# MAPPING LOCATIONS AND SHORTEST ROUTE OF TOURISM OBJECTS IN CENTRAL LOMBOK USING GIS-BASED A-STAR ALGORITHM

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**Abstract**—Central Lombok tourism is a tourism that foreign and domestic tourists often visit. There are many tourist objects offered by the Central Lombok Government, such as waterfall tours, beach tours, traditional village tours, cultural tours, and Pertamina Mandalika International Street Circuit. However, there are many tourist objects, and not all tourists know the location of these tourist objects. Tourists often experience constraints, are the location of tourist objects that is not quite right, it is still difficult to determine the shortest route to the location, and the lack of complete information about existing tourist objects, which can hinder the journey of tourists to the destination location. This study aims to map the location and shortest route of tourism objects in Central Lombok using an Android-based Geographic Information System by applying the A-Star algorithm. The results of this study are to develop an Android-based Geographic Information System or GIS by applying the star algorithm to Central Lombok tourism objects. So that the mapping of the location and information of tourist objects and obtain the search for the shortest route to tourist objects. The A-Star algorithm uses heuristic principles to find the shortest route to a tourism object and is optimal in finding the shortest route to tourism objects.

**Keywords:** Location_mapping; shortest_route; geographic_information_system; A Star_algorithm; Central_Lombok_tourism.

***Abstrak****—Wisata Lombok Tengah merupakan salah satu objek wisata yang sering dikunjungi oleh wisatawan, baik dari wisatawan mancanegara maupun nusantara. Objek wisata yang ditawarkan oleh Pemerintah Lombok Tengah tergolong banyak seperti adanya wisata air terjun, wisata pantai, wisata desa adat, wisata budaya dan Pertamina Mandalika International Street Circuit. Namun banyaknya objek wisata tersebut, tidak semua wisatawan mengetahui lokasi keberadaan objek wisata ini. Kendala yang sering dialami oleh wisatawan yaitu lokasi objek wisata kurang tepat, masih sulit menentukan rute terpendek menuju lokasi, dan kurang lengkapnya informasi tentang objek wisata yang ada, sehingga dapat menghambat perjalanan wisatawan menuju lokasi tujuan. Tujuan penelitian ini, untuk melakukan pemetaan lokasi dan rute terpendek objek wisata di Lombok Tengah menggunakan Geographic Information System berbasis android dengan menerapkan algoritma A Star. Hasil penelitian ini yaitu mengembangkan Geographic Information System atau GIS berbasis android dengan menerapkan algoritma a star pada objek wisata Lombok Tengah. Sehingga memperoleh pemetaan lokasi dan informasi objek wisata serta pencarian rute terpendek objek wisata. Algoritma A Star menggunakan prinsip heuristik dalam pencarian rute terpendek objek wisata dan algoritma ini optimal dalam menemukan rute terpendek objek wisata.*

***Kata Kunci****: Pemetaan_lokasi; rute_terpendek; Geographic_Information_System; algoritma_A_Star; wisata_Lombok_Tengah.*

## INTRODUCTION

Tourism is a travel activity of a person or group of people to visit tourist objects with the aim of recreation, self-development, and learning the uniqueness of tourism objects (Hadi, 2022; Kawatu et al., 2020; Sambiu & Amir, 2018; Wartarius et al., 2020). Almost everyone realizes that tourism is important as pleasure or satisfaction, especially related to physical and spiritual refreshment (Hadi, 2022). The Indonesian government fully supports tourism because tourism meets tourists' physical, spiritual, and intellectual needs through recreation and travel (Undang-Undang Republik Indonesia, 2009). In addition, tourism can improve the country's economy (Kawatu et al., 2020; Saniati et al., 2022).

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The Tourism and Creative Economy Agency of the Republic of Indonesia informed that foreign tourist visits to Indonesia through all entrances in December 2021 amounted to 163.619 people (Kurnianingsih, 2020). This data shows that many visitors from foreign tourists come to Indonesia, apart from domestic tourists. Visitors to tourism objects on the island of Lombok in 2021 were 37,566 people from foreign tourists and 838,207 domestic tourists (data.ntbprov.go.id).

This large number of visitors proves that the interest of tourists both from abroad and in the archipelago towards tourism objects on the island of Lombok is not small, allowing tourists to continue to grow in the future.

Examining the above statement related to the importance of tourist objects for tourists, mapping the location and the shortest route of tourist objects is an important activity carried out to help tourists find the location of tourist objects and choose the shortest route on their way to the tourist attraction.

Recently, Central Lombok Regency has received public attention both nationally and internationally due to the existence of the Pertamina Mandalika International Street Circuit by combining the concept of tourism in the racing area. In addition to offering tourism objects on this circuit, the government of Central Lombok offers several attractive tourism objects for tourism as their vacation spots, such as waterfalls, beaches, traditional villages, and other tourism objects (Makmun et al., 2022). However, several obstacles are often experienced by tourists, namely the location of tourist objects is not precise, it is still difficult to determine the shortest route to the location, and the lack of complete information about tourist objects in Central Lombok.

Developing an android-based geographic information system can help foreign or domestic tourists find tourist locations in the Lombok Region, West Nusa Tenggara (Subki et al., 2021). Researchers (Erniwati & Subki, 2020) designed an Android-based culinary tourism GIS to make it easier for culinary lovers to find culinary tourism locations in the West Lombok area, and research (Wartarius et al., 2020) had the same discovery that creating an Android-based tourist map application in Pesawaran Regency could make it easier for tourists to find tourist routes. Moreover, research (Subhan & Umar, 2019) found that a geographic information system for Web-based tourist objects can make it easier for the public, both foreign and domestic tourists, to find tourist objects in West Lombok Regency.

Unlike the research case (Pugas et al., 2011) found the shortest route distance by comparing the Dijkstra and A Star algorithm methods by obtaining the results of calculating the same distance. However, the speed of finding the shortest route with Dijkstra's algorithm differs from the Astar algorithm, where the Astar algorithm is faster in finding the shortest route with an average time difference of 40 ms. The best route can be determined using the A Star Algorithm so it can be implemented properly. This simulation can determine the best route from the starting point to the ending point (Bagus et al., 2018). Research (Suhendri et al., 2021) applies the A Star algorithm to find the closest route so that the android-based Majalengka District health facility mapping application that has been developed successfully displays the closest health facility by presenting information more quickly, easily, and accurately. Likewise in research (Mutsaqov, Ativ, Muhammad Fernando & Megawaty, Ayu, 2020) developing an Android-based photographic location search application in Bandar Lampung using the A-Star Algorithm calculation, which provides detailed information from photo previews of locations, photo spots, location descriptions, addresses, photo recommendation times, and routes that can be taken to the location.

From some of the previous similar studies above related to Android or web-based GIS for tourist objects in the Lombok area, no one has examined the A Star Algorithm as a search for the shortest route to tourist objects, and also there has been no research on Android-based Tourism GIS with the A Star algorithm in other regions. Although some research Android-based GIS with the A Star Algorithm in other case studies such as searching for mosque routes, searching for health facilities, and searching photography locations.

By the constraints experienced, this study aims to map the location and shortest route to tourism objects in Central Lombok using an Android-based Geographic Information System by applying the A-Star algorithm.

## MATERIALS AND METHODS

### Algoritma A* (A-Star)

The A* (A Star) algorithm is the shortest route search algorithm with heuristics (Yamin et al., 2015) and searches for optimal and complete routes, optimal means that the route obtained is the best in achieving the expected destination (Hisyam Fadhlurrahman et al., n.d.; Mutsaqov, Ativ, Muhammad Fernando & Megawaty, Ayu, 2020). The A Star algorithm is a best-first search algorithm that combines Uniform Cost Search and Greedy Best-First Search. The distance obtained from the calculation of the actual distance (actual cost) plus the estimated distance (estimated cost) (Suhendri et al., 2021; Sunaryo et al., 2016)

Based on the concept of the A Star algorithm, it is divided into two points; namely, the points that can be passed are usually called Open Lists, and points that cannot be passed are usually called Close Lists. Functionally, the Close List is enabled so that the algorithm does not re-check the points that have been passed so that the search process can work faster and reduce the unlimited checking process for each node or point. Usually, finding the closest route to an algorithm is where the algorithm will stop if there is no longer an Open List or an endpoint has been determined (Anwar et al., 2017). The equation used by the A-Star algorithm is as follows:

$$f(n) = g(n) + h(n) \quad (1)$$

Where:
f(n) = node evaluation function or lowest estimation cost
g(n) = costs that have been incurred from the initial node to node n
h(n) = estimate cost/ cost from node n to destination node or heuristic value of the node
To get the value of h(n), use the following equation:

$$h(n) = \sqrt{(x_n - x_{goal})^2 + (y_n - y_{goal})^2} \quad (2)$$

Where:
$x_n$ = coordinate x from node n / starting node
$y_n$ = coordinate y from node n / starting node
$x_{goal}$ = coordinate x from node to 1 (destination node)
$y_{goal}$ = coordinate y from node to 1 (destination node)

The research method used is Research and Development (R & D). R & D research methods are used for developing a new product or improving an existing product and improving its effectiveness. The R & D research method stages are Problems, Data Collection, System Design, Design Validation, Design Revision, System Development, Limited Trial, Limited Trial Revision, Field Trial, Field Trial Revision, Dissemination, and Implementation. The stages in the R&D model are shown in Figure 1:

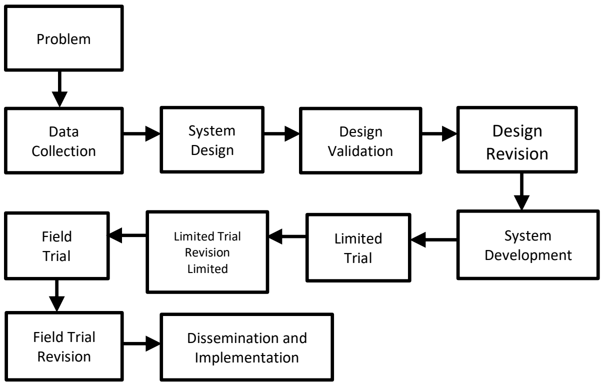

Figure 1. Research Model R&D

Figure 1. are the stages of this research using the R&D model. The following describes the details of each of these stages.

**Problem**

Solving the problem in this study is by mapping the location and the shortest route to tourism objects in Central Lombok and building an Android-based Geographic Information System (GIS) application by applying the A-Star algorithm.

**Data Collection**

In this study, the data was collected in the form of primary data from tourism objects in Central Lombok. Data retrieval is done using observation and documentation of each tourism object. The time required for data collection is five days in April 2022.

From the data retrieval that has been done, the researcher gets the data that is the system requirement in developing GIS applications. The number of locations for Central Lombok tourism objects taken is 72 object. Then the 72 tourist objects were used as data samples in this study. The data obtained are in the form of names and information on tourist objects and coordinate points consisting of the latitude and longitude of tourist sites. To get latitude and longitude, use the Google Maps tool according to the location of the tourism object. The following in Table 1. describes the coordinates of the Central Lombok tourism object.

Table 1. Coordinate Points of Central Lombok Tourism Object

| No | Tourism object location | Latitude | Longitude |
|---|---|---|---|
| 1 | DWH (Tourism Village Green) Bilebante | -8.620271 | 116.186590 |
| 2 | Pasar Pancingan | -8.619913 | 116.187269 |
| 3 | Taman Wisata Alam (TWA) Lembah Gardena | -8.620645 | 116.189500 |
| 4 | D Gonggress | -8.614769 | 116.198262 |
| 5 | Tebing Purba Bonjeruk | -8.632059 | 116.224940 |

| No | Tourism object location | Latitude | Longitude |
|---|---|---|---|
| 6 | Desa Wisata Nostalgia | -8.647284 | 116.219792 |
| 7 | Wisata Telaga Ijo | -8.661678 | 116.220182 |
| 8 | Wisata Kolam Kelandur | -8.636500 | 116.277604 |
| 9 | Longtun Waterpark | -8.634892 | 116.357411 |
| 10 | Taman Wisata Edukasi Jabal | -8.694528 | 116.415062 |
| 11 | Swimming Pool Odes | -8.628431 | 116.350484 |
| 12 | Desa Wisata Masmas | -8.595436 | 116.352991 |
| 13 | Wisata Aik Bukak | -8.576861 | 116.344035 |
| 14 | Air Terjun Lembah Sriti | -8.547125 | 116.333163 |
| 15 | Sirkuit Cross Internasional | -8.543220 | 116.322610 |
| 16 | Air Terjun Babak Pelangi | -8.545777 | 116.331831 |
| 17 | Blue Lake | -8.528884 | 116.311274 |
| 18 | Air Terjun Batu Benciwe | -8.529965 | 116.329189 |
| 19 | Air Terjun Sesere | -8.534047 | 116.338921 |
| 20 | Air Terjun Benang Kelambu | -8.532427 | 116.337007 |
| 21 | Air Terjun Benang Stokel | -8.532982 | 116.341388 |
| 22 | Air Terjun Batu Janggot | -8.536005 | 116.349637 |
| 23 | Air Terjun Smilir | -8.508260 | 116.326333 |
| 24 | Air Terjun Titian Batu | -8.486480 | 116.336977 |
| 25 | Wisata Alam Pedewaq | -8.703627 | 116.214982 |
| 26 | Bendungan Batujai | -8.725810 | 116.257428 |
| 27 | Tonjeng Beru Smart Garden | -8.714019 | 116.263301 |
| 28 | Savana Bale Tepak | -8.745910 | 116.280536 |
| 29 | Desa Wisata Sasak Ende | -8.821189 | 116.293815 |
| 30 | Sade Village | -8.839275 | 116.291991 |
| 31 | Pantai Mandalika Kuta | -8.894104 | 116.282194 |
| 32 | Bundaran Kuta Lombok | -8.895707 | 116.295900 |
| 33 | Pertamina Mandalika International Street Circuit | -8.898234 | 116.305048 |
| 34 | Patung Putri Mandalika | -8.906253 | 116.298007 |
| 35 | Pantai Seger | -8.907113 | 116.297064 |
| 36 | Bukit Seger | -8.907770 | 116.29958 |
| 37 | Bukit Merese | -8.913838 | 116.31901 |
| 38 | Pantai Tanjung Bongo | -8.920049 | 116.31966 |
| 39 | Pantai Tanjung Aan | -8.909153 | 116.32113 |
| 40 | Pantai Batu Berang | -8.897451 | 116.34532 |
| 41 | Pantai Bumbung | -8.902966 | 116.37495 |
| 42 | Wisata Alam Gunung | -8.910879 | 116.38110 |
| 43 | Pantai Batu Jangak | -8.921934 | 116.37053 |
| 44 | Pantai Terasak | -8.931075 | 116.36810 |
| 45 | Pantai Teluk Ujung | -8.942315 | 116.37172 |
| 66 | Pantai Sari Goang | -8.934510 | 116.39420 |
| 47 | Goa Bangkang Prabu | -8.886436 | 116.25475 |
| 48 | Pantai Areguling | -8.903911 | 116.24427 |
| 49 | Pantai Mawun | -8.900118 | 116.22966 |
| 50 | Pantai Tampah | -8.901637 | 116.21506 |
| 51 | Pantai Lancing | -8.900673 | 116.20704 |
| 52 | Pantai Jagog Luar | -8.911384 | 116.19884 |
| 53 | Pantai Jagog Dalem | -8.914500 | 116.19543 |
| 54 | Pantai Seruni | -8.911315 | 116.19061 |
| 55 | Pantai Penggantung | -8.911059 | 116.18788 |
| 56 | Gili Gansing | -8.914308 | 116.18778 |
| 57 | Pantai Munah | -8.899297 | 116.16444 |
| 58 | Pantai Mawi | -8.887598 | 116.16066 |
| 59 | Pantai Telawas | -8.895336 | 116.16206 |
| 60 | Pantai Teogok – Ogok | -8.904181 | 116.16350 |
| 61 | Pantai Tunting-unting | -8.904812 | 116.16729 |
| 62 | Pantai Batu Rudal | -8.905506 | 116.16233 |
| 63 | Kolam Kaca Teogok-ogok | -8.906039 | 116.16207 |
| 64 | Tanjung Rudal | -8.906599 | 116.16303 |
| 65 | Pantai Selong Belanak | -8.872284 | 116.16202 |
| 66 | Pantai Ketapak | -8.864084 | 116.15454 |
| 67 | Pantai Tomang-omang | -8.862772 | 116.15145 |
| 68 | Pantai Serangan | -8.869163 | 116.13975 |
| 69 | Pantai Amber Lombok | -8.864990 | 116.12475 |
| 70 | Pantai Torok | -8.866461 | 116.12175 |
| 71 | Air Terjun Nambung | -8.872136 | 116.10902 |
| 72 | Pantai Nambung | -8.868827 | 116.10427 |

At the time of data collection, researchers also analyzed the system requirements needed in developing GIS applications. The following is Table 2. Describes the analysis of system requirements

Table 2. Functional Needs Analysis

| No | Functional Needs | User |
|---|---|---|
| 1 | Login | Admin |
| 2 | Pengolahan Data Wisata | Admin |
| 3 | Logout | Admin |
| 3 | Informasi Wisata | Wisatawan |
| 4 | Pencarian Rute Wisata | Wisatawan |
| 5 | Help | Wisatawan |

Table 2 describes the functional requirements in the system, what functions or processes must exist, and who the system's users are. There are 2 (two) types of users who can access the system: admins and tourists. Admin users are intended to access web server applications, while tourist users will access Android-based GIS applications.

Algorithm Calculation A* (A-Star)

This route search uses 7 (seven) tourism object data to show the calculation steps in searching tourist routes using the A-Star algorithm.

- Determination of nodes/coordinate points

The following in Table 3. explains the coordinates of the 7 (seven) data in this simulation.

Table 3. Coordinate points of 7 (Seven) simulation data

| No | Tourism object location | Node abbreviation | Latitude | Longitude |
|---|---|---|---|---|
| 1 | DWH (Tourism Village Green) Bilebante | A1 | -8.620271 | 116.186590 |
| 2 | Pasar Pancingan | A2 | -8.619913 | 116.187269 |
| 3 | Taman Wisata Alam (TWA) Lembah Gardena | A3 | -8.620645 | 116.189500 |
| 4 | D' Gonggress | A4 | -8.614769 | 116.198262 |
| 5 | Tebing Purba Bonjeruk | A5 | -8.632059 | 116.224940 |
| 6 | Desa Wisata Nostalgia Bonjeruk | A6 | -8.647284 | 116.219792 |
| 7 | Wisata Telaga Ijo | A7 | -8.661678 | 116.220182 |

- Determination of costs between two connected nodes

After getting the coordinates of each tourism object's location, determine the cost between the two related nodes. This cost determination is taken through the distance measurement feature on Google Maps. Nodes A1 to A2 measurement gets a distance of 102.54 meters. From the cost measurements between the two nodes that have been carried out, the following results are obtained:

1) Cost of nodes A1 to A2 and vice versa = 102.54 m
2) Cost of nodes A2 Ke A3 and vice versa = 394,76 m
3) Cost of nodes A3 Ke A4 and vice versa = 1,41 km
4) Cost of nodes A4 Ke A5 and vice versa = 5,73km
5) Cost of nodes A4 Ke A6 and vice versa = 8,29 km
6) Cost of nodes A5 Ke A6 and vice versa = 2,69 km
7) Cost of nodes A6 Ke A7 and vice versa = 6,52 km
8) Cost of nodes A1 Ke A7 and vice versa = 12,76 km

The result of determining the node/coordinate point, the cost between two related nodes, is formed in a graph as shown in Figure 2 below:

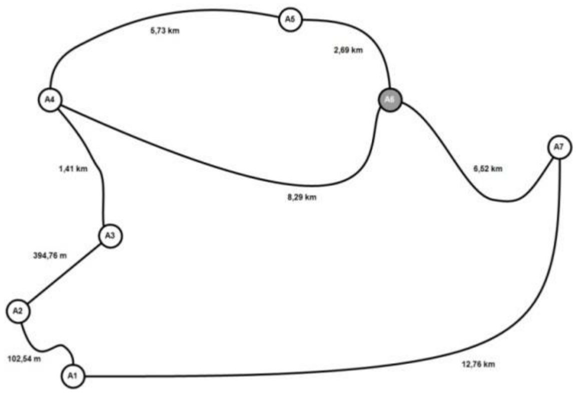

Figure 2. Graph of Coordinate Points and Costs Between Two Nodes

Figure 2. In this route search simulation, select node A1 as the starting node (start point) and node A6 as the destination node (endpoint).

- Determination of the estimated cost of the node

The determination of the estimated cost of the node or the heuristic value of the node is the straight line distance between node n to the destination node. Therefore, the researcher determines the cost of the node based on a straight-line distance reference obtained from Google Maps. The following is in Table 4. Straight lines between the nodes that have been obtained:

Table 4. Straight Line Distance

| n | A1 | A2 | A3 | A4 | A5 | A6 | A7 |
|---|---|---|---|---|---|---|---|
| h(n) | 4,72 km | 4,70 km | 4,46 km | 4,32 km | 1,79 km | 0 | 1,60 km |

- Node evaluation function calculation

After determining the node/coordinate point, the cost between the two related nodes, and the estimated cost of the node, the node evaluation function is calculated. The following is in Figure 3. Graph of the Initial A-Star Algorithm.

Figure 3. A-Star Algorithm Graph (Beginning)

Figure 3. A1 is the initial node, and then A1 is selected as the best node. Then the next best node is f(A2). *Close* : A1 ; Open : A2

Then in Figure 4. Graph of the Final A-Star Algorithm after each calculation process is carried out.

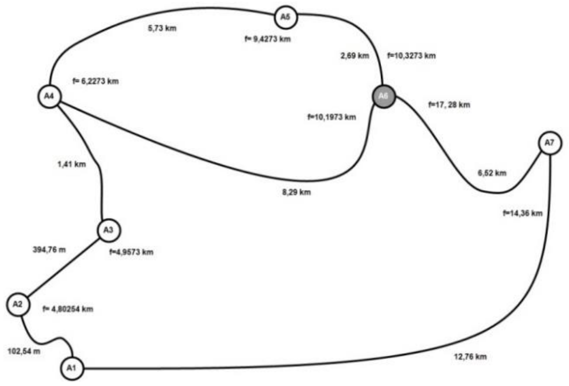

Figure 4. A-Star Algorithm Graph (Final)

Figure 4. explains the final results of the A-Star Algorithm calculations, along with an explanation of the final results:

A2 has the lowest estimated cost of 4.80254 km and was chosen as the best node, then moved to close. Then A3 is opened and entered into the open. The next best node is f(A3). *Close* : A1,A2 ; Open : A3

A3 has the lowest estimated cost, 4.9573 km, chosen as the best node, then moved to close. Then A4 is opened and entered into the open. Next best node f(A4). *Close* : A1,A2, A3 ; Open : A4

A4 has the lowest estimated cost of 6.2273 km, selected as the best node, then moved to close.

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Then A5 and A6 are opened and entered into the open. *Close* : A1,A2, A3, A4 ; Open : A5, A6

The shortest route search has been found, and the lowest estimated cost is on the A1-A2-A3-A4-A6 route, with a distance of 10.1973 km. Then the calculation continues to line A5. *Close* : A1,A2, A3, A4, A6 ; Open : A5

After the search for the shortest route is found, the second shortest path is calculated. So that it gets the second line A1, A2, A3, A4, and A5 with a distance of 10.3273 km. Then the A7 line is opened. *Close* : A1,A2, A3, A4, A5 ; Open : A7.
Calculations on the third shortest path are found on lines A1, A7, and A6, with a distance of 17, 28 km.

**System Design**

In designing the Central Lombok Tourism GIS, it is necessary to pay attention to the results of data collection and analysis of functional requirements obtained. This GIS design consists of system flowchart design, UML (Unified Modeling Language) modelling on use case diagrams, and activity diagrams. Moreover, supported by the program interface design. The following is in Figure 5. explains the flowchart of the Central Lombok tourism GIS application system

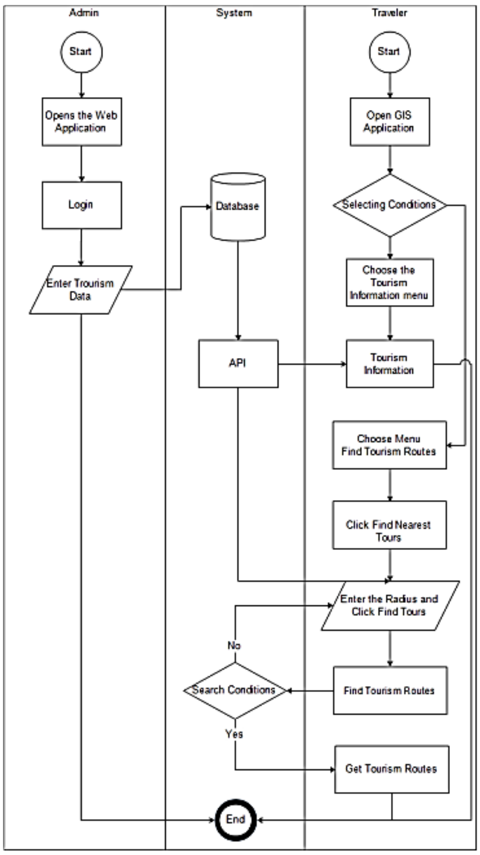


Figure 5. Central Lombok Trourism GIS Application System Flowchart

Figure 5. is the system flow of the Central Lombok tourism GIS application. Two applications were developed: the tourism web server application and the tourism GIS application. The following in Figure 6. explains the use case diagram of a tourist GIS application.

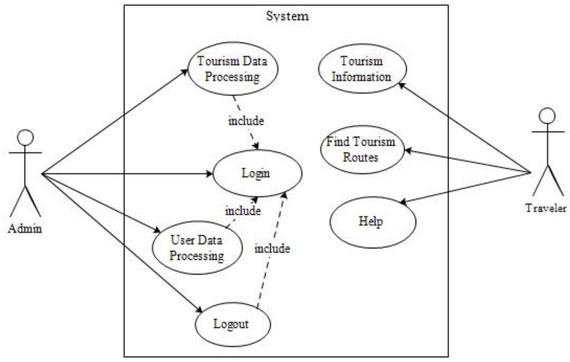


Figure 6. Use Case Diagram Figure 6. Use Case Diagram of a Tourism GIS Application

Figure 6. is a use case diagram for admin actors/users and use case diagrams for tourist actors/users. The admin actor can only access the travel server web application, while the tourist actor can only access the travel GIS application.

**Design Validation**

At this stage, the system design that has been carried out will be tested for correctness by involving information systems experts. Attachments 1 and 2 show the results of system design validation carried out by information systems experts involving 2 (two) experts. The results of the validation from this information system expert become the refinement of the system design made.

**Design Revision**

Stages of Design Revision, according to the results of system design validation, the next researcher makes improvements based on the results of system design validation by the results of validation instruments from information systems experts. If there is no revision, then proceed to the system creation stage.

## RESULTS AND DISCUSSION

**System Development**

This GIS application is built based on Android using the Android Studio editor tools using the Java programming language. Obtaining dynamic data requires a website server application to function as tourist data processing that can only be accessed by the admin, while an Android-based GIS application is used for tourist information and tourist route searches that can be accessed freely by tourists. The process of retrieving data from the website server to an Android-based GIS application using an API intermediary in the form of a JSON data format that has been created.

**Limited Trial**

The following is a limited trial that has been carried out on an Android-based GIS application that has been made.

Figure 7. Tourist Information Page

Figures. 7. explain the page for tourist information in the Central Lombok area. From the data that has been collected, there is 72 tourist information that has been provided in this application.

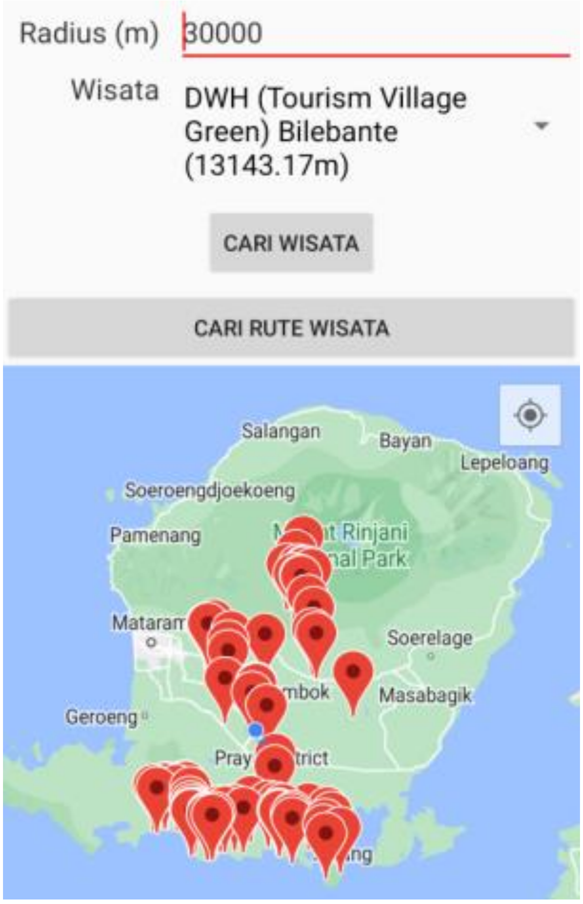

Figure 8. Search Route Pages

Figure 8. The search for tourist routes has displayed tourism objects in the Central Lombok area according to the coordinates the admin has input through the website server. Tourism objects data will change in real-time according to changes made by the admin.

**Limited Trial Revision**

From the limited trials that have been carried out, whether the GIS application being tested functions by the system design. If it is not appropriate or there are still errors in the application, it will be repaired, and if it is running according to the system design, it will proceed to the next stage.

**Field Trial**

Field trials were carried out on an Android-based tourist GIS application that had been created to ensure accuracy in the search and measurement of tourist routes by comparing them to searches on google maps. The trial was carried out ten times at different locations.

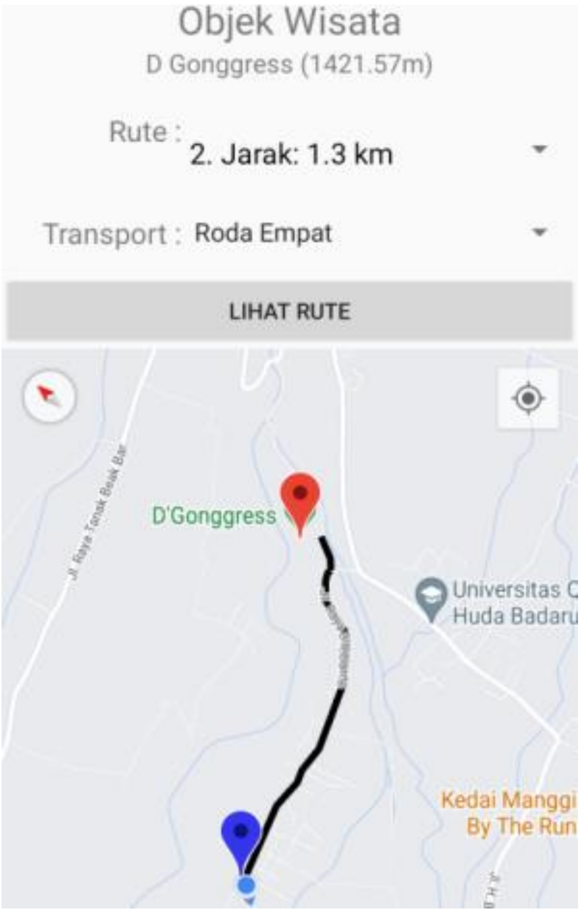


Figure 9. Route Search using Tourist GIS Application

Figure 9. describes the search for the shortest route on the D Gonggress tour to get a distance of 1.3 m.

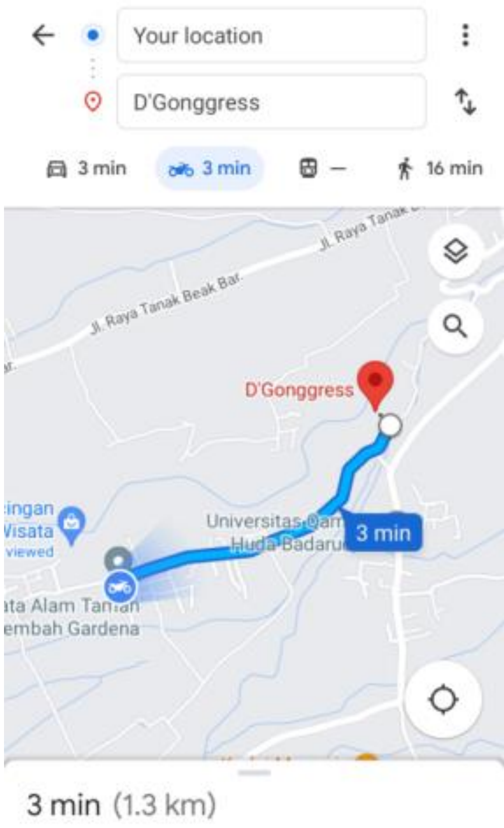


Figure 10. Route Search using Google Maps.

Figure 10. explain the results of the search for the shortest route using google maps to get a distance of 1.3 m. Table 4. below describes the results of trials carried out using the Tourism GIS application and Google Maps. Of the ten trials, the accuracy in finding routes and determining distances between the two applications is almost the same.

Table 4. Test Results for Searching Tourism Objects Route

| No | Initial latitude | Early longitude | Latitude destination | Latitude destination | GIS Application Distance (m/km) | Google Maps distance (m/km) |
|---|---|---|---|---|---|---|
| 1 | -8.620412 | 116.189436 | -8.614769 | 116.198262 | 130 m | 130 m |
| 2 | -8.620858 | 116.187174 | -8.619913 | 116.187269 | 131.73 m | 130 m |
| 3 | -8.616911 | 116.199417 | -8.632059 | 116.224940 | 5.5 km | 5.5 km |
| 4 | -8.616911 | 116.199417 | -8.647284 | 116.219792 | 8.2 km | 8.2 km |
| 5 | -8.646515 | 116.193298 | -8.661678 | 116.220182 | 5.1 km | 5.1 km |
| 6 | -8.667123 | 116.218268 | -8.714019 | 116.263301 | 7.7 km | 7.7 km |
| 7 | -8.688050 | 116.244804 | -8.745910 | 116.280536 | 11.1 km | 11 km |
| 8 | -8.712189 | 116.263071 | -8.821189 | 116.293815 | 15.6 km | 16 km |
| 9 | -8.712189 | 116.263071 | -8.894104 | 116.282194 | 25.1 km | 25 km |
| 10 | -8.709746 | 116.279664 | -8.545777 | 116.331831 | 24.5 km | 24 km |

**Field Trial Revision**

From the results of field trials that have been carried out, if there are errors or defects in the GIS application, repairs will be made again, but if the field trials run well and are successful, then proceed to the next stage.

**Dissemination and Implementation**

Dissemination or an activity to direct an android-based GIS application with the A Star Algorithm to users so that they obtain information and raise awareness in utilizing GIS applications. Then the implementation of GIS applications to users so they can use them.

## CONCLUSION

Location mapping and finding the shortest route to tourism objects using an Android-based Tourism GIS application with the A Star algorithm makes it easy for tourists to get complete tourist information, thus creating an attraction to visit. Moreover, tourists will get the shortest route to the tourist object they want to visit. As well as providing more flexible management control for local governments in managing existing tourism information.

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