Geographic Information System Mapping of Location Distribution Homestay Area Waingapu City Sumba Web-Based East Sumba

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Abstract

Based on the results of the identification of the needs of tourists looking for lodging in the city of Waingapu, there is a lack of spatial information (latitude and longitude), non-spatial (owner's name, price, facilities, address, contact) with the nearest route. Although available on google maps, it is still lacking because it is still incorporated with hotels, boarding houses and other housing. Therefore, a Web-based Geographic Information System for Mapping the Distribution of Homestay Locations in the Waingapu City Area of East Sumba is made to provide recommendations to tourists who need lodging in accessing Homestay information by determining the user's location point and the nearest Homestay will appear. Maps will direct to the location of the selected lodging house accompanied by the desired information. This system was built using the PHP programming language with the MySQL Database. The method used in this research is the Waterfall model for system development and Euclidean Distance for the calculation of the closest distance.

Keyword: Distribution and Homestays, Geographic Information Systems, Mapping

1.   INTRODUCTION

Geographic Information System (GIS) is a database system with special capabilities for spatially referenced information or geographic coordinates or in other words data identified based on a location in a database [1]. GIS in the form of spatial (area) and non-spatial data that can be in the form of information on the existence of an area, this is the use of mapping information on the distribution of Homestay locations in Waingapu City [2].

Waingapu is a city located in East Sumba and has a variety of tourist attractions that many people admire. Of the many people who want to visit Waingapu, often experience limited information about Homestay objects including spatial data (latitude and longitude) and non-spatial data (description, owner's name, price, facilities, address and contact) with the closest route that suits their needs. In Google Maps, it is still incorporated with other building locations such as hotels and housing besides Homestay, when prospective users search on Google Maps, there is often an error when typing the name of a Homestay which brings up other location options listed on Google Maps. Homestay is a residential house where some of the rooms are rented out to guests for a certain period of time for a place to stay [3]. This Web-based Geographic Information System is different because it only provides special Homestay so that it is not disturbed by others when searching like on Google Maps.

From the existing problems, a Waingapu City Area Homestay Mapping Information System was created as a solution to make it easier for tourists or users to access information related to Homestay. Through this website, tourists or people who want to stay in Waingapu city can access Homestay information quickly by determining the user's location point and the nearest Homestay will appear. Maps will direct to the location of the selected homestay along with the desired information. This certainly adds to the effectiveness and efficiency of the work of people who are looking for lodging. Therefore, prospective users who want to stay in the city of Waingapu need a Web-Based Geographic Information System Mapping of Homestay Location Distribution in Waingapu East Sumba City Area, which only provides special Homestay so that they are not disturbed by others when searching like on Google Maps. The formulation of the problem in this

study is divided into three things, namely: 1) how to provide recommendations for affordable lodging to tourists, 2) features to display Homestay latitude and longitude information, 3) calculate the closest distance using the Euclidean Distance formula to find the nearest Homestay location.

2. MATERIALS AND METHOD
2.1 Geographic Information System
Geographic Information System (GIS) is a personal computer system used to integrate, collect, investigate and analyze information related to the earth's surface [6]. GIS is an information technology used to analyze, store and display both spatial and non-spatial data. GIS are also defined as personal computer systems used for storing, examining, integrating, capturing, manipulating, analyzing, and displaying a lot of data affiliated using various positions on the top of the earth [7]. Geographic data sources are obtained in several ways, namely: aerial photographs, Remote Sensing, GPS, terrestrial surveys, contour maps and DEMs, as well as maps that are already available or thematic maps.

2.2 Use Case Diagram
Captures the functional requirements of a system by describing the actors (users or external systems) and the interactions they have with the system. Use case diagrams show the relationship between actors and use cases in the form of arrows. The arrow leads from the actor to the associated use case, indicating the actor's participation in that use case[8].

Use case diagrams help in understanding the functional requirements of the system from the user's perspective. It can also be used as a basis for designing or identifying test scenarios, as well as aiding in communication between software developers and stakeholders.

Table 1. Use Case Diagram

Symbol	Name	Description
	Actor	System users interact directly with the system, such as humans, applications and other objects.
Use Case Name	Use case	An eclipsed circle with the use case name written in the center of the circle
———————	Association	In the form of a line that serves to connect actors with the use case.
————————▶	Generalization	A generalization and specialization relationship between two use cases where one function is common to the other.
--------▶	Extend	The relation of an additional use case to a use case where the use case is added

2.3 Waterfall Method
The waterfall model is a method that describes a systematic and sequential approach or known as the classic life cycle in order starting from analysis, design, Code & Testing, Implementation and finally the Maintenance stage [9].
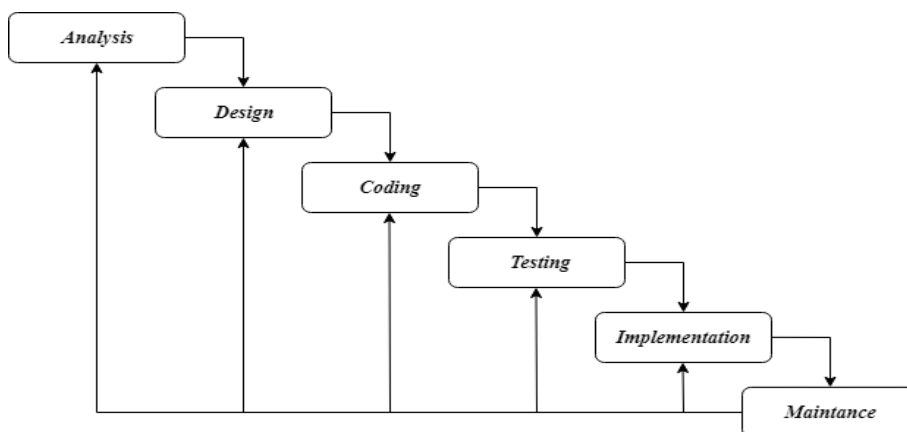

Figure 1. Waterfall Method

1. Analysis
   system analysis is carried out to identify and evaluate problems, obstacles that occur and expected needs so that improvements can be proposed to the system that is built.

2. Design
   System design is a multi-step process that focuses on the program design of the system including data structures, system architecture, interface representations, and coding procedures.

3. Code & Testing
   Coding is the result of the design translation stage into a system program, namely a computer program in accordance with the design that was made at the design stage.

4. Implementation
   Implementation focuses on implementing the system made both functionally and ensuring that everything is in accordance with user needs. This is done to minimizeerrors and ensure that the output is as desired.

5. Maintenance
   Maintenance is carried out when the system is used directly by the user and if there are feature updates or fixing errors found in the system being built.

2.4 Implementation of Euclidean Distance Method

Calculations are made to measure the distance of Homestay locations in the city of Waingapu by utilizing   skeleton data obtained from calibration. The Euclidean Distance equation for points that have 2-dimensional space is as follows:

Euclidean Distance Formula:

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} \qquad (1)$$

Where:

d	: Euclidean distance in degrees
x_1	: Latitude of starting location
x_2	: Destination latitude
y_1	: Initial longitude
y_2	: Destination longitude
S	: Degree units (1 earth degree = 111,319 km)

1 degree (latitude/longitude) = 111,319 km = 111319 Meters
Map coordinates consist of points (x,y)
Where the x-axis is latitude and the y-axis is longitudinal
from the formula above we can implement it into:

$$\text{Distance} = \sqrt{(\text{lat}_1 - \text{lat}_2)^2 + (\text{long}_1 - \text{long}_2)}$$

From the case study calculating the distance of the new Waingapu Port location. With latitude -9.62906 and longitude 120.24906 to the location of Baim Homestay with latitude -9.65371 and longitude 120.26878.

Formula:
$$\text{Distance} = \sqrt{(\text{lat}_1 - \text{lat}_2)^2 + (\text{long}_1 - \text{long}_2)^2} \cdot 111.319$$

The results of the calculation (distance) above are still in decimal degrees (according to the latitude and longitude format used, therefore to adjust it needs to be multiplied by **111,319 km** (1 earth degree = 111,319 km). Until it can be implemented as:

Completion:
Location Waingapu New Pier to location Baim Homestay Jl.M.T.Haryono, Kamalaputi, Kec.Kota Waingapu
Lat1, long1(-9.62906. 120.24906) to Lat2, long2(-9.65371, 120.26878)

$$\text{Distance} = \sqrt{(\text{lat}_1 - \text{lat}_2)^2 + (\text{long}_1 - \text{long}_2)^2} . 111.319$$
$$= \sqrt{(9.62906_1 - 9.65371_2)^2 + (120.24906_1 - 120.26878_2)^2} . 111.319$$
$$= 3.5140516778448 \text{ Km}$$

3. RESULTS AND DISCUSSION

The result of this research is the achievement of objectives by designing and implementing an effective and efficient website. This website can speed up the process of finding the location and detailed information of Homestay in the city of Waingapu East Sumba quickly. Thus, this research provides excellent recommendations in improving the quality and efficiency of finding spatial and non-spatial information of a Homestay quickly. The successful implementation of this website shows that the proposed solution is able to overcome the identified problems well, has a positive impact and provides a strong basis for further development at the stage of submitting a thesis title in the future.
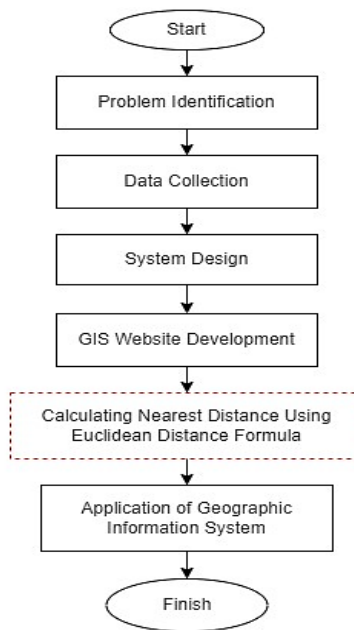
3.1 Research Method

Figure 2. Flowchart

3.1.1 Problem Identification

The stages in this research begin with identifying the problems found based on the results of direct observations and interviews by the author in the city of Waingapu, the difficulty of prospective users when searching on Google Maps because it is still incorporated with other building locations such as hotels and housing in addition to Homestay, when prospective users search on Google Maps often errors occur when typing the name of a Homestay which brings up other location options listed on Google Maps. For this reason, this research plays an important role for the community, especially those who need and are looking for a place to stay in Waingapu in obtaining information on spatial data (latitude and longiude) and non-spatial data (description, name, price, facilities, address, contact) of Homestay in Waingapu.

3.1.2 Data Collection

At this stage, information collection is carried out related to the data needed in making the information system for mapping the distribution of Homestay locations in the Waingapu city area of East Sumba. The data collected is in the form of spatial data (latitude and longitude) and non-spatial data (description, name, address, facilities, price, owner, contact). Some existing locations such as, Baim Homestay which is located on Jl.M.T. Haryono, Kamalaputi, Kec.Kota Waingapu Kab East Sumba NTT, Eva Homestay which is located on Jl.S. Parman, no 86 A Waingapu-Tandarotu and Sumba Permai at Perumnas KM4 near Mutiara Kindergarten. The following is Homestay data from direct interviews with Homestay owners in the city of Waingapu East Sumba.

3.1.3 System Design

This stage is done before coding. Aims to provide an overview of what will be done and how it looks. This process involves data structure, architecture, software, interface representation and procedural details (algorithms). The design that the author does is web-based, so that the system that the author makes can be accessed anywhere by potential users. As well as adding Google Maps to clarify information. The stages of designing a GIS that will be made include making Use Case Diagrams, Class Diagrams, Activity Diagrams and System Design.

3.1.4 GIS Website Creation

At this stage begins with creating a database of Homestay data obtained in the previous stage. The database is created using PHP My admin with Xampp localhost. Then the coding process is carried out with Sublime Text or Visual Code. When the coding is successful, the mapping GIS Website is finished and can be displayed on localhost and finally registering a domain and hosting and uploading data to Webhostimg via firefox.

3.1.5 Application of Euclidean Distance Method

Calculations are made to measure the distance of Homestay locations in the city of Waingapu by utilizing skeleton data obtained from calibration. The Euclidean Distance equation for points that have 2-dimensional space is as follows:

Euclidean Distance Formula:

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} \tag{2}$$

Where

d	: Euclidean distance in degrees
x_1	: Latitude of starting location
x_2	: Destination latitude
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S	: Degree units (1 earth degree = 111,319 km)

1 degree (latitude/longitude) = 111,319 km = 111319 Meters
Map coordinates consist of points (x,y)
Where the x-axis is latitude and the y-axis is longitudinal
from the formula above we can implement it into:

$$Distance = \sqrt{(lat_1 - lat_2)^2 + (long_1 - long_2)^2}$$

From the case study calculate the distance of the location of the new Pelanuhan Waingapu. With latitude -9.62906 and longitude 120.24906 to the location of Baim Homestay with latitude -9.65371 and longitude 120.26878.

Formula :
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The results of the calculation (distance) above are still in decimal degrees (according to the format of latitude and longitude used, therefore, to adjust it, it needs to be multiplied by 111,319 km (1 earth degree = 111,319 km). Multiplied by 111,319 km (1 earth degree = 111,319 km).
Until it can be implemented as:
$$Distance = \sqrt{(lat_1 - lat_2)^2 + (long_1 - long_2)^2} . 111.319$$

Completion:
Location of Waingapu New Pier to the location of Baim Homestay Jl.M.T. Haryono, Kamalaputi, Kec.Kota Waingapu Lat1, long1 (-9.62906. 120.24906) to Lat1, 2 (-9.65371, 120.26878)

$$Distance = \sqrt{(lat_1 - lat_2)^2 + (long_1 - long_2)^2} . 111.319$$
$$= \sqrt{(9.62906_1 - 9.65371_2)^2 + (120.24906_1 - 120.26878_2)^2} . 111.319$$
$$= 3.5140516778448 \text{ Km}$$

3.1.6 System Testing

This system testing is carried out with the aim of ensuring whether the system created is in accordance with the usability function and user needs or not. At this stage, improvements are also made to the errors that exist in the system and tests are carried out on the system being built.

3.2 System Design

At this stage, we will explain the big picture of the system design that will be formed. In this study, it can be seen in the use case diagram. Use case diagrams help in understanding the functional requirements of the system from the user's perspective[10]. This diagram can also be used as a basis for designing or identifying test scenarios, as well as assisting in communication between software developers and stakeholders. Use cases are used to find out what functions exist in an information system that will be created and who can use the system. Here is the use case of the designed system[11].
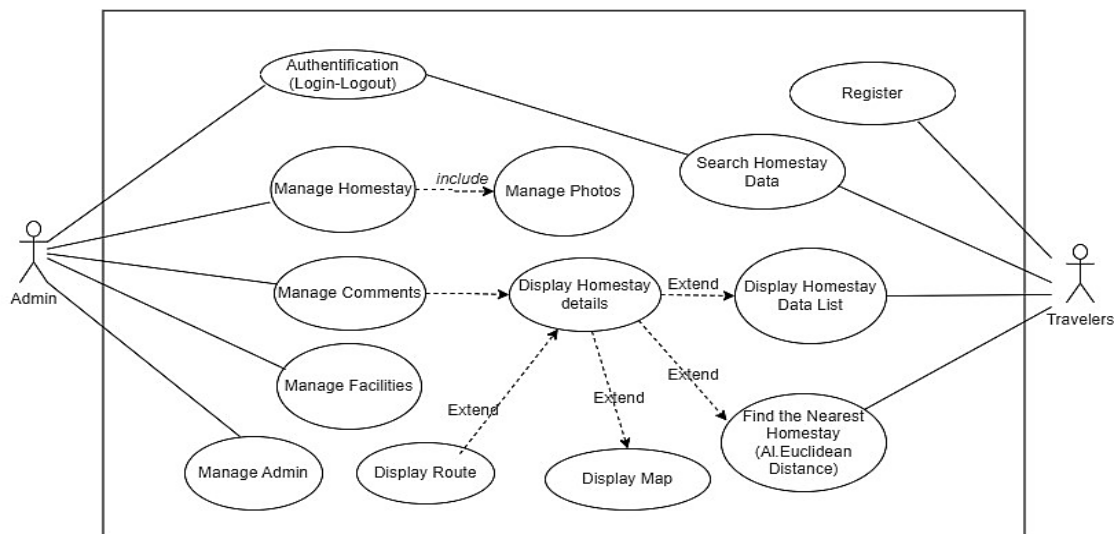
3.2.1 Use Case Diagram

Figure 3. Use Case Diagram

3.2.2 Class Diagram

These symbols are used to describe the static structure of a system, including classes, attributes, relationships and methods that belong to a class. More complex class diagrams usually include more classes, attributes and relationships between classes, such as association, aggregation or inheritance. Class diagrams help in understanding the structure and relationships between classes in a software system, and provide guidance in the software design and development process[12].
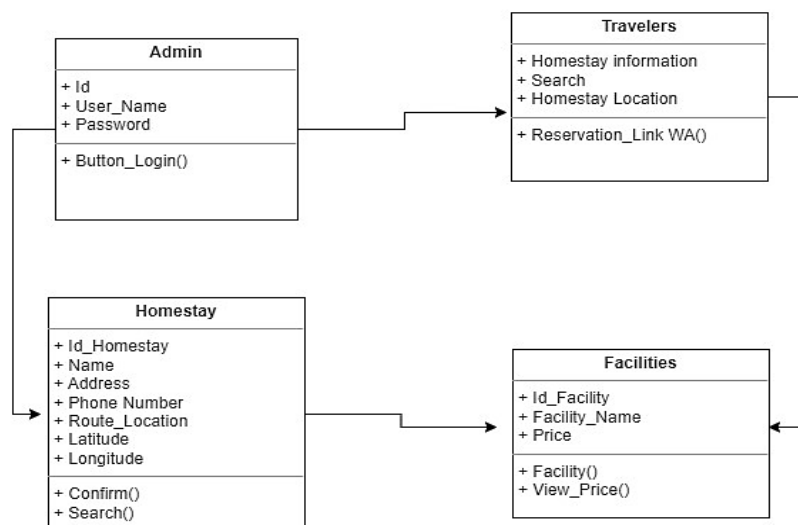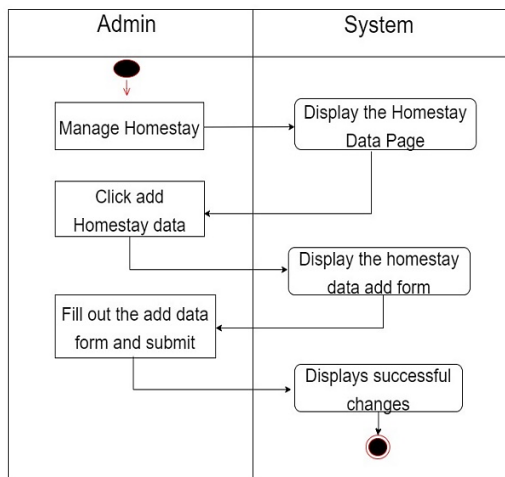

Figure 4. Class Diagram

3.2.3 Activity Diagram

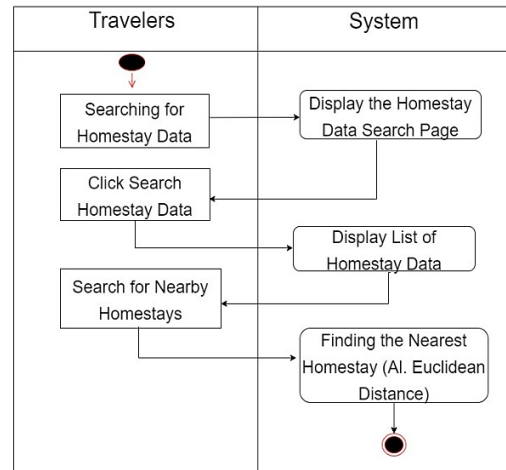**Figure 5.** Admin Page Add Homestay Data

Figure 6. Travelers Access Web Page

3.3 System Implementation

The application of the Waingapu City Area Homestay Mapping Geographic Information system is described in a website display to describe the system that has been built along with an explanation of each display. The websitedisplay is as follows:

1. Login Page Display

Figure 3 below is the Traveler and Homestay Owner Login page after registering by entering Email and Password. Homestay Owner Login to be able to add, edit and save attribute data (description, owner's name, price, facilities, address and contact) and see people who makebookings and reviews. While Travelers login to see the history of orders (booking) and reviews.
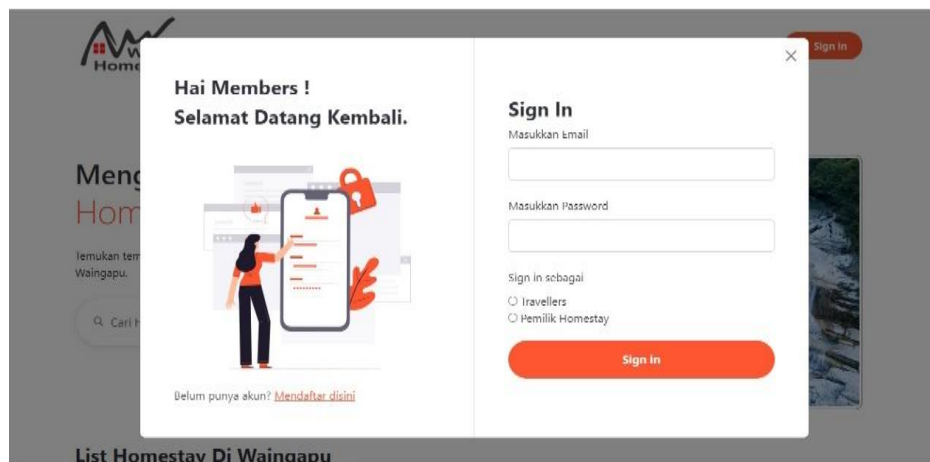

Figure 3. Login page

2. Nearby Location Search Display

Figure 4 below is a display of Homestay location search . On this page Tourists can see the nearest Homestay by typing the location in the search button , then the location of the nearest Homestay will be offered.
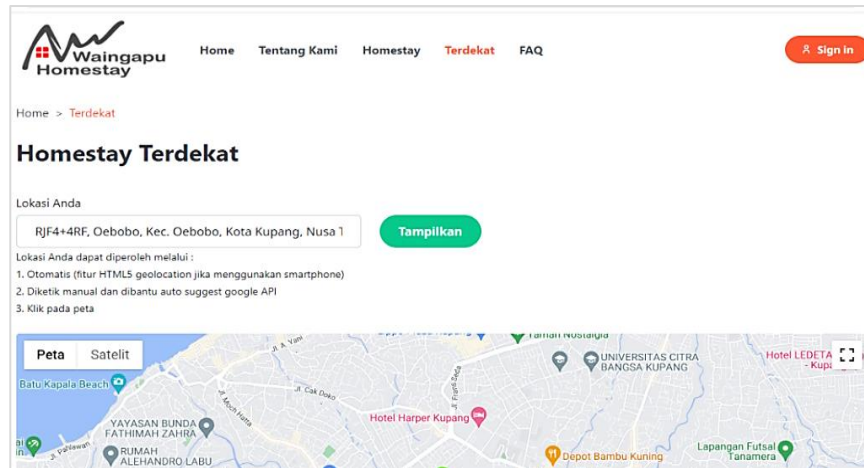
Figure 4. Nearby Location Search

3. Homestay Detail View
   Figure 5 below is a display of Homestay information details carried out by Tourists and Homestay Owners who want to know the complete information of the desired Homestay . This page contains information on the owner's name, address, contact, facilities and prices.
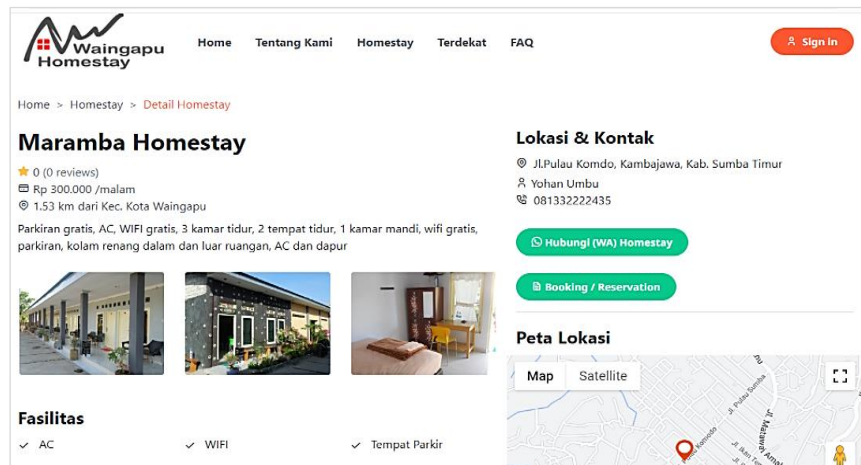

Figure 5. Homestay Information Details

3.3 Blackbox Testing

The blackbox testing method is a testing method with the approach of assuming a software system or program as a black box (blackbox). This approach only evaluates the program based on the output or final result issued by the program. The structure of the program and the codes in it are not included in this test. The advantage of using this test is that it is cheap and simple. However, testing with this method cannot detect coding effectiveness deficiencies in the program. Then the test data is executed in the software and then checks whether it is as expected.

Blackbox testing attempts to find errors in the categories.
1. Missing or incorrect functions
2. Interface errors
3. Errors in data structure or external database access
4. Performance errors
5. Initiation and termination errors.

Tabel 2. Hasil Pengujian *Black Box Testing*

Function Name	Description	Expected results	Testing Results
Login data menu	Users can enter their username and password to enter the	The system is able to display the user login page and after that the system	Success

		system.	will display home.	
		The user entered the wrong username and password.	The system will display the message "wrong username and password" and display the login form to be filled in with the correct username and password.	Success
Registration data menu	Display the user account registration menu.	This system will display the registration form. The user account registration menu is used to add new user data, where the user data to be entered is username, password, password confirmation, email.	Success
Home data menu	Display the home menu.	This system will display the home menu. The page that appears when the admin successfully logs in to the geographic information system for distributing homestay locations.	Success
Homestay data CRUD	Display CRUD homestay data.	This system will display the homestay data menu. The homestay data page is the page that appears when the user selects the homestay details menu in the System.	Success
CRUD user data	Display CRUD user data.	This system will display the user data menu when the admin selects the user data button when the admin wants to see the user data registered into the system.	Success
CRUD Logout data	Users can exit the system by clicking the logout button.	The user selects logout and the system returns to login.	Success

4. CONCLUSION AND SUGGESTION

The conclusions that can be drawn from the Geographic Information System Mapping the Distribution of Homestay Locations in the Web-Based Waingapu East Sumba City Area are as follows: This system has features to display Homestay latitude and longitude information, this system makes it easier for tourists to find the closest Homestay location to them using the Euclidean Distance calculation formula and the system built can provide recommendations to tourists who want to stay in the city of Waingapu East Sumba in accessing Homestay information online.

From the conclusions described above, researchers can find several suggestions to be used as a source of development and improvement of system quality in the future. The suggestions are as follows: It is necessary to update or upgrade the system both in terms of appearance, content presented and others that aim to make it easier for users to use the system and need to display an additional menu for calculations using the Euclidean Distance formula in determining the location of the nearest Homestay.

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