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M-Guide: Recommending Systems of Food Centre in Buleleng Regency

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Abstract—**Buleleng is Regency located in the North of Bali. Buleleng becomes one of the tourist destinations for both domestic and international tourist to travel. Buleleng Regency is known for its natural attractions. Besides its numbers of tourist attractions, this Regency also presents a lot of food choices, especially special cuisine in Buleleng. Not only has the special cuisine, Buleleng also had many choices of foods from the outside area. The price, the taste, the atmosphere (view), the service and the facilities vary at each centre. So, the tourists who visit Buleleng are confused when they have to choose one. This system stores 140 food courts in the Buleleng area and each of them is grouped into 15 groups based on its territories. Based on this reason, the collaborative method was chosen for this system. Besides the collaborative method, this system also uses the Location-Based Service (LBS) technology that utilizes the Global Positioning System (GPS) in its application, which the users can find out their position, define and search for specific locations either far or near; one of them is finding the food centre in the area of Buleleng Regency. This system is running on an Android mobile device. This system is expected to (1) facilitate the user in searching the food centre in the area of Buleleng Regency (2) the user can find out the nearest food centre from their location.**

Keywords—Recommending system; food cour; Buleleng; Android; location-based service (LBS); global positioning system (GPS).

I. INTRODUCTION

Food is basic needs of human that we should have in time. Indonesia with its various tribes, customs and cultures have many kinds of food or special cuisine in every area which spread not only in the area of origin but also in every region in Indonesia.

Buleleng is Regency located in the North of Bali area. Buleleng becomes one of the tourist destinations for both domestic and international tourist to travel. This region is known for its natural attractions. Not only famous its natural attractions, but this place is also known for its various food choices, especially the special cuisine in Buleleng. Besides the special cuisine in Buleleng, there are also many foods from the outside area served in this district. The price, the taste, the atmosphere (view), the service and the facilities vary at each centre. Based on this reason, the LBS system

that utilizes the GPS technology will help people especially the tourists to find out their position and certain places, which the places discussed in this research, is food centre in Buleleng area.

The recommending system is software developed in the mid-1990s, as a response to the excessive information upgrades. For example, the recommending system was used in the field of education and business, which this system aimed to give the suggestions or recommendations of items used by the users [1]–[2]. The recommending system is indispensable nowadays because this system can help the users in comparing multiple objects (food courts, tourism object, and so on). This system worked by collecting the best objects. Then, this system will filter out these objects and look for objects that are most similar to the object searched by the user. After that, this system will display the location of the object and user position in the map, so the user can find out the location of the object sought [3].

Most mobile devices in modern days are equipped with GPS. GPS is very useful to determine your position when you are outdoors. GPS does not work if the user is indoors because the radio-frequency identification (RFID) will replace the GPS as a user position determiner [4].

The Location-Based System (LBS) is a system that utilizes the Global Positioning Service (GPS) technology. There was previous research about the Spatial-Temporal Behavior (STB) from Backpackers in Beijing based on the Trajectory. This research collected the data that would support the LBS performance in the future in cities other than Beijing. The LBS was growing rapidly due to the following technologies: The Spatial Positioning Technologies, The Geographical Information Systems (GIS) Technologies and the Wireless Communication Technologies; Position is core, GIS is the platform, and wireless communication is media. We can get the spatial location from an entity through The Spatial Positioning Technologies. Then, these technologies used the GIS as a platform to manage and analyze the geographical information to fulfill the needs of users, which the service is delivered to the users via wireless communication media. The study used 1,078 samples of track data to analyze the STB from Backpackers in Beijing. This study concludes that the trajectories are a good source in viewing STB from the Backpackers [5].

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II. LITERATURE REVIEW

A. Mobile Guide

Mobile Guide is a smartphone used to direct the users to a particular place in accordance with the user's command [6]. Mobile guide is a system installed on mobile devices, which this system uses the GPS technology as a determinant of the system location activated and as the determinant of distance also the path used to direct the user to the desired place or object. [7] Mobile Guide continually requires connectivity to the internet. Currently, mobile guide is becoming more sophisticated, where the users will be directed to a place or object that matches the information provided by users [7]. Mobile guide will provide current information to its users such as current location (user location), time, the reference to tourism object, as well as reservations for cars rentals, hotels and airline tickets [8].

B. Recommendations System

The recommending system is a modern system that has an ability to inform the users about some interesting items and locations. There are some practical applications that have used this system, such as, the Amazon.com for books recommendation, Movie lens for movies recommendation, last.fm for music recommendations, etc. [9]. The recommending system requires a real model and the recommendations of the system are based on the user. In addition, the recommendations of an object are done collaboratively based on the user's participation in ranking the recommended item [10]. The recommending system can help the users in finding the data. By using multiple methods of information and computing, the users are able to incorporate their experience that results in a good review of a recommendation. The recommending system displays the results like a search engine but emphasize better results based on the users' preference [11].

C. Location Based Service (LBS)

LBS (Location Based Service) are composed of three technology intersections: NICTS technologist (New Information and Communication Technologies) which includes: mobile telecommunication system with the data taken from the Internet and geographic information system (GIS) where this technology uses the spatial database [12]. LBS is a system that utilizes the user's location as a context that gives the users the ability to access the information in their areas [12]. According to [13] LBS can only be used on mobile devices that have GPS technology. The LBS applications are widely available today because of the modern technology. Before the development of the technology, there are only the limited features contained in the phone which affect the LBS performance in its service, such as it can only search for goods and employees; identify certain places; the current location; and very limited access to the weather forecast and traffic conditions. So, LBS-based Smartphone that uses the GPS and Wi-Fi can demonstrate a high degree of accuracy and are applicable in many business areas [13].

D. Clustering

Clustering is an important task in data mining when performing cluster analysis. First, partition sets the data into groups based on the similarity of data as well as specifies labels for the group [14]. Clustering is a method for grouping data sets into one or more groups based on the similarities of the group. This method is one of the most popular grouping methods used by various researchers, because of its ability to group similar problems based on their specifications, for example, the food courts grouping based on their area, home price groupings, customer data groupings, etc. [15]. Clustering technique has been applied to different domains, such as pattern recognition, image processing, search, and so on. This technique group objects into each division that is a similar object based on the information that describes the relationship of interconnected objects. The goal is to compare similar objects in a group with different objects in different groups [16]. According to [17], to find people that have similar interest with the user, this cluster model divided the user bases into multiple segments to address classification issues. The algorithm aims to assign users to segments that have the most similar customers and later use the purchases as well as ratings from users to generate a recommendation [17].

III. RESEARCH METHOD

A. Draft Scheme of Research Methods
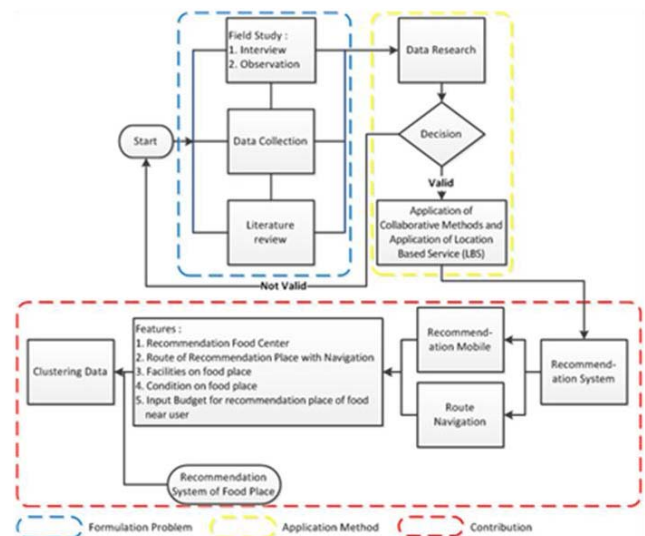
Figure 1.   Draft of Research Scheme

Draft of the research scheme is a method used by the researchers as a reference to conduct the research to adjust the stages that have been prepared, as well as display the contribution given in the research conducted (Fig-1). The information shown in Fig. 1 is the blue dashed line which shows the first step done by researchers was determining the topic. After that, the researchers conducted the field study by interviewing and observation. There is also a yellow dotted

line which described the method used in previous research by the previous researcher. The red dashed lines are the contribution given by researchers, that is providing a mobile-based recommending system equipped with route navigation and also providing features contained in the system such as food courts recommendations, routes to recommended places, facilities that includes the restaurant (Wi-Fi, pool, toilet, etc.). The condition and atmosphere of the place and the features where the users can input the budget they have to get the recommended place. By utilizing the research methods used in previous research, this research is expected to advance the modern culinary tourism in Buleleng regency.

B. Collaborative Filtering (CF)

Collaborative filtering (CF) is a popular basic technique in determining the recommendations, where the predictions and recommendations are based on the ratings assigned by other users in the system to an object or item available [18]. CF consists of two parts; the User-Based Collaborative Filtering Algorithm and the Item-Based Collaborative Filtering Algorithm which obtained from the information searched by the previous user items. The User-Based Collaborative Filtering obtained from the calculation of the rating between users also the suggestions of the items that have the highest ratings from the users. In contrast to the Item-Based Collaborative filtering that obtained from the search of item information used by the previous user. This algorithm briefly compares the similarity between items [19] [20]. In its application to the movie recommendation system [21], Collaborative filtering recommends items based on the similarities between the users of the item. In its system, collaborative filtering suggests the items selected by the same user. This system is based on a scenario of a person who has the similar interest with his or her friend, for example in recommending some films [21]. CF is a method with filtering items process based on the opinions of others. This technique is done by using profiles, which can be said that CF is a technique used to collect and build profiles and determine the relationship between the same model data [22]. CF is one of the most successful and effective methods of generating recommendations. This method uses relevant feedback to predict or recommend something to other users [23].

In collaborative filtering approach, the calculation of the distance is done between the ratings of each user with another user. In calculating the distance, the Euclidean Distance can be used. Here is the formula where the dimension space used is **n**:

$$d([x_1, x_2, \dots x_n], [y_1, y_2, \dots y_n]) = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2} \qquad (1)$$

Where, $d(x, y)$ is Euclidean Distance from user x and user y (the user that will be given the recommendation). x_i is the value of user rating x to item i, and y_i is the value of user rating y to item i.

After obtaining the Euclidean Distance value, the next is calculating the value based on the result of equation (1). Here's the formula:

$$Sim(x, y) = \frac{1}{1 + d(x, y)} \qquad (2)$$

Where, $Sim(x, y)$ is the similarity rating value between user x and user y. Meanwhile, $d(x, y)$ is the Euclidean Distance rating between users x and y.

IV. RESULT AND DISCUSSION

In this section, the examples of methods and scenarios calculation by using the collaborative filtering method with Euclidean distance as a measure of the similarity ratings given by the user are explained. Then, this scenario will be applied to the application recommendation system of food courts in Buleleng District.

TABLE I.   DATA CLUSTERING

	Group Area	Member of Group
1	(Kota)	9
2	(Pemaron)	8
3	(Tukad Mungga & Anturan)	2
4	(Kalibukbuk)	36
5	(Kaliasem)	8
6	(Temukus)	3
7	(Pemuteran)	21
8	(Umeanyar)	5
9	(Kaliasem)	11
10	(Banjar)	2
11	(Munduk)	13
12	(Pancasari)	4
13	(Wanagiri)	2
14	(Kayu Putih)	2
15	(Buleleng Timur)	14
	Total Data	140

TABLE II.   THE RESTAURANT LIKING FORM RATING SCALE

Liking	Rating Scale
Very Like	5
Like	4
Normal	3
Not Like	2
Do Not Like	1

Table III shows the ratings of six customers (U1, U2, U3, U4, U5, and U6) for five restaurants, where the sixth customer (U6) is a new customer and is a customer that will be given the recommendation.

TABLE III.   RATING OF FIVE RESTAURANTS BY FIVE CUSTOMERS (U1, U2, U3, U4, U5).

Custo-mer	Restaurant Rating				
	Villa Mayo	Bali Nibana	Coconut Grove	Manyar Sea Beach	Zen Resort Bali
U1	5	3	3	4	2
U2	4	2	4	5	1
U3	3	1	3	5	2
U4	3	4	3	3	3
U5	2	3	2	4	2
U6	?	?	?	?	?

Based on the data presented in Table III, it will be calculated as follows:

Step 1: Calculate the distance of the customer (U1, U2, U3, U4, U5) to the new customer (U6) using equation (1). Please note that the equation (1) is equal to equation (3) but in equation (3) we use n = 5.

$$d(x_i, y_i) = \sqrt{\sum_{i=1}^{5}(x_i - y_i)^2} \qquad (3)$$

Euclidean distance between U1 and U6:
$$d(U_1, U_6) = \sqrt{(5-0)^2 + (3-0)^2 + (3-0)^2 + (4-0)^2 + (2-0)^2}$$
$$= 7,937$$

Euclidean distance between U2 and U6:
$$d(U_2, U_6) = \sqrt{(4-0)^2 + (2-0)^2 + (4-0)^2 + (5-0)^2 + (1-0)^2}$$
$$= 7,874$$

Euclidean distance between U3 and U6:
$$d(U_3, U_6) = \sqrt{(3-0)^2 + (1-0)^2 + (3-0)^2 + (5-0)^2 + (2-0)^2}$$
$$= 6,928$$

Euclidean distance between U4 and U6:
$$d(U_4, U_6) = \sqrt{(3-0)^2 + (4-0)^2 + (3-0)^2 + (3-0)^2 + (3-0)^2}$$
$$= 7,211$$

Euclidean distance between U5 and U6:
$$d(U_5, U_6) = \sqrt{(2-0)^2 + (3-0)^2 + (2-0)^2 + (4-0)^2 + (2-0)^2}$$
$$= 6,083$$

Step 2: Calculate the value of similarity based on the value of the Euclidean distance. For this use the equation (2). Please note when the interests of the customers are alike, the ratings given are most likely to be similar. Here's the calculation:

The Similarity rating values between U1 and U6:
$$Sim(x, y) = \frac{1}{1 + 7.937} = 0,112$$

The Similarity rating values between U2 and U6:
$$Sim(x, y) = \frac{1}{1 + 7.874} = 0,113$$

The Similarity rating values between U3 and U6:
$$Sim(x, y) = \frac{1}{1 + 6.928} = 0,126$$

The Similarity rating values between U4 and U6:
$$Sim(x, y) = \frac{1}{1 + 7.211} = 0,122$$

The Similarity rating values between U5 and U6:
$$Sim(x, y) = \frac{1}{1 + 6.083} = 0,141$$

Step 3: In this step, the rating similarity score will be used to calculate the total recommendation value at each restaurant or food courts, in order to get the recommended restaurant visited by U6. To get the recommended value, multiply the similarities of each customer's rating with the rating of each customer that shown in Table III. The calculation process will be shown. For example in Table IV:

Based on the multiplication results above for example in Table IV, the order of the restaurant recommendations that will be given to U6 users can be seen in Table V. Please note that the greatest multiplication value, will be the main recommendations in this application.

TABLE IV.   VALUE OF U6 RECOMMENDATION FOR RESTAURANT VILLA MAYO

Customer	Similarity Value	Rating for Restaurant Villa Mayo	Recommend-ation Value
U1	0.119	5	0.595
U2	0.112	4	0.448
U3	0.126	3	0.378
U4	0.116	3	0.348
U5	0.141	2	0.282
Recommendation Value Total			2.051

TABLE V.   ORDER OF RECOMMENDATIONS OBTAINED

Restaurant	Recommendation Value	Note
Manyar Sea Beach	2.578	Rekomendasi 1
Villa Mayo	2.051	Rekomendasi 2
Coconut Grove	1.813	Rekomendasi 3
Bali Nibana	1.594	Rekomendasi 4
Zen Resort Bali	1.232	Rekomendasi 5

From the results shown in Table V, the U6 is recommended to visit Manyar Sea Beach Restaurant with a recommendation value of **2.578**. Here is the Fig. 2 as described above.
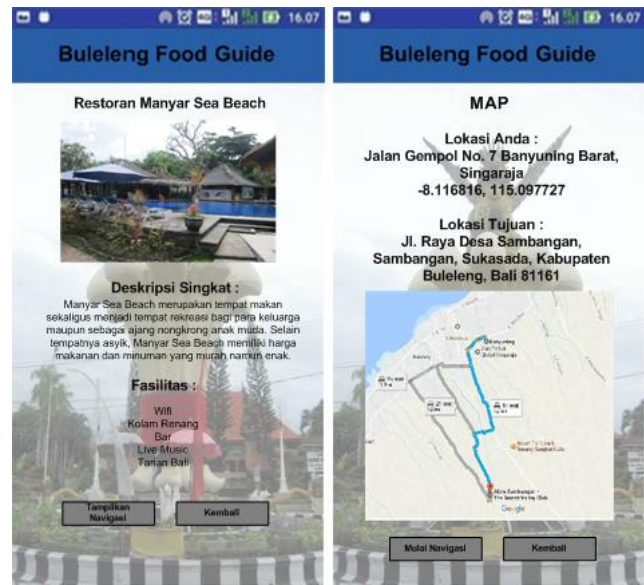

Figure 2.   The Display of The Results of Recommendation

V.   CONCLUSION

Currently, the recommending system plays important role in all fields, especially restaurant or the food centre or tourism. The research in terms of recommending system development has led to various ways in getting good

recommendations. In this paper, we have demonstrated the approach by using collaborative filtering with Euclidean distance as the order of the users rating similarity done by taking samples from five restaurants in Umeanyar area that aimed to give a good result for the new user of recommending system in food courts in Buleleng regency based mobile android (M-Guide). The recommendation given is Manyar Sea Beach Restaurant with the highest recommendation value of 2.578. In developing this research, the writers expected the new researcher to develop the M-Guide more, not only for food courts recommendation but also for tourism object or historic sites recommendation in Buleleng regency. Besides, the writer also expected other researchers to develop this system with other approaches, for a better recommendation based on users' interest.

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