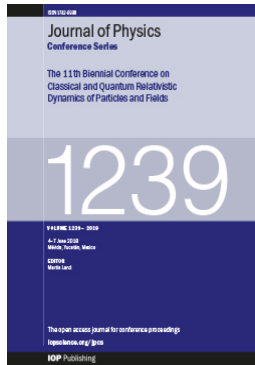


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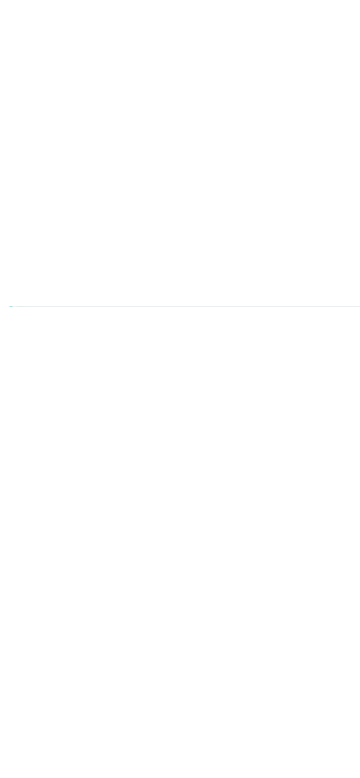
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## Preface

The International Conference on Electronics Representation and Algorithm (ICERA 2019) has been organized by STMIK EL RAHMA (<http://stmikelahma.ac.id/>). This international conference has taken place 29 January 2019 in Grand Zuri Malioboro Hotel, Yogyakarta, Indonesia. This conference has invited academicians, students, practitioners, researchers, and who are keen on engineering and science to contribute original research papers (both empirical and conceptual) and case studies on any of the following areas.

The theme that has been brought to this conference is: "Innovation and Transformation for Best Practices in Global Community"

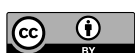
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This conference has attracted 148 papers. From the total of submitted papers, this conference has accepted 68 papers from 7 countries i.e. Indonesia, Malaysia, South Africa, Philippines, United Arab Emirates, USA, and Jordan. So that, the acceptance ratio of this conference is 45.94%.

And we also thank all the committees, reviewers, session chairs, keynote speakers, and sponsors for the success of this event. Hope you all enjoy this conference and have a great day in Yogyakarta.

Editor of the ICERA 2019

Ferry Wahyu Wibowo



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## Mobile Recommendation System for Culinary Tourism Destination using KNN (K-nearest neighbor)

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**Abstract.** Currently culinary tourism is becoming very popular among the Indonesian people. People make visits to interesting culinary places. They want to visit a culinary place that is strategic, comfortable, and cheap as their culinary destination. The culinary destination in Yogyakarta that continues to grow every year makes the tourists who will visit be confused to determine the location of culinary tourism that they will choose. Travelers need references and recommendations to help them determine culinary destinations that meet their expectations. Mobile devices and application guides are able to gather information about an environment and suggest certain places such as tourism locations, based on context factors such as location, weather conditions, and the time needed to get there. The purpose of this study is to develop a recommendation system for culinary tourism destinations in Yogyakarta based on mobile using the KNN (K-nearest neighbor) algorithm. The method used in this study consists of five main steps: literature study, identification, data collection, implementation, and evaluation. The recommendation system is based on previous user ratings of food taste, environmental atmosphere, price, service and distance between users and location. The weight of each criterion is tailored to the needs of the user. The results showed that the mobile application recommendation system was able to provide recommendations to users to determine culinary tourism destinations in Yogyakarta in accordance with the parameters of user desires.

**Keyword:** recommendation system, collaborative filtering, KNN, culinary

### 1. Introduction

In recent years, people often communicate and exchange information through mobile devices [1]. For example, in the context of tourist visits, tourists often bring smartphones to find information about a tourist spot. When people visit a tourist spot, they will share information with others. The development of information technology now has the potential that can be used as a medium to improve service. One technology that is often used is the map feature. This feature will make it easy for users to find locations and find routes that can guide you to go there. This technology can be used to find the location of tourist attractions so that users can consider the distance.

The rapid development of tourism in Indonesia, both natural tourism, cultural tourism, religious tourism and so on, shows that community needs for tourism are not only limited to natural tourism, but other places of interest such as culinary tourism. Culinary tourism is becoming very popular among



Indonesian people today. people make visits to interesting places of food. They want to visit a strategic, comfortable and inexpensive food place as their culinary destination. Yogyakarta is one of the cities of tourism in Indonesia. Every weekend or holiday period many domestic and international tourists visit Yogyakarta with one of them being a culinary tour. Yogyakarta offers many culinary locations that are varied by offering a different ambience, whether modern, classic, or with a particular theme. The culinary destination in Yogyakarta that continues to grow every year makes the tourists who will visit be confused to determine the location of culinary tourism that they will choose. Travelers need references and recommendations to help them determine culinary destinations that meet their expectations.

Mobile technology has an important role in changing the way people connect, interact and share information in their daily lives. Mobile devices have a significant impact on various sectors such as banking, tourism (GIS Web), and health services [2]. Mobile devices and application guides are able to gather information about an environment and suggest certain places such as tourism locations, based on context factors such as location, weather conditions, and the time needed to get there [1]. The progress of mobile technology has brought a new paradigm, many companies have begun to develop mobile-based services. Mobile application services are starting to be enhanced with more adequate features and providing services with better results. One such service is location-based services [3].

The recommendation system application is an application that can provide assistance to users to choose one of several alternatives. The recommendation system can help users to choose profitable products efficiently from a large number of candidate products by analyzing the related user matrix. This is very important in the recommendation system for accurately assigning ratings to an item. There are three important components in this system including users, items, and ratings [4]. The recommendation system automatically suggests items to users who might be interested [5] even though the user doesn't have to choose it. The recommendation system has been adopted by many online stores or e-commerce to provide recommendations to users when searching for a product [6].

One method that is often used in recommendation systems is the collaborative filtering method. Model based collaborative filtering method is a recommendation system that uses similarities between item-to-item and to calculate relationships between different items. The important thing in a good and useful recommendation system for users is the use of efficient and accurate recommendation techniques [7]. The recommendation system will be very based on the interests of other users in the past, so users will not get a product recommendation with low value but get recommendations with high scores. This will improve the quality of recommendations [8]. The recommendation system with the collaborative filtering method is generally only based on one recommendation value that shows the overall rating does not describe in detail. Culinary tourism requires recommendations in detail such as the taste of food, the atmosphere of the environment, service, price and distance to the location.

Based on these problems, to help users determine culinary destinations in Yogyakarta, need an application that can provide recommendations on culinary destinations based on previous user ratings. Existing recommendation system applications, such as Gofood and other applications do not meet this need because their functions are too broad. The application recommends restaurants and food in general for daily needs. Culinary tour is a tourist activity to find unique and interesting food, also an attractive place so tourists want to visit it instead of getting a delivery order service. The purpose of this study is to develop a mobile system application recommended for culinary tourism destinations in Yogyakarta to help tourists. The recommendation system is built based on several assessment criteria and weights that can be tailored to the needs of users. This application is equipped with location-based services that are used to determine the distance between users and tourist locations. The method used in this recommendation system is K-NN (K-Nearest Neighbor).

## 2. Current Research

Research on the mobile system to recommend restaurants to groups, based on the preferences of all group participants, which integrates restaurant information from well-known platforms. The recommendation strategy considers the importance of users for each platform. To support group



decision making, the system uses methods that determine the best alternative for groups from individual preferences and provides a voting process so that groups can reach consensus [9].

Modarresi (2016) conducted a system recommendation research with similarity-based targeting that has been combined with a baseline approach and a latent factor model and has been treated with adaptive regularization that allows complete personalization with respect to users and items [10].

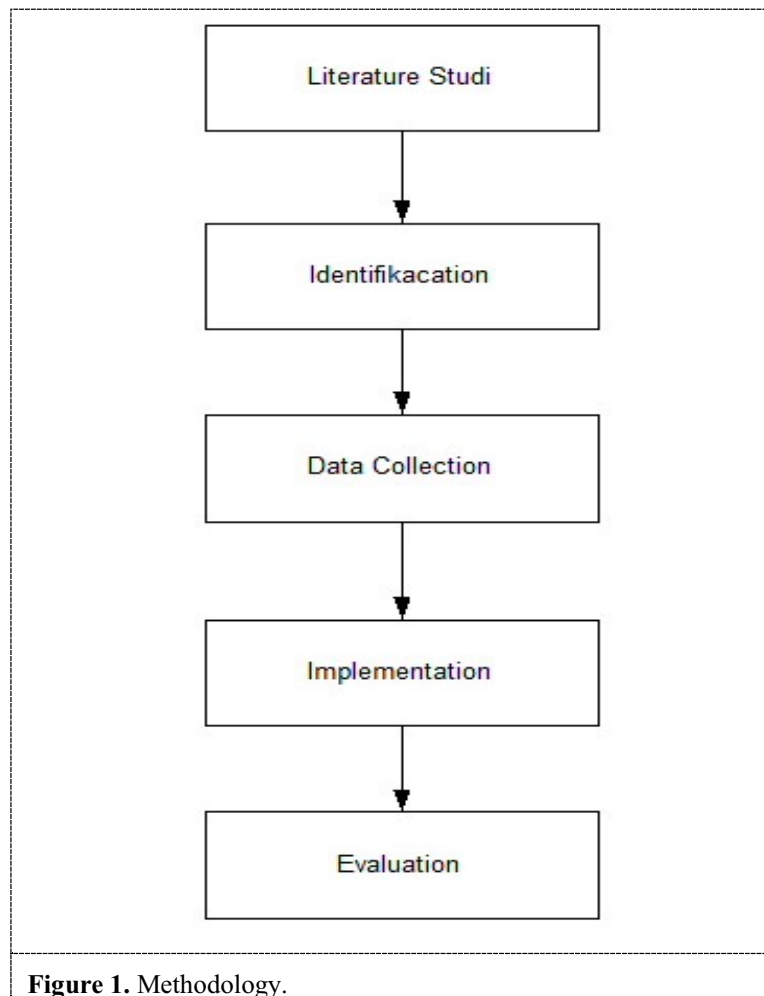
Joa (2016) conducted a study with the title Implementation of a Recommendation System using Association Rules and Collaborative Filtering. This study aims to design and implement a recommendation system by analysing customer patterns and personal trends using association analysis and collaborative filtering. The recommendation algorithm used in the proposed system uses the results of analysis of distance data and data from the GPS (Global Positioning System) to recommend local businesses [11].

Lin (2018) proposed a new recommendation system for the selection of courses in the specificity of information management at the University of China. To implement this system, first collect data sets for the course registration for a particular group of students. Rare linear methods (SLIM) are introduced within our framework to produce top-N course recommendations that are appropriate for students. Meanwhile, the term regularization is exploited as an optimization strategy developed based on observing course items in the current recommendation system [12].

Pawar et al. in 2016 designed a tour guide system based on three layers of architecture. The architecture includes the browser layer, the top layer and the bottom layer. This study uses the KNN algorithm and collaborative filtering to calculate and recommend tourism information to users. Limitations in this study are not very efficient in providing information and predictions of the correct place [13].

### **3. Methodology**

The method used in this study consisted of five stages which were carried out sequentially. These stages are the study of literature, identification, data collection, implementation, and evaluation. Figure 1 shows the design made in several stages in this study.



### 3.1. Literature Study

This stage is data collection with literature studies. The data collected is data relating to the recommendation system and culinary attractions in Yogyakarta.

### 3.2. Identification

This stage is carried out to identify user needs for criteria for culinary attractions. What factors influence users when they want to visit culinary attractions.

### 3.3. Data Collection

Data collection is the stage of collecting user interest data on culinary attractions. This interest is made in the form of questionnaires. This data is used as preliminary data to make a recommendation system for culinary tourism destinations.

### 3.4. Implementation

The implementation stage is the stage of building a prototype Application system for culinary tourism objectives using the model based collaborative filtering method that uses the similariras method and the KNN algorithm.

### 3.5. Evaluation

At this stage an evaluation of the implementation of the model based collaborative filtering on the application of the recommended system for culinary tourism destinations is appropriate.

## 4. Discussion

### 4.1. Data Collection

In this study, the data used to provide recommendations to users consisted of 5 criteria. These criteria are food taste, environmental atmosphere, price, service, and distance. Data collection is done to obtain these data. Data of food taste, environmental conditions, prices, and services are obtained from the experience of users who provide reviews. Users who have visited culinary attractions provide ratings on culinary tourism with a rating.

Distance data is automatically obtained by the system when the user accesses the application. The system will detect the coordinates of the user's location and calculate the distance between the user's location and the surrounding culinary attractions.

Based on these five criteria, the system is designed to provide recommendations to users. The number of items recommended to users is five items.

### 4.2. LBS (Location Base Service)

Location base service is a service to find out the location of a place. In this study LBS is used to find out the location of the user and calculate the distance with the culinary attractions. LBS is also used to find out the location of the culinary destination chosen by the user from the system recommendations. The results of recommendations based on similarities between items are presented in the form of a list. This information is displayed by presenting the distance from the user's location. If the user is interested in visiting a culinary tourism site, the user can see the coordinates and paths that can be reached through the map.

### 4.3. Model based collaborative filtering using Algoritma KNN

The working principle of K-NN (K-Nearest Neighbor) is to find the closest distance between the data to be evaluated with the nearest K (Neighbor) in the training data. K-Nearest Neighbor Algorithm is a method for classifying objects based on the highest proximity to an object. Nearest Neighbor is an approach to look for cases by calculating the closeness between new cases and old cases which is based on matching weights of a number of features. Here is the order of the K-NN work process:

1. Determine the parameter k (number of nearest neighbors).
2. Calculates the square of the euclidean distance (euclidean distance) of each object (training data) for the sample data provided.

$$dt_i = \sqrt{\sum_{i=1}^p (x_{2i} - x_{1i})^2} \quad (1)$$

Description:

x1 = Data Sample

x2 = Data Testing

i = Data Variable

dt = Distance

p = Data Dimension

3. Sort objects into groups based on the smallest euclidean distance.
4. Collect the y category (class of the nearest object) as much as k.

The KNN algorithm is also performed for KNN improved by using a similarity distance. How to calculate similarity is used the following formula.

$$Sim(Problem, case) = \frac{w_1 + w_1 + w_2 + w_2 + \dots + w_n + w_n}{w_1 + w_2 + \dots + w_n} \quad (2)$$

Description:

Sim = Similarity (similarity value)

V = Value of criteria

W = Weight given

Formula 2 is used to calculate the closeness of the similarity between the problem and the case. In this study the formula is used to calculate the closeness between a tourist destination that the user wants and the criteria that have been chosen compared to the countries of all available tourist destinations.

#### 4.4. Criteria and Weight

Each criterion explained in the data collection section is given a value so that the similarity value can be calculated. Data that is given a value are data on taste (T), environmental atmosphere (E), price (P), service (S), and distance (D). Granting values on taste criteria, environmental atmosphere, price, and service is based on the rating given by the user. This rating is in the range of 0 to 5.

Distance data is obtained from calculating the distance between the user's location and the location of culinary attractions. This distance is obtained in real time by the system. Giving this distance value by considering the area of Yogyakarta. Table 1 below is the distance criteria value.

**Table 1.** Distance Value

Distance (D)	Value	Description
0.0 - 9.99km	5	Near
10.00 – 29.99 km	3	Normal
> 30.00 km	1	Far

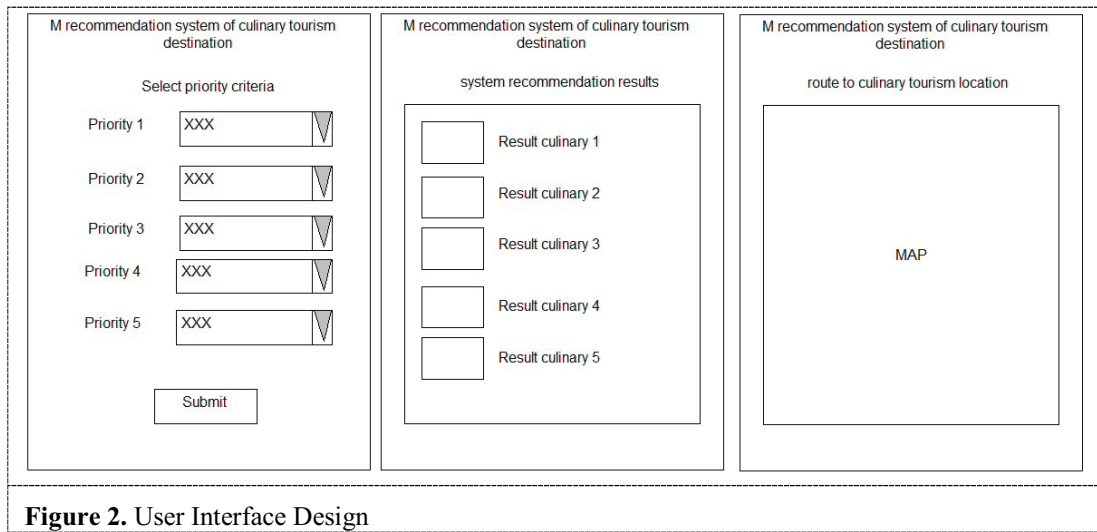
In addition to the criteria value, this recommendation system aims to provide recommendations to users based on priorities chosen by the user. Each user will have a different priority. There are users who prioritize prices over the environment and there are also users who prioritize taste over price. Giving priority weighting based on user perceptions with weight values as in table 2.

**Table 2.** Priority Weight

Priority	Weight	Description
Priority 1	5	Very important
Priority 2	4	Important
Priority 3	3	Normal
Priority 4	2	Not Important
Priority 5	1	Very unimportant

#### 4.5. Implementation

The implementation of the mobile recommendation system for culinary tourism consists of 3 pages. The first page is the page for selecting priority criteria by the user, the second page is the result of a system recommendation, and the third page is the display of the route to the location of culinary tourism in the form of a map. Figure 2 below is the design of the application interface.



**Figure 2.** User Interface Design

The application program as an implementation of the application design in figure 2. The results of the implementation of the mobile application system recommendation for culinary tourism destinations in Yogyakarta can be seen in Figure 3.



**Figure 3.** Mobile Application System Recommendation

4.6. Evaluation

Evaluation is done to test whether the system in the application has been running as expected. Testing this system is done by comparing the weight of similarity between systems with manual calculations. To calculate the suitability between the criteria of a culinary tourist spot and the criteria selected by the user, use equation 2.

$$S_{sim}(P, C) = (v_1 * w_1 + v_2 * w_2 + \dots + v_n * w_n) / (w_1 + w_2 + \dots + w_n)$$

Description:

P: Problem

C: case

V: similarity value

W = weight (given weight).

To do an evaluation, a similarity calculation is done manually on the sample data. Table 3 is sample data on culinary attractions that have been reviewed by 100 visitors. The review is to give a rating on the taste, environment, price and service.

**Table 3.** Destiation culinary tourism data

Code	Name	Rating			
		Taste (T)	Environmental(E)	Price (P)	Service (S)
T01	Bakmi mbah mo	4.10	3.40	4.00	4.00
T02	Angkringan lek man	3.80	3.50	4.20	4.00
T03	Kopi klotok	3.90	4.10	4.30	3.90
T04	Raminten	3.90	3.90	4.10	4.00
T05	Kopi cengkir	4.00	4.00	4.20	4.00
T06	Sate klatak pak pong	4.10	3.70	4.00	3.80
T07	Bong kopitown	3.80	3.90	3.80	3.90
T08	Banyu mili	3.90	4.00	3.70	4.20
T09	Gudeg pawon	3.80	3.70	4.10	3.80
T10	Jejamuran	4.00	3.90	4.10	3.90

Users who will look for culinary destinations have determined important and not important criteria for them. 5 criteria for culinary destinations are chosen by users based on priority with priority weights as in table 4.

**Table 4.** Priority by user

Priority	Criteria	Weight
Priority 1	Environmental(E)	5
Priority 2	Taste (T)	4
Priority 3	Service (S)	3
Priority 4	Distance (D)	2
Priority 5	Price (P)	1

Table 4 is an example of priority chosen by the user so that it will determine the weight of each criteria. When users access the system and activate GPS in realtime, the system will calculate the distance between the user's location and the location of the surrounding culinary attractions. This distance will be converted to the weight of the distance between the user and the kulier tourist spot. Table 5 shows the distance between users and real-time culinary tourism destinations.

**Table 5.** Distance between user and culinary tourism destinations

Code	Name	Distance (D)	Value
T01	Bakmi mbah mo	Far	1
T02	Angkringan lek man	Far	1
T03	Kopi klotok	Near	5
T04	Raminten	Near	5
T05	Kopi cengkir	Near	5
T06	Sate klatak pak pong	Far	1
T07	Bong kopitown	Far	1
T08	Banyu mili	Medium	3
T09	Gudeg pawon	Medium	3
T10	Jejamuran	Medium	3

Based on the location of the user who gave the distance (Table 5) and based on the priority weights of the criteria chosen by the user (table 4), the similarity value of the criteria of the user can be calculated with the culinary attractions. The similarity value between the criteria of users and tourist attractions T01 can be calculated as follows:

$$\begin{aligned} \text{Sim}(u, T01) &= (VT*WT + VE*WE + VP*WP + VS*WS + VD*WD) / \\ &\quad WT + WE+WP+WS+WD \\ &= 4.10*4 + 3.40*5 + 4.00*1 + 4.00*3 + 1*2 / 4+5+1+3+2 \\ &= 41,4 / 15 = 3,42 \end{aligned}$$

The similarity value for culinary tourism destination **Bakmi Mbah Mo (T01)** is 3.42. Calculations for tourist attractions T02 to T10 are carried out in the same way.. The results of this calculation can be seen in table 6.

**Table 6.** Result of similarity

Code	Name	Similarity
T01	Bakmi mbah mo	3,42
T02	Angkringan lek man	3,39
T03	Kopi klotok	4,14
T04	Raminten	4,08
T05	Kopi cengkir	4,14
T06	Sate klatak pak pong	3,48
T07	Bong kopitown	3,48
T08	Banyu mili	3,86
T09	Gudeg pawon	3,68
T10	Jejamuran	3,82

From table 6, the results of the similarity calculation can be obtained 5 recommendations for culinary tourism destinations with the highest similarity value. Data that can be recommended to users is shown in table 7.

**Table 7.** Highest similarity value

Code	Name	Similarity
T03	Kopi klotok	4,14
T05	Kopi cengkir	4,14
T04	Raminten	4,08
T08	Banyu mili	3,86
T10	Jejamuran	3,82

Table 7 is data on 5 tourist destinations recommended by the system with the highest similarity value.

## 5. Conclusion

The model-based collaboration filtering method using the KNN algorithm produces recommendations to assist users in choosing culinary destinations in Yogyakarta. This system can provide appropriate recommendations to users according to the parameters that the user wants. This recommendation system has shown that the mobile application recommended by culinary tourism destinations using the KNN algorithm has gone well.

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# SEKOLAH TINGGI MANAJEMEN INFORMATIKA DAN ILMU KOMPUTER EL RAHMA YOGYAKARTA

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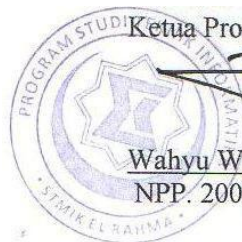
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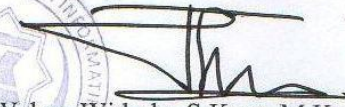
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