

IMPLEMENTATION OF THE HAVERSINE METHOD FOR THE APPLICATION OF FINDING TOURIST ATTRACTIONS IN THE NANGGUNG DISTRICT

Fety Fatimah^{1*}, Safaruddin Hidayat Al Ikhsan², Berlina Wulandari³

Teknik Informatika
Universitas Ibn Khaldun
www.uika-bogor.ac.id

fety.fatimah@uika-bogor.ac.id^{1*}; safaruddin@uika-bogor.ac.id²; berlina@uika-bogor.ac.id³

(*) Corresponding Author

Abstract— Traveling is one of the most popular hobbies nowadays. Natural tourist destinations located in the countryside are a choice for travellers. There are several tourist sites located in the country of Bogor, one of which is in the district of Nanggung. Nanggung sub-district is in the region of west Bogor, approximately 60 km from the capital city of Bogor Regency (Cibinong). The location of the Nanggung sub-district has an area of 135.25 km², located near the foot of Mount Salak, creating a beautiful atmosphere and quite cold air. There are approximately 30 tourist destinations in the Nanggung sub-district. Base mobile application to help tourists determine the nearest destination. This mobile application helps domestic and foreign tourists select the closest tourist sites visited in Nanggung, Bogor Regency. The haversine method used to calculate the distance is the haversine method. The haversine method estimates the distance. Haversine will calculate the distance between the application user and the location of the surrounding tourist points located in the Nanggung sub-district. This study aims to calculate the length of application users to tourist sites. So that users get convenience in determining the closest location from the application user's position.

Keywords: distance measurement, tourist destination, Nanggung District, Haversine Method

Abstrak— Travelling menjadi salah satu hobi yang diminati saat ini. Tujuan wisata alam yang terletak disudut-sudut kota menjadi alternatif pilihan bagi para traveller. Terdapat beberapa lokasi wisata yang terletak dikabupaten bogor, salah satunya adalah di kecamatan nanggung. Kecamatan nanggung terletak di sebelah barat kota bogor sekitar 60 km dari ibu kota kabupaten bogor (Cibinong). Lokasi kecamatan Nanggung memiliki luas wilayah 135.25 km², terletak di dekat kaki Gunung salak membuat suasana asri dan udara yang cukup dingin. Ada kurang lebih 30 titik tujuan wisata di kecamatan nanggung. Untuk

memudahkan wisatawan menentukan lokasi tujuan terdekat dirancanglah aplikasi berbasis mobile. Aplikasi berbasis mobile ini dibuat untuk membantu para wisatawan domestik maupun luar negeri untuk menentukan lokasi wisata terdekat yang bisa dikunjungi selama berada di Nanggung, kabupaten Bogor. Metode perhitungan yang dipergunakan dalam menghitung jarak adalah metode haversine. Metode haversine merupakan metode yang banyak dipergunakan dalam perhitungan jarak. Haversine akan menghitung jarak antara pengguna aplikasi dengan lokasi titik wisata disekitarnya yang terletak di kecamatan nanggung. Tujuan dari penelitian ini adalah melakukan perhitungan jarak pengguna aplikasi ke lokasi wisata. Sehingga pengguna mendapatkan kemudahan dalam menentukan lokasi terdekat dari posisi pengguna aplikasi.

Kata Kunci: jarak, destinasi wisata, kecamatan nanggung, metode haversine

INTRODUCTION

Bogor Regency has great tourism potential, especially in the Nanggung district. Nanggung sub-district at the latitude -6.6063215, Longitude: 106.5289422. With a beautiful atmosphere, 60 km from the centre of Bogor Regency, Cibinong (Astaire Kartika, Indarti Komala Dewi, 2019). Excellent road access is also an added value to developing Nanggung sub-district as a tourist destination. Approximately 30 points of the tourist destinations are spread over ten villages in the Nanggung sub-district. Many distribution points make it difficult for tourists to determine the travel route while in the Nanggung sub-district.

For this reason, we need a travel application that provides alternative trips to Nanggung tourist points. Research related to Nanggung is a Web-Based Data Management System to Support Android Applications for the

Distribution of Nanggung Tourist Locations (Hidayat et al., 2020) and Web-Based Design of a Tourism System Nanggung District, Bogor Regency (Ikhsan et al., 2019). This study aimed to determine the distance between android application users and tourist sites.

This research aims to make a Nanggung tourism application using the Haversine method. Android-based tourist location distribution application using the Location-Based Services (LBS) method and the Haversine formula to measure the distance of application users to tourist locations. So that users get convenience in determining the closest location from the application user's position while they are in the Nanggung sub-district.

MATERIALS AND METHODS

Mobile Application

Applications are made based on pre-made designs. The application is based on Mobile Application, using Android Studio as its IDE (Integrated Development Environment). The primary programming language in making this mobile application is Java. In making the mobile application for the distribution of tourist sites, apply the LBS Method and the Haversine formula. The use of the LBS Method to map the location of application users according to the coordinates of the smartphone location (Fatimah & Ikhsan, 2019)

Location-Based Service Analysis (LBS) provides an overview of determining location-based services in the application (Capah & Herdi, 2021). This LBS service starts when you open an application asking the user to activate the GPS, which helps access the user's location in coordinates (latitude, longitude). LBS in this application determines which tourist location information services are appropriate based on the user's location and the filters provided.

Use Case Diagram

Use case diagrams to understand system functions and present actor interactions with the system. The component then describes the communication between the actor and the design. The use case diagram of Figure 1 shows the mobile-based tourism application in this study.

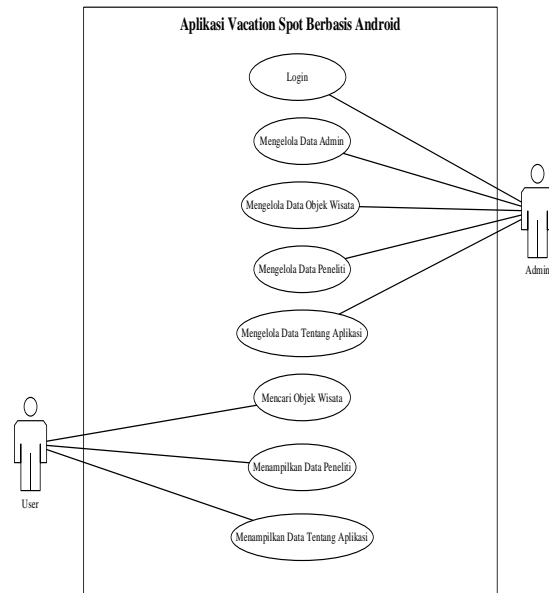


Figure 1. Use Case Diagram

Data collection

Stages of data collection by direct observation of tourist sites in Nanggung District, by obtaining the coordinates of the latitude and longitude of tourist sites and data related to these tourist sites. The results of the database design through the tables used in mobile-based tourism applications (Figure 2).



Figure 2. Database Table on Travel Application

Haversine Method

The method used in calculating the distance between Mobile application users and tourist destinations is the Haversine Method. Haversine is a method to determine the distance between two points, which assumes that the earth is not a line but a curve with a curvature degree [Arizal]. The

Haversine formula is a method of measuring between points by measuring latitude and longitude. Assuming that the earth is perfectly spherical with a radius of R 6,371km, the locations of the 2 points on the coordinates of the sphere (latitude and longitude) are long1, lat1, and long2, lat2, respectively. The Haversine formula gives the distance of a large circle between two points on the surface of a sphere (earth) based on longitude and latitude (Pamungkas, 2019).

Haversine Formula Implementation in the SoH Application The Haversine formula calculates the distance between the user's location and the intended destination point. How to calculate it as below (Purbaningtyas et al., 2019):

1. The system will retrieve the coordinate data (lat one and lon1) of the current location of the user
2. From each potential group of selected areas, it will collect the coordinates' data (lat two and lon2) of the potential point
3. System will display the selected potential area in a sequence based on the value of the nearest distance.

Haversine Formula has its law that all equations are used based on the shape of the spherical earth by eliminating the factor that the world is slightly elliptical (ellipsoidal element). It is a particular case of a general formula in spherical trigonometry related to the sides and angles of a spherical triangle. A certain degree of curvature affects the calculation of the distance from one point to another on the earth's surface (Dauni et al., 2019). Therefore, the choice of distance calculation method on the earth's surface dramatically affects the accuracy of the results obtained. The haversine formula is a method that calculates the considered distance appropriately and accurately. The Haversine formula calculates the distance between two points using latitude and longitude data in this research. (Basyir et al., 2018)

Use the Haversine formula to calculate the distance between two different points. We are applying the Haversine formula to calculate the distance between a user and a series of events. Determine visitor attendance by calculating the half-sine procedure's results with each event's radius. If the user is within the radius, the number of visitors is updated. In this research, we implemented this method in the android application. (C. N. Alam, K. Manaf, 2016)

RESULTS AND DISCUSSION

Nanggung sub-district is administratively a Bogor Regency, West Java Province region. Nanggung District at an altitude of 400 m above sea level (masl), with rainfall of 3000 - 3500 mm per year. Nanggung sub-District has ten villages, 32 backwoods, 98 community units (RW), and 342 neighbourhood units (RT). The area of the Nanggung sub-district consists of a wavy to the hilly area (70%), then a hilly to the mountainous area (50%), and a flat to a choppy site (40%).

With an area of ±11,972,962 hectares, the Mount Halimun Salak National Park [2] is a part of the Nanggung sub-district, as shown in Figure 3.

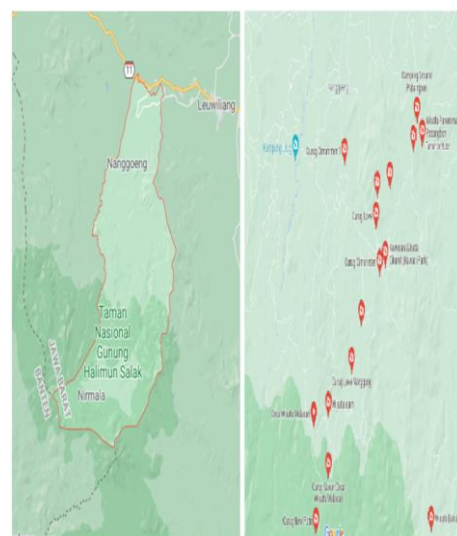


Figure 3. Map of Nanggung sub-district and the distribution of tourist sites

This research uses Latitude and Longitude data. Latitude determines the location north or south of the equator. Space is measured from 0 degrees from the equator to 90 degrees at the poles. Longitude determines the location to the west or east of the north-south line, often called the meridian. Longitude is measured from 0 degrees in the Greenwich area to 180 degrees on the International Date Line (Pamungkas, 2019). Table 1 shows examples of tourist location data in the Nanggung District.

Table 1. Data for Tourism Locations in Nanggung sub-district

NO	NAMA WISATA	LATITUDE	LONGITUDE
1	Air Terjun Curug Macan	-6,709881	106,523002
2	Curug Piit	-6,709305	106,535369
3	Kebun Teh Nirmala	-6,706935	106,524521
4	Leuwi Bombang	-6,693889	106,526111
5	Curug Sawyer	-6,690555	106,53109
6	Sawah Terasing 1001 Undak	-6,684258	106,524704

NO	NAMA WISATA	LATITUDE	LONGITUDE
7	Kecamatan Nanggung	-6,679577	106,519427
8	Desa Wisata Malasari	-6,679545	106,521208
9	Curug Pasakan	-6,668611	106,532222
10	Curug Bajing	-6,668333	106,529167
11	Kolam Renang Cisangku Endah	-6,6675	106,514722
12	Curug Nyunclung	-6,667002	106,527911
13	Prasasti Jambu Batu Tulis	-6,571822	106,55789
14	Rumah Sejarah Bupati Bogor	-6,668611	106,532222
15	Spot Jamur Supalumar	-6,746477	106,537633
16	Canopy Trail	-6,746636	106,537714
17	Homestay Citalahab Central	-6,738225	106,530861
18	Green House	-6,730182	106,497885
19	Curug Love	-6.63085	106.56275

Here is the formula of the Haversine Formula (Fauzi et al., 2018):

$$X = (LoT - LoA) * \cos((LA + LT))/2$$

$$Y = (LT - LA)$$

$$d = \text{sqrt}(x * x + y * y) * R$$

Information:

x = Longitude (Latitude)

y = Latitude (longitude)

d = Distance

R = Radius of the Earth = 6371 km

(1 degree = 0.0174532925 radians)

Steps to calculate the closest distance to a tourist location:

1. Determine the starting location of the search

Let's say the starting point is:

Location of Origin: Kujang Antam Monument
(Nearest location to the main road)

Latitude: -6.56476

Longitude: 106.56197

2. Find the distance from the starting point to the tourist location

An example destination point:

Destination Location: Curug Love

Latitude: -6.63085

Longitude: 106.56275

Calculation Process:

LA : -6.56476 LoA : 106.56197

LT : -6.63085 LoT : 106.56275

$$d = \text{sqrt}(x * x + y * y) * R$$

$$= \text{sqrt}(0,000000001829 + 0,0000013305369) * 6371$$

$$= \text{sqrt}(0,0000013307198) * 6371$$

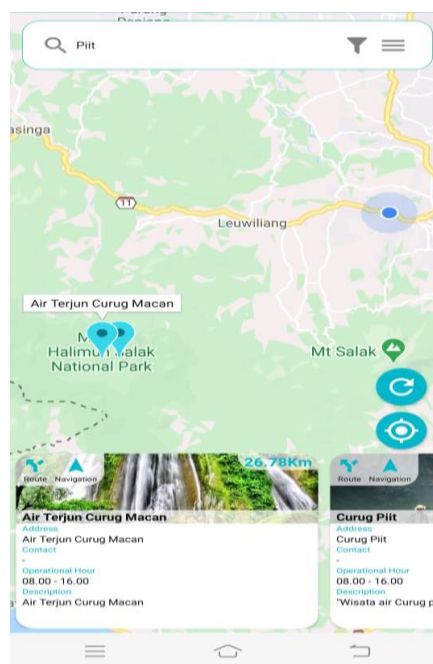
$$= 0,001153569 * 6371 = 7,349388099 \text{ km}$$

The calculation starts from the point of origin of the application user to the end of the tourist location. After the analysis results appear, the user quickly decides on a tourist route in the Nanggung district area. Some sections in the

Mobile application show Distance Calculations with the Haversine Method (Fatimah & Ikhsan, 2019).

The application explains the name of the tour in Nanggung Regency and complete information in the form of operational times and an explanation of the tourist attractions. And there is a distance from the application user's position to the location of the destination tourist point. We see this in Figure 4 and Figure 5.

The needs of Android users for a system that uses this tourist location detection application are the user's needs for tourist sites. Tourist locations using the tourist attractions map interface are available to place information in the application. (Putra, 2019)



Picture 4. Distribution and Distance to Tourist Locations

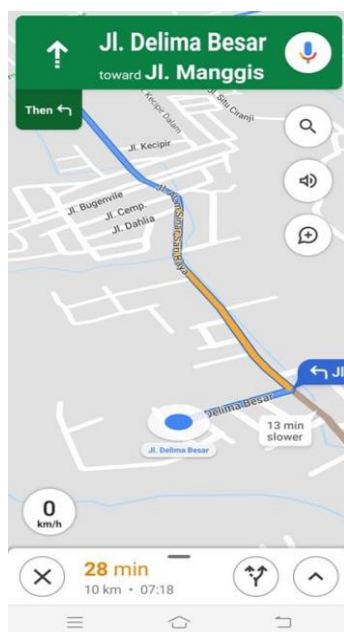
The calculation data for the distance from tourist sites to the position of the application user using the Haversine formula is displayed in the detailed information of each tourist attraction. Figure 4 shows the radius filter page on the Android-based tourist location distribution

application and the Haversine formula calculation results related to the distance of the tourist location from the user's location. (Abdillah et al., 2019)



Picture 5. Operational Hours Information and Tourist Attraction Description

In applications, be it interface design for input and the output is searched which is familiar to the end-user, so that more easy and fast for end-users to adapt to this app. Interface design consists of the top of the frontend and backend interfaces. (Anwar et al., 2015)



Picture 6. Android-Based Travel Application Route Navigation Module

The Haversine formula will calculate the distance between two GPS points. In this case, it is the users and destination GPS points. This GPS point contains latitude and longitude as the primary key in comparing distances to determine the closest location. (Malik & Rosalina, 2019) Figure 6 shows the route navigation module in an application travel mobile-based.

CONCLUSION

This research concludes that the Nanggung sub-district has excellent potential as a tourist area. It needs a development plan to facilitate tourists to determine the best route. Distance calculation in mobile applications is a solution. The Haversine Method generates the distance between the application user and the tourist location points. This calculation facilitates tourists to decide the travel route they will take while in the Nanggung sub-district, Bogor Regency.

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