Designing Jakarta Halal Tourism Application with Collaborative and Location-Based Filtering Method as Jakarta Smart City Optimization

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Abstract: Jakarta is one of the Muslim-friendly tourist destinations in Indonesia. The DKI Jakarta government has various limitations in managing existing facilities, so community participation is needed. It encourages people to utilize application-based new media to answer the challenges and problems faced by Jakarta. A platform is required in the form of a digital application that can load destinations ranging from places, lodging, food, and facilities owned by tourist attractions labeled halal tourism to make it easier to find halal tourist destinations in Jakarta as an optimization of intelligent cities and contribute to SDGs. Halal tourism applications make it easier for people to get information related to Halal Tourism in Jakarta with the most popular development methods, namely collaborative filtering and location-based filtering methods. This method uses knowledge gathered from monitoring the behavior and personal choices of system users, who are generally known as personal profile users. The research method used is Research and Development (R&D) by designing an Android-based system. Data collection is an interview with sources with the DKI Jakarta Tourism and Creative Economy Office accompanied by expert information. The result of this research is the design of the Jakarta City Halal Tourism Application (SI PAHAJI) aimed at local and foreign tourists. The application contains information about tourist attractions, accommodations, and other facilities that are friendly to halal visitors in DKI Jakarta to help recommend tourist destinations in DKI Jakarta that follow user preferences and locations.

Keywords: Halal Tourism, Jakarta City, Smart City, Tourism Application

A. Introduction

There is an increase in the number of halal tourist destinations in various countries, and it turns out that halal tourism is not only developing in countries with a majority Muslim population. It is driven by the increasing number of Muslim tourists traveling to various countries worldwide, followed by multiple tourists demands for halal products and services in their destinations. The rising growth of halal tourism results in various tourist destinations having a competitive advantage in responding to the demand for halal tourism. Especially in countries where most of the population is Muslim, such as Indonesia (Hanifah, 2015).

The Ministry of Tourism organized the Indonesia Muslim Travel Index (IMTI) in 2018 and 2019 to accelerate the development of national halal tourism destinations with global standards. The IMTI assessment is conducted by CrescentRating-Mastercard using four leading indicators set by the Global Muslim Travel Index (GMTI), namely accessibility, communication, environment, and service. The results of the assessment of the four main aspects will automatically determine the top five priority halal tourist destinations in Indonesia in 2019, successively achieved by Lombok (West et al.) with a score of 70, Aceh with a score of 66, Riau and Riau Islands with a score of 63, DKI Jakarta with a score of 59, and West Sumatra with a score of 59 (Kemenparekraf.go.id., 2019).

Jakarta is one of the Muslim-friendly tourist destinations in Indonesia. One of the advantages is, of course, the facilities available in Jakarta. In fact, in World Halal Tourism Award 2016, Jakarta was awarded World's Best Hajj & Umrah Operator. Of course, this success becomes a new door in creating Muslim-friendly tourism in Jakarta. Halal hotel facilities are also widely available in Jakarta. Based on the data contained in the Kemenparekraf (Ministry of Tourism and Creative Economy) website, Jakarta has 510 halal-certified hotels, 5 sharia-type hotels, 7,795 mosques, 20 Islamic heritage sites, and 19 Muslim-friendly destinations (Tempo.com, 2022).

Information and communication technology development, especially new media, is utilized in government activities in DKI Jakarta to help improve good governance in general and as an application of the Smart City concept that is being implemented. Jakarta, as the capital city, has learned from several towns worldwide to respond to the complexity of its problems by optimizing resources and utilizing technology to make it easier for citizens to interact with the government and enjoy public facilities. The breakthrough made is by implementing the Jakarta Smart City concept.

A smart city is an innovative concept that utilizes technology to change systems, operations, and services. It then oversees and integrates all infrastructure to optimize resources, plan maintenance activities, and manage security to maximize its benefits to the community (Pratiwi & Sakarov, 2014). The reality faced by Jakarta as a sizeable multi-ethnic city with a high population density makes people's expectations of government services and fulfillment of facilities a challenge in realizing this intelligent city. The DKI Jakarta government has various limitations in managing existing facilities, so community participation is needed. It encourages people, such as academics or students, to utilize application-based new media as a way to answer the challenges and problems faced by Jakarta.

The development of technology has greatly assisted the world of tourism. However, the application of halal tourism in Indonesia still needs to be improved and requires more socialization to introduce halal tourism. The presence of information technology creates many business opportunities to introduce halal tourism. Tourism actors and stakeholders can easily promote their assets through available media. With the company of technology, it is hoped that in the future, there will be more innovations and creations developed for the advancement of halal tourism at the global level. A platform is needed in the form of a digital application containing all

destinations ranging from places, lodging, food, and facilities owned by tourist attractions labeled halal tourism to make it easier to find halal tourist destinations in Indonesia. The application platform also has a travel map to provide detailed information on the distance tourist's travel.

Tourism is a very strategic sector in implementing the Sustainable Development Goals (SDGs) because tourism has an important role in cultural preservation, environmental protection, creating jobs, economic growth, and development (UNWTO, 2018). One of the tourism segments that can contribute to the SDGs is halal tourism.

Halal tourism is tourism that is run following Islamic principles. The Organization of Islamic Cooperation (OIC) uses the term Islamic Tourism which means tourist trips made by Muslim tourists to historical, religious, and Islamic-related tourist destinations (Musa, Ali, & Moghavvemi, 2017). This type of halal tourism is also often referred to as Halal Friendly Tourism, a tourism product that complies with Islamic sharia. This type of tourism can be an option for tourists who avoid conventional tourism to join the activities of women and men in public places, such as beaches and swimming pools with minimal clothing, and restaurants and hotels that serve pork or alcoholic beverages (Ramli, 2012).

Tourism and the SDGs are mutually beneficial. With the increase in international tourist visits and the halal tourism segment, it can impact a country's economy so that it can overcome poverty, protect the environment, and empower inclusive communities to improve people's welfare. Halal tourism also has the same principles as the SDG, which focuses on the environment and community empowerment and enhances tourist destinations' economies. It can also be applied in various countries because halal tourism is an option to provide service facilities and access to worship to Muslim tourists. Still, non-Muslim tourists can also enjoy these facilities, such as halal food and drinks (Subarkah & Rachman, 2018).

The design of tourism applications that are widely developed today has been recognized by researchers in mobile tourism as a factor in commercial success in tourism. Initially, the emergence of tourism applications using personalization systems was successful in e-commerce sites because it provided a recommendation system by offering products and information to consumers to help them decide on purchasing products or services. These systems are known as "Recommender Systems" because they are based on filtering information to recommend content to users, such as movies, books, news, and web pages. One of the most popular methods in recommender systems is collaborative filtering. This method uses knowledge gathered from monitoring system users' behavior and personal choices, commonly known as individual user profiles (Arief et al., 2012).

Then, the Location Based Filtering method will produce recommendations for tourist attractions closest to the user's current location. The Location Based Filtering method aims to make it easier for tourists to find nearby tourist destinations. This method was chosen because it can take reference to the user's coordinate points in real time and automatically filter the tours to sort them based on the closest distance.

Previous research that is relevant to this research is conducted by Githa (2019). The research designed a recommendation system for tourist destinations in Bali. The results obtained from the study state that the recommendation system that has been made can run as expected. Another related research is a recommendation system for choosing tourist attractions in Batu City which was conducted by Ningrum (2020) using Item-Based Collaborative Filtering and Location Based Service methods. The results obtained in this study show that the system can be used in selecting tourist attractions in Batu City and helping users get information. In addition, research conducted by Rendra Sandi (2020) made a culinary tourism recommendation system for Malang City using two methods, namely Collaborative Filtering and Location Based Filtering. The Location Based Filtering method in the study can provide recommendations for the closest location to the user. Then, the Collaborative Filtering Method performs the process of filtering or evaluating items based on other people's opinions by providing information to consumers based on similar characteristics. This research's novelty is applying the Collaborative Filtering and Location Based Filtering methods in making halal tourism applications in Jakarta.

One of the most popular mobile operating systems (OS) is Android, with Android accounting for 76.3% of the market, iOS 13.2%, Windows Home 3.7%, BB OS 2.9%, Linux 0.8%, Symbian 0.2%, and others 0.0% (IDC, 2014). From this data, the Android operating system has the most significant number of users. Android is also an open-source operating system, so developing and using applications is relatively more straightforward. The ease of software development is an advantage of the Android operating system. Halal tourism application for Jakarta in optimizing Jakarta Smart City was made as an Android application.

This research designed halal tourism applications with the Android operating system to make getting information about halal tourism in Jakarta easier. The application is designed to run on the user's mobile device using collaborative filtering and location-based filtering methods to help recommend tourist attractions that match the user's preferences and location. This research discusses how to build a better tourism application system than the manual way. The result of this research is the design of an Android-based halal tourism application in Jakarta. The application is expected to optimize the Smart City concept that the Jakarta City government is running to facilitate tourists in obtaining information about halal tourist destinations in Jakarta to increase tourists in Jakarta. An increase in tourists can also improve the economic conditions of the surrounding community, which is in line with the ideals of the SDG's.

B. Methods

The research method used in designing applications is Research and Development (R&D) by developing an Android-based system. According to Sugiyono (2017), research and development methods are used to produce products and test the effectiveness of a product. To produce specific products, research is used, which is a needs analysis (need assessment) and to test the product's effectiveness to function in the community (Sugiyono, 2017).

System development in this study used the Software Development Life Cycle (SDLC). SDLC is the process of making and changing the system and the flow and methods used in developing a strategy. SDLC is a type of method used to develop a software system consisting of several stages: planning, analysis, design, implementation, testing, and maintenance. The SDLC model used in this research is the Waterfall model because stage by stage must be passed until completion and run sequentially. This model is generally used in learning Software Engineering (SE), which offers a more real way of making software (Bassil, 2012). The details of each stage are explained in the figure below.
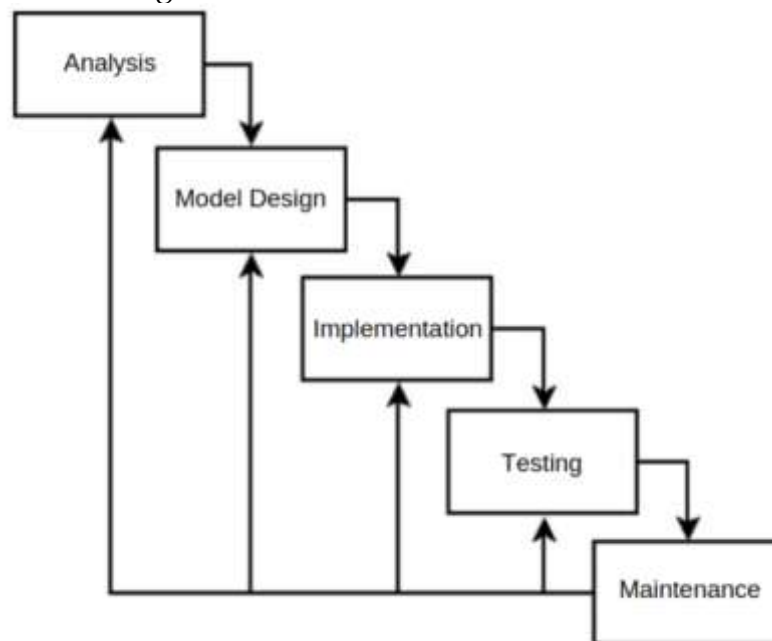

Figure 1. Waterfall Model

a) The analysis stage was carried out to obtain the information needed to develop the system to suit user needs. At this stage, interviews were conducted with the DKI Jakarta Tourism and Creative Economy Office to find an overview of DKI Jakarta halal tourism and identify the content needed during the application development process. In addition, an analysis of user and system needs is carried out in the form of a use case diagram at this stage.

b) The Model Design stage was used to recap the needs in making the system, including flowchart, Use Case Diagram, Database, and System Interface Design. In this stage, designing the system's needs was carried out, and then a solution to the existing problems will emerge by presenting it in the form of a *Flowchart* and data structure and discussion. In this design, there is an implementation of the needs mentioned in the previous stage.

c) The Implementation Stage was making and coding the Jakarta halal tourism recommendation system. At this stage, an information system was created according to the results of the design stage. The predetermined methods were implemented to determine recommendations for halal tourist attractions based on user character and location. The *Collaborative Filtering* method produces

recommendations for halal tourist attractions based on user character. Then, the *Location Based Filtering* method produces recommendations for culinary tourist attractions closest to the user's current location. This stage is the application of the design stage, which the programmer technically did.
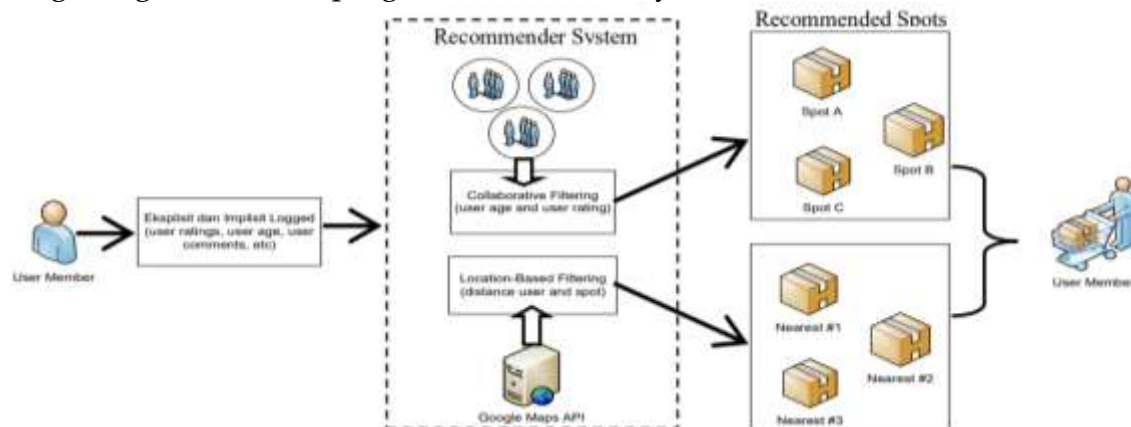

Figure 2. Blog Diagram of Recommendation System (Arief et al., 2012)

d) The System Testing stage in this study used User Acceptance Test (UAT) and black box testing to determine whether the system was as expected. The black box testing method aims to test the function of each part of the software being developed, whether the input and output have run as expected, and whether the information stored is always kept up to date (Krismadi et al., 2019). UAT testing conducted by users is intended to form a document that is used as evidence that the system developed is acceptable or not by the user. In this test, the end-user is responsible for ensuring that all system functionality has been tested correctly. UAT is the last stage of testing a system (Supriatna, 2018).

e) System Maintenance Stage in this process was carried out to maintain the system that has been successfully developed. Software that has been sent to the customer can change because the software has an error, or the software must be adapted to adjust to the external environment, for example, the existence of a new operating system or new peripherals, software that is more refined due to requests from customers.

C. Results and Discussion

The research procedure used was the SDLC Waterfall Model. Based on the steps in the model, the research was grouped into three main stages. The design stage consists of the analysis stage, model design stage, and implementation stage. Next is the testing stage, which consists of the system testing and maintenance stages. The design stage was carried out in the first year of this research, while the testing stage was carried out in the following year. The following is an explanation of the SI PAHAJI design stage process.

Analysis Stage

At this stage, interviews were conducted with the DKI Jakarta Parekraf Office to find an overview of DKI Jakarta halal tourism. At this stage, identifying features and content needed during the application development process was also done. In addition, at this stage, an analysis of user and system needs was carried out in the form of a use case diagram. The following is the explanation.

Overview of DKI Jakarta Halal Tourism
Based on the Final Report of DKI Jakarta Halal Tourism Product Development Activities in 2019, halal tourism in DKI Jakarta presents a variety of destinations and experiences that follow Islamic principles to meet the needs of Muslim tourists. The following is an overview of halal tourism in DKI Jakarta and its characteristics:
1. **Halal Food**: DKI Jakarta offers many restaurants and food stalls that serve halal food. Muslim travelers can enjoy dishes that comply with Islamic principles, local Indonesian food, Asian food, or international dishes. Some restaurants also have halal certification to assure travelers.
2. **Worship Facilities**: DKI Jakarta has several mosques scattered in various locations. Muslim travelers can easily find places of worship to perform prayers, ablutions, or other worship. Some hotels and shopping centers also provide worship facilities, such as prayer rooms, for the convenience of Muslim tourists.
3. **Religious Destinations**: Several destinations in DKI Jakarta have religious value for Muslim tourists. An example is the Istiqlal Mosque as, the largest mosque in Southeast Asia, which is a spiritual tourist destination. In addition, tourists can also visit the Old City area, which has a rich Islamic history with several interesting historical buildings and museums.
4. **Halal Shopping Center**: DKI Jakarta has various shopping centers that provide halal products and services. Muslim travelers can find various shops selling halal products, ranging from food and beverages, Muslim clothing, and halal cosmetics to prayer equipment.
5. **Halal Activities and Events**: DKI Jakarta also organizes activities and events that follow Islamic principles. For example, Quran recitation, Islamic seminars, Islamic arts and culture festivals, and halal product exhibitions. These events allow Muslim travelers to deepen their religious knowledge and experience.
6. **Muslim-Friendly Transportation**: Transportation systems in DKI Jakarta (such as taxis, *online transportation*, and public transportation) generally provide Muslim-friendly facilities, such as stops close to mosques or facilities for ablution at airports and terminals (DKI Jakarta Provincial Tourism and Culture Office, 2019).

The characteristics of halal tourism in DKI Jakarta reflect a commitment to providing services and facilities that meet the needs of Muslim tourists. With halal food, adequate worship facilities, religious attractions, halal shopping malls, Islamic events, and Muslim-friendly transportation, DKI Jakarta strives to be a comfortable and Islamic-friendly destination for Muslim tourists. Therefore, DKI Jakarta has great

potential as the center of the world's halal tourism destination with good accessibility, especially adequate infrastructure.

Based on the response from the DKI Jakarta Parekraf (Tourism and Creative Economy) Agency, developing an application that provides halal tourism information in DKI Jakarta is a good and important step in meeting the needs of Muslim tourists. With the application, tourists will find it easier to find and access information related to attractions, accommodations, and other facilities that are friendly to them. Halal tourism application can help promote DKI Jakarta tourism to local and foreign tourists. Comprehensive information on tourist attractions, mosques, and travel tips and guidelines can help tourists better plan their visit. In addition, this application can also benefit DKI Jakarta's tourism sector, as it can increase the attractiveness of friendly tourist destinations and provide services that suit the needs of Muslim tourists. The application can help build a positive image by optimizing Jakarta Smart City by providing accurate and up-to-date information.

User Requirement Analysis

The Si Pahaji application system was aimed at prospective global tourists who want to know halal tourism information in DKI Jakarta. Users need an information guide that is expected to offer information passively and be more active in recommending halal tourist spots/places in DKI Jakarta automatically based on user preferences and needs. The user and system needs are analyzed using a use case diagram at this stage. The use case diagram describes the sequence of actions of the actors and the capabilities they can perform in the system. The figure below describes the actors and their actions in the system.
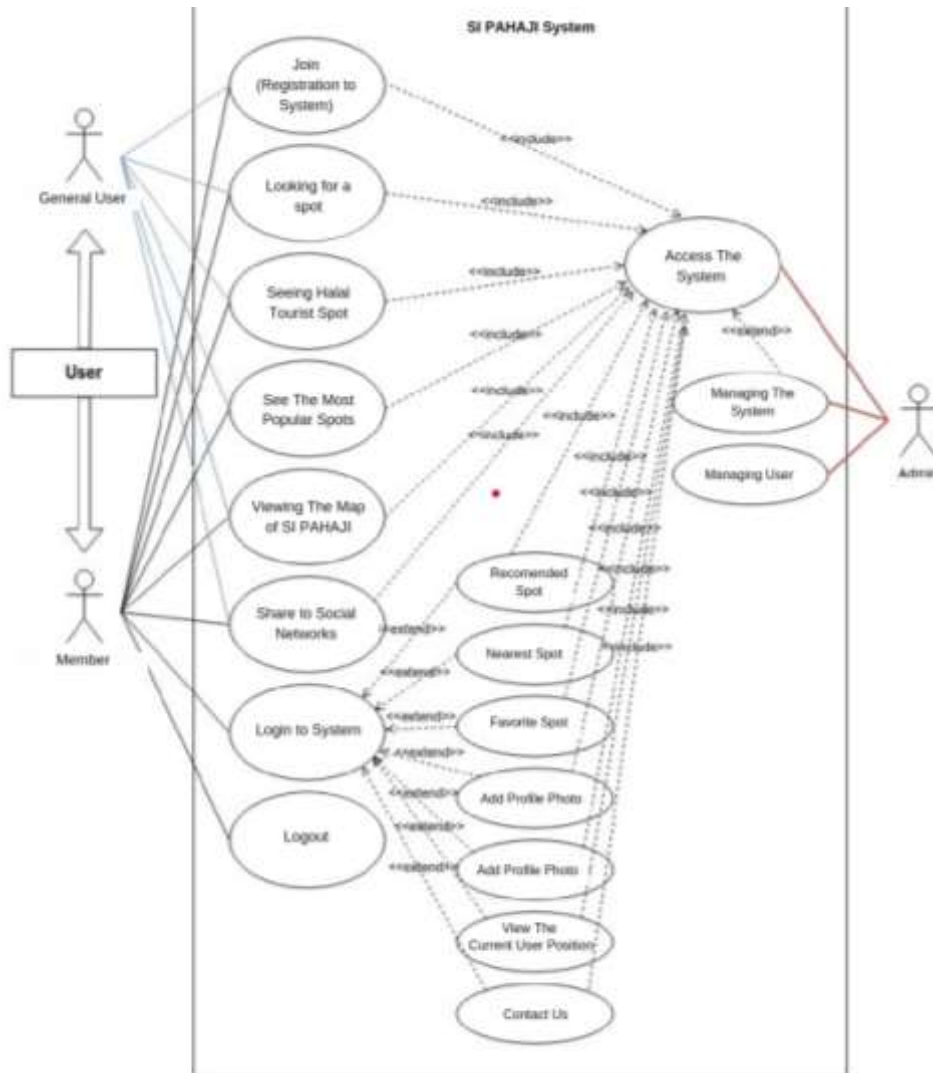
Figure 3. *Use Case Diagram of SI PAHAJI*

System Requirements Analysis

Si Pahaji is a mobile web application based on the JQuery Mobile platform. This application consumes data already available in a more extensive Si Pahaji system. The system architecture can be seen in the figure below.
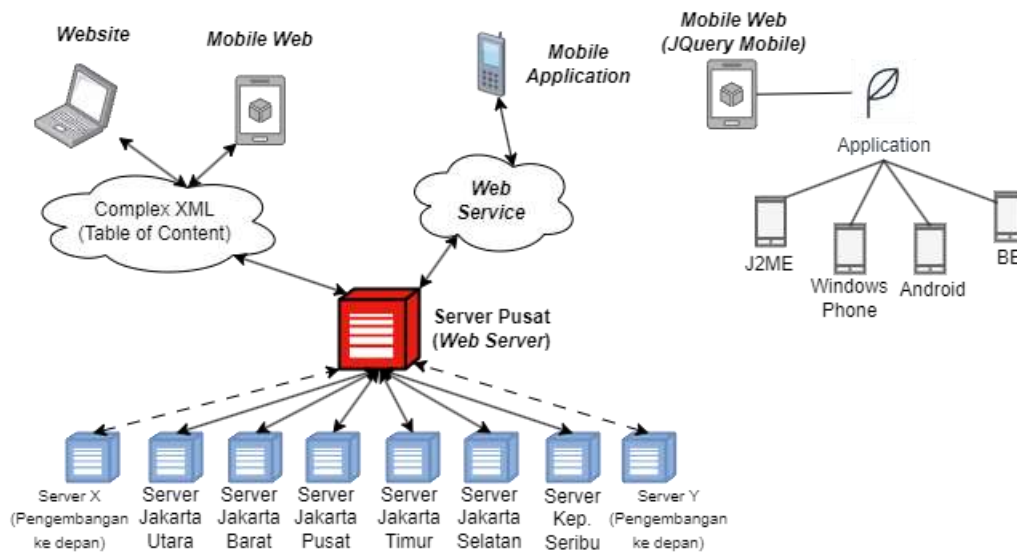
Figure 4. SI PAHAJI System Architecture

Model Design Stage

At this stage, database design and interface design were carried out. The following is an explanation of the two stages.

Database Design

Database design was the database system design that would be used according to system needs. In implementing the JMG system, we use MySQL as the database system used. The system database design is shown in the figure below.

Figure 5. System Database

Interface Design

The interface in the Si Pahaji application uses browser support as an application page to display information to users. The sketch display in the Si Pahaji halal tourism application is shown in the figure below.
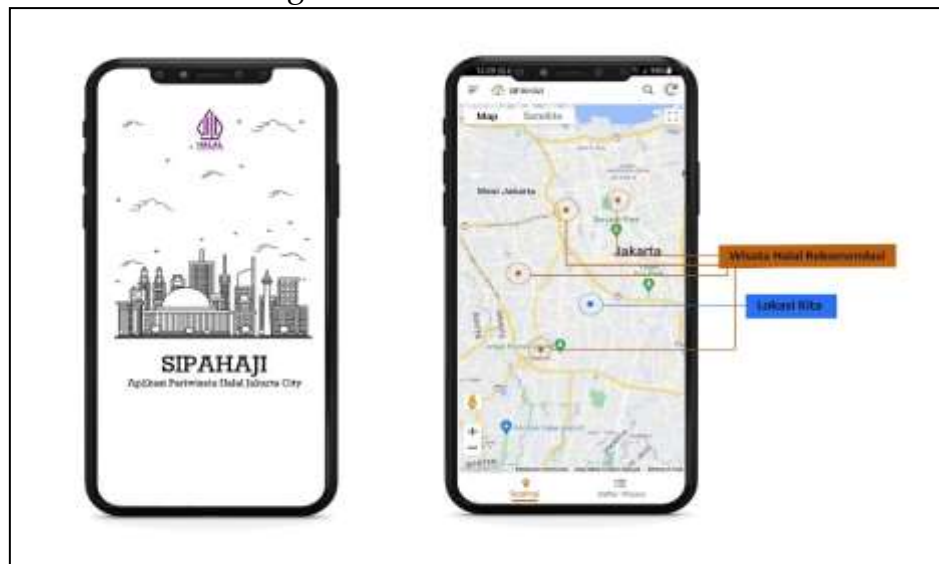

Figure 6. *SI PAHAJI* Interface Design

Implementation Stage

In the implementation stage, practical system testing of the products that have been developed was carried out. System tests carried out include functionality testing, compatibility testing, and recommendation system testing. This test was intended to determine whether the application has been made per the specified design. Testing was also carried out to determine if there were functions that still could not run properly.

Functionality Testing

This functionality test was carried out on a simulator or mobile apps emulator on a computer and tested on an actual device. The test interface using Opera mobile simulator is shown in the figure below.

Figure 7. Display of Application Testing Results

Compatibility Testing

At this stage, application compatibility testing was conducted on differences in cellphone specifications and various browsers. It is done to determine whether the application can run competently with various mobile devices and existing browser technologies. The figure below shows the application's compatibility with real devices (mobile phones).
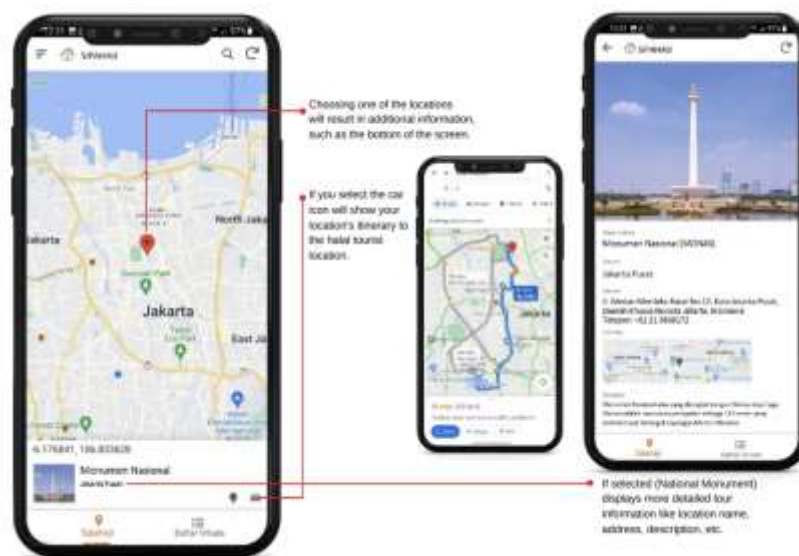

Figure 8. Display of *SI PAHAJI* on a *smartphone*

The Testing of CF and LBF Recommendation System

Testing the recommendation system is checking the recommendation system made using the collaborative filtering method, compared with the output of the data mining software tool WEKA version 3.6.6, a good modeling simulation tool for data mining calculations (Witten, 2011). Then, the LBF method was tested by comparing the output of the JMG system with the results of manual calculations (calculations with formulas). It was done so that the results of the system output can be seen with the basic theoretical calculations used, whether appropriate or not.

Testing the recommendation system with the CF method was done by comparing the JMG system's output with the WEKA tools that use the Hiracrical Clusterer method. The results are shown in the table below.

Table 1. Comparison Data with CF Method

User_name	Spot Recommendation Based on WEKA *Clustering* Simulation	Spot Recommendation Based on SI PAHAJI Application
User_1	Spot_3	Spot_3
User_2	Spot_10	Spot_10
User_3	Spot_1	Spot_1
User_4	None	None
User_5	Spot_9	Spot_9
User_6	Spot_1	Spot_1
User_7	Spot_4	Spot_4
User_8	Spot_3	Spot_3
User_9	Spot_5	Spot_5
User_10	Spot_6	Spot_6
User_11	Spot_1 and Spot_3	Spot_1 and Spot_3
User_12	Spot_10	Spot_10
User_13	Spot_2 and Spot_3	Spot_2 and Spot_3
User_14	Spot_5	Spot_5
User_15	Spot_5	Spot_5
User_16	None	None
User_17	Spot_4	Spot_4
User_18	Spot_9	Spot_9

User_19	Spot_5	Spot_5
User_20	Spot_6	Spot_6
User_21	Spot_7	Spot_7
User_22	Spot_5	Spot_5
User_23	Spot_9	Spot_9
User_24	Spot_4 and Spot_7	Spot_4 and Spot_7
User_25	Spot_2 and Spot_3	Spot_2 and Spot_3
User_26	Spot_2	Spot_2
User_27	Spot_1	Spot_1
User_28	Spot_9 and spot_10	Spot_9 and spot_10
User_29	Spot_2 and Spot_10	Spot_2 and Spot_10
User_30	Spot_3 and Spot_5	Spot_3 and Spot_5

Testing the recommendation system based on the LBF method was done by comparing the system implementation with the results of manual calculations. System testing by manual calculation is quite simple, namely by calculating the closest distance based on distance calculations using the Haversine formula by knowing the latitude and longitude coordinates of the user from the latitude and longitude coordinates of the spot contained in the system database.

Table 2. Comparison Data with LBF Method

Coordinates	User Position	Spot_1	Spot_2	Spot_3	Spot_4	Spot_5
Latitude	-7,766981	-8,03412	-8,017233	-7,97191	-7,974861	-7,919762
Longitude	111,371875	110,336112	110,298566	110,318177	110,279566	110,352161
Distance (based on a formula) (Km)	0	17,68777	15,98444	15,454545	14,67777	10,17770
Distance (based on system) (Km)	0	± 17,01	± 13,45	± 10,22	± 14,31	± 16,11

D. Conclusions

The development of the SI PAHAJI system as a mobile tourism guide based on the CF method can automatically provide recommendations/suggestions for halal tourist spots to users according to their preferences. The SI PAHAJI application uses

a Location Based System approach using the Location Based Filtering (LBF) method that can provide recommendations for tourist and culinary spots based on the closest distance from the user's current location. The SI PAHAJI system was built as a mobile web using JQuery Mobile technology/framework, which has an attractive interface because of its interactive appearance and uses a good theme. The system has also been developed using the concept of personalization so that system users are grouped into three user levels: general users, member users, and admins. The testing of the recommendation system with the CF method compared to the WEKA data mining tools output and the LBF method compared to manual calculations shows that both have the same output results (the system is successful).

Acknowledgments

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