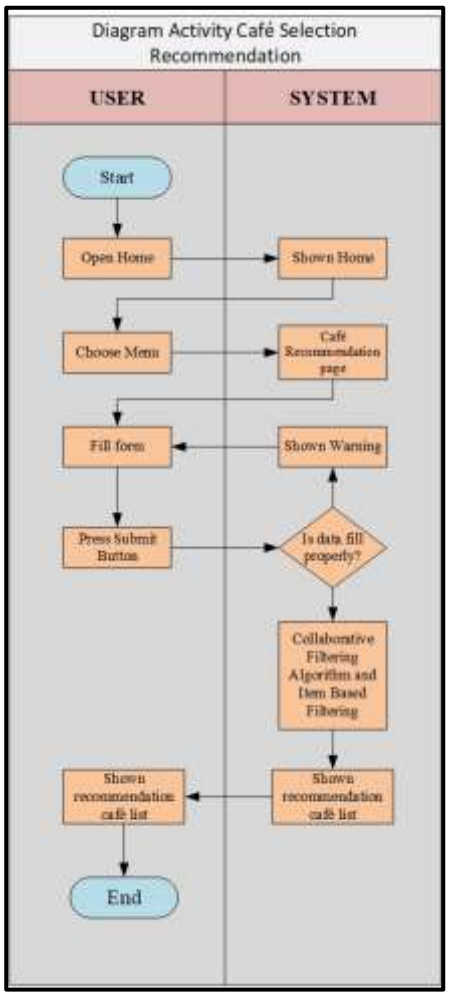

Fig 2. Flowchart Diagram

Visitors can search for the best café by choosing a café recommendation menu. On the page, visitors fill in questions such as the type of café sought, hangouts, and the presence of air conditioning. After that the visitor presses the submit button. The system will perform calculations using Collaborative Filtering and Item Based Filtering algorithms to determine the café's taste buds.

3.3. Collaborative Filtering Method

3.3.1. Algorithm Selection

Collaborative filtering method has two types of algorithms in general, namely item based filtering, namely the provision of recommendations based on similarities between items and user based filtering, namely the provision of recommendations based on similar tastes between customers. In this case, the authors used an item based filtering algorithm to provide recommendations based on similarities between customer tastes and café traits.

3.3.2. Sample Data

The sample used for customer data is named Andika who has the following tastes:

- Coffee-only café;
- Indoor and outdoor cafes;
- The café is not air-conditioned.

3.3.3. Counting

The calculation of collaborative filtering methods depends on the type of algorithm. In this case using an item based filtering algorithm.

3.4. Item Based Filtering Method

3.4.1. Create a Rating

The first stage of rating creation is to give a rating of each object. Table 1. shows the division of item categories as follows:

Table 1. Cafe Item Category

No.	Object	Items
1	Coffee Lodge	a. Coffee-only café; b. Outdoor café; c. The café is not air-conditioned.
2	Legend Coffee	a. Coffee-only café; b. Indoor and outdoor cafes; d. Air-conditioned café.
3	Leon Café	a. Restaurant café; b. Indoor and outdoor cafes; e. Air-conditioned café.
4	Retro Cafe	a. Restaurant café; b. Indoor café; f. The café is not air-conditioned.
5	Clapper Movie Café	a. Restaurant café; b. Indoor café; g. Air-conditioned café.
6	Andika's taste café	a. Coffee-only café; b. Indoor and outdoor cafes; h. The café is not air-conditioned.

3.4.2. Create an inverted index of an item

After each object is given the item criteria, then an invert is carried out so that now each item is assigned an object value [1]. Table 2. shows the object value of each item after the invert is performed.

Table 2. Inverted Index of Items

No.	Items	Object	Sum
1	Coffee-only café	a. Coffee cottage; b. Legend Coffee; c. Andika's taste café.	3
2	Restaurant café	a. Leon Café; b. Retro Café; c. Clapper Movie Café.	3
3	Indoor café	a. Retro Café; b. Clapper Movie Café.	2
4	Outdoor café	a. Coffee cottage.	1
5	Indoor and outdoor cafes	a. Legend Coffee; b. Leon Café; c. Andika's taste café.	3
6	Air-conditioned café	a. Legend Coffee; b. Leon Café; c. Clapper Movie Café.	3
7	The café is not air-conditioned.	a. Coffee cottage; b. Retro Café; c. Andika's taste café.	3

3.4.3. Calculate similarity between items

The third stage is to find the similarity values between items with the formula (Table 3).

$$similarity\ (A,B) = \frac{count(A)}{count(B)} \qquad (1)$$

Table 3. Similarity Between Items

No.	Items Compared	Account	Score
1	Sim (coffee-only café, indoor café)	3/2	1,5
2	Sim (coffee-only café, outdoor café)	3/1	3
3	Sim (coffee-only café, indoor and outdoor café)	3/3	1
4	Sim (coffee-only café, air-conditioned café)	3/3	1
5	Sim (coffee-only café, un-aired café)	3/3	1
6	Sim (restaurant café, indoor café)	3/2	1,5
7	Sim (restaurant café, outdoor café)	3/1	3
8	Sim (restaurant café, indoor and outdoor café)	3/3	1
9	Sim (restaurant café, air-conditioned café)	3/3	1
10	Sim (restaurant café, un-aired café)	3/3	1
11	Sim (indoor café, coffee-only café)	2/3	0,67
12	Sim (indoor café, restaurant café)	2/3	0,67
13	Sim (indoor café, air-conditioned café)	2/3	0,67
14	Sim (indoor café, un-aired café)	2/3	0,67
15	Sim (outdoor café, coffee-only café)	1/3	0,33
16	Sim (outdoor café, restaurant café)	1/3	0,33
17	Sim (outdoor café, air-conditioned café)	1/3	0,33
18	Sim (outdoor café, un-aired café)	1/3	0,33
19	Sim (indoor and outdoor café, coffee-only café)	3/3	1
20	Sim (indoor and outdoor café, restaurant café)	3/3	1
21	Sim (indoor and outdoor café, air-conditioned café)	3/3	1
22	Sim (indoor and outdoor café, un-aired café)	3/3	1
23	Sim (air-conditioned café, indoor café)	3/2	1,5
24	Sim (air-conditioned café, outdoor café)	3/1	3
25	Sim (air-conditioned café, indoor and outdoor café)	3/3	1
26	Sim (air-conditioned café, coffee-only café)	3/3	1
27	Sim (air-conditioned café, restaurant café)	3/3	1
28	Sim (un air-conditioned café, indoor café)	3/2	1,5
29	Sim (un air-conditioned café, outdoor café)	3/1	3
30	Sim (un air-conditioned café, indoor and outdoor café)	3/3	1
31	Sim (un air-conditioned café, coffee-only café)	3/3	1
32	Sim (un air-conditioned café, restaurant café)	3/3	1

3.4.4. Calculate the number of scores per item

The next stage is to calculate the number of scores each item gets by summing the similarity score between items involving related items (Table 4).

Table 4. Number of Scores Per Item

No.	Score for	Items Compared	Score Value	Number of Scores
1	Score (coffee-only café)	Sim (coffee-only café, indoor café)	1,5	7,5
2		Sim (coffee-only café, outdoor café)	3	
3		Sim (coffee-only café, indoor and outdoor café)	1	

No.	Score for	Items Compared	Score Value	Number of Scores
4		Sim (coffee-only café, air-conditioned café)	1	
5		Sim (coffee-only café, un-aired café)	1	
6	Score (restaurant café)	Sim (restaurant café, indoor café)	1,5	7,5
7		Sim (restaurant café, outdoor café)	3	
8		Sim (restaurant café, indoor and outdoor café)	1	
9		Sim (restaurant café, air-conditioned café)	1	
10		Sim (restaurant café, un-aired café)	1	
11	Score (indoor café)	Sim (indoor café, coffee-only café)	0,67	2,67
12		Sim (indoor café, restaurant café)	0,67	
13		Sim (indoor café, air-conditioned café)	0,67	
14		Sim (indoor café, un-aired café)	0,67	
15	Score (outdoor café)	Sim (outdoor café, coffee-only café)	0,33	1,33
16		Sim (outdoor café, restaurant café)	0,33	
17		Sim (outdoor café, air-conditioned café)	0,33	
18		Sim (outdoor café, un-aired café)	0,33	
19	Score (indoor and outdoor café)	Sim (indoor and outdoor café, coffee-only café)	1	4
20		Sim (indoor and outdoor café, restaurant café)	1	
21		Sim (indoor and outdoor café, air-conditioned café)	1	
22		Sim (indoor and outdoor café, un-aired café)	1	
23	Score (air-conditioned café)	Sim (air-conditioned café, indoor café)	1,5	7,5
24		Sim (air-conditioned café, outdoor café)	3	
25		Sim (air-conditioned café, indoor and outdoor café)	1	
26		Sim (air-conditioned café, coffee-only café)	1	
27		Sim (air-conditioned café, restaurant café)	1	
28	Score (un-aired café)	Sim (un air-conditioned café, indoor café)	1,5	7,5
29		Sim (un air-conditioned café, outdoor café)	3	
30		Sim (un air-conditioned café, indoor and outdoor café)	1	
31		Sim (un air-conditioned café, coffee-only café)	1	
32		Sim (un air-conditioned café, restaurant café)	1	

4. Results and Discussions

4.1. Similarity Score Aggregation

Similarity score aggregation tests to recommend potential buyers by calculating the number of scores each object gets and summing the scores of each item on the object based on the item being searched. If the item sought does not match the object item, it is assigned a value of 0 (Table 5).

Table 5. Aggregation of Similarity Score

No.	Object	Items	Number of Scores	Total Score
1	Coffee Lodge	Coffee-only café	7,5	15
		Outdoor café	0	
		The café is not air-conditioned.	7,5	
2	Legend Coffee	Coffee-only café	7,5	11,5
		Indoor and outdoor cafes	4	
		Air-conditioned café	0	
3	Leon Café	Restaurant café	0	4
		Indoor and outdoor cafes	4	
		Air-conditioned café	0	
4	Retro Cafe	Restaurant café	0	7,5
		Indoor café	0	
		The café is not air-conditioned.	7,5	
5	Clapper Movie Café	Restaurant café	0	0
		Indoor café	0	
		Air-conditioned café	0	

The total score of each object, ranking is the stage of sorting the total score from largest to smallest. The object with the largest score means that the object is most recommended for potential customers (Table 1.6).

Table 6. Ranking

No.	Object	Items	Number of Scores	Total Score	Rank
1	Coffee Lodge	Coffee-only café Outdoor café The café is not air-conditioned.	7,5 0 7,5	15	1
2	Legend Coffee	Coffee-only café Indoor and outdoor cafes Air-conditioned café	7,5 4 0	11,5	2
3	Leon Café	Restaurant café Indoor and outdoor cafes Air-conditioned café	0 4 0	4	4
4	Retro Cafe	Restaurant café Indoor café The café is not air-conditioned	0 0 7,5	7,5	3
5	Clapper Movie Café	Restaurant café Indoor café Air-conditioned café	0 0 0	0	5

Based on the above role, the customer named Budi who has the following tastes or items:

- Coffee-only café;
- Indoor and outdoor cafes;
- The café is not air-conditioned.

So the most recommended café for Budi is Pondok Kopi with a total score of 15, followed by Legend Coffee with a total score of 11.5, Retro Café with a total score of 7.5, Leon Kafe with a total score of 4, and lastly Clapper Movie Café with a total score of 0.

Fig 3. Login interface

Fig 4. Dashboard view

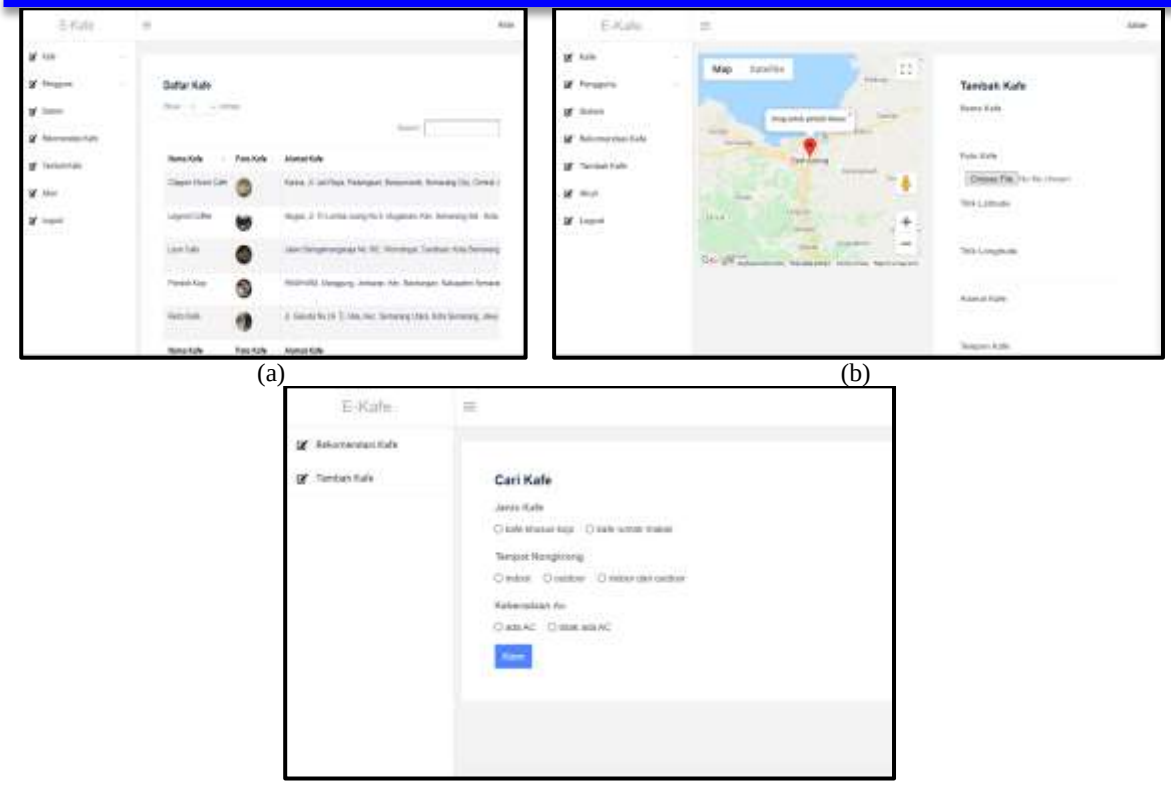

Fig 5. a) Café List View, b) Add Cafe View, c) Find A Cafe View

On the café recommendation page, visitors are asked to enter data requested by the system such as the type of café, hangout, and the presence of air conditioning according to the visitor.

Fig 6. Cafe Recommendation Detail View

Once visitors enter all that information, the system will do the calculation with collaborative filtering algorithms and item based filtering to determine the café that suits the visitor's taste.

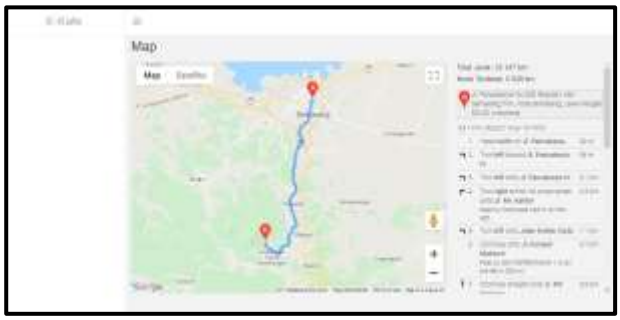

Fig 7. Travel Route View To The Cafe

On the café recommendation page, the system displays not only the recommended café details, but also the route of travel to the café location.

5. Conclusion

Based on the tests that have been conducted in accordance with what is expected by the user for the selection of cafes using the Collaborative Filtering algorithm and Item Based Filterin provide recommendations based on the similarity of items liked by customers and the roles that have been calculated. The *Collaborative Filtering* algorithm helps provide recommendations to users by specifying items similar to other items that are liked by those customers. While the *item based filtering* algorithm to provide recommendations based on similarities between customer tastes and café characteristics).

References

[1] Adi, P. S. (2015, July). Course Value Recommendation System Using Content-Based Filtering Methods. In the National Seminar on Informatics (SEMNASIF) (Vol. 1, No. 1).

[2] Fathurrahman, M., Nurjanah, D., & Rismala, R. (2017). Recommendation System on Books Using Trust-aware Recommendation Method. eProceedings of Engineering, 4(3).

[3] Jepriana, I. Wayan, and Shofwan Hanief. 2020. "Analysis and Implementation of Item-Based Collaborative Filtering Method for Concentration Recommendation System in Stmik Stikom Bali". *National Journal of Informatics Engineering Education: Janapati* 9.2: 171-180.

[4] Prasetyo, Bondan, Et Al. 2019. "Implementation of Item-Based Collaborative Filtering Method in The Provision of Recommendations for Prospective Buyers of Smartphone Accessories". *Journal of Exploratory Exploration* 9.1: 17-27.

[5] Prasetyo, B., Haryanto, H., Astuti, S., Astuti, E. Z., & Rahayu, Y. (2019). Implementation of Item-Based Collaborative Filtering Method in The Provision of Recommendations for Prospective Buyers of Smartphone Accessories. Journal of Exploratory Informatics, 9(1), 17-27.

[6] Setiawan, Yudi, Angga Nurwanto, and Aan Erlansari. 2019. "Implementation of Item Based Collaborative Filtering in The Provision of Android-Based Travel Agenda Recommendations". *Pseudocode* 6.1:13-20.

[7] Wijaya, Anderias, and Deni Alfian. 2018. "Laptop Recommendation System Using Collaborative Filtering and Content-Based Filtering". *Computech Journal & Business* 12.1: 11-27.

[8] Zhang, S., Yao, L., Sun, A., & Tay, Y. (2019). Deep learning based recommender system: A survey and new perspectives. *ACM computing surveys (CSUR)*, *52*(1), 1-38.

[9] Alhijawi, B., & Kilani, Y. (2020). A collaborative filtering recommender system using genetic algorithm. *Information Processing & Management*, *57*(6), 102310.

[10] Thakkar, P., Varma, K., Ukani, V., Mankad, S., & Tanwar, S. (2019). Combining user-based and item-based collaborative filtering using machine learning. In *Information and Communication Technology for Intelligent Systems: Proceedings of ICTIS 2018, Volume 2* (pp. 173-180). Springer Singapore.