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Geolocation data incorporation in Mapbox for comprehensive mapping of tourism areas on Lombok Island

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Abstract: Lombok Island is one of the islands that has many tourist areas. With so many tourist areas spread to various regions on the island of Lombok, an accurate and comprehensive tourist area mapping system is needed. The problem faced is that the existing mapping is still constrained regarding accuracy and data persistence. The solution offered in this research is the incorporation of geolocation data on the Mapbox platform to improve the accuracy and detail of data in mapping tourism areas on the island of Lombok. In this research, there are several stages carried out starting from data collection to testing. This research results in a tourist area mapping information system that applies geolocation data incorporation on Mapbox. The test results show an increase in accuracy of 8% from the previous mapping and a usability test score of 81 which means that the system developed is acceptable or feasible by users.

Keywords: comprehensive, data incorporation, Lombok Island, mapping, tourism area

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Introduction

Lombok Island is one of the islands of West Nusa Tenggara Province with enormous tourism sector potential [1] ranging from natural beauty, to its culture [2], [3]. Based on data obtained from the NTB Tourism Office, Lombok Island has approximately 25 tourism destinations [4] and 56 tourist villages [5]. With so many tourist areas on the island of Lombok, accurate and comprehensive mapping of tourist areas is needed [6] to support tourism development and also make it easier for tourists to obtain information related to tourist areas. However, until now there are still problems related to the accuracy of the information and detailed data. Often users do not reach their destination due to inaccurate information provided

Several solutions can be used for these problems, one of which is the incorporation of geolocation data on the Mapbox platform to improve the accuracy and detail of data in mapping tourism areas on the island of Lombok. This can be done by collecting geolocation data integrated with Mapbox, then performing spatial analysis and visualization of the data. Geolocation is a technology that can be used to determine the geographic location of an object using GPS, Wifi, Bluetooth or cellular signal technology [7] which also allows devices to send or receive information based on their geographic location, and can be used in various applications, such as navigation, environmental research, and location-based marketing [8]. Meanwhile, Mapbox is a platform that can be used to create interactive, flexible mapping applications [9] and provides various options for displaying data on maps such as spatial data, aerial photographs, and satellite maps [10].

This research will develop a mapping system based on the incorporation of geolocation data on Mapbox which is expected to provide accuracy and detail in mapping tourist areas on Lombok Island. Thus, the mapping results can be an important reference for tourists, government, and tourism industry players in developing and improving the quality of tourism on Lombok Island.

There are several previous studies related to the research to be conducted such as research conducted by Nurhadianto et al in 2020. The research discusses the development of a geographic information system application for tourist and culinary objects in Kudus Regency. The result of

this research is a mobile application that can be used by users to find tourist and culinary places. [11]. The next research is research conducted by Adil et al in 2022 which discusses the development of the nearest tourist recommendation spatial application using the Haversine method. This research applies geolocation technology to find the user's location with the nearest tourist area. [12]. The next research is a study conducted by Cabezuelo in 2020 which discusses the use of geolocation in organising passengers from the Airport to the City. This research combines geolocation information obtained from the user's device with the results obtained from the Mapbox service to calculate the optimal route between several destinations [13]. And there are still many other studies such as research by Sunarto and Noviawan in 2022 [14], Febrian and Nasir in 20221 [15], Suwanti and Usman in 2021 [16], Hidayat and Harjanta in 2019 [17], Hardiyanto and Airlangga in 2021 [18] and others.

The difference between the research that will be conducted by researchers and the research mentioned above is that this research focuses not only on one of the technologies, either geolocation or Mapbox, but focuses on both technologies. This research incorporates geolocation data on the Mapbox platform intending to increase the accuracy and detail of the information produced. Another difference is also in the object under study. In this research, the focus of the object studied is the mapping of tourist areas on Lombok Island including tourist attractions and tourist villages.

Methodology

In this research, there are several stages of research carried out. The stages can be seen in Figure 1.

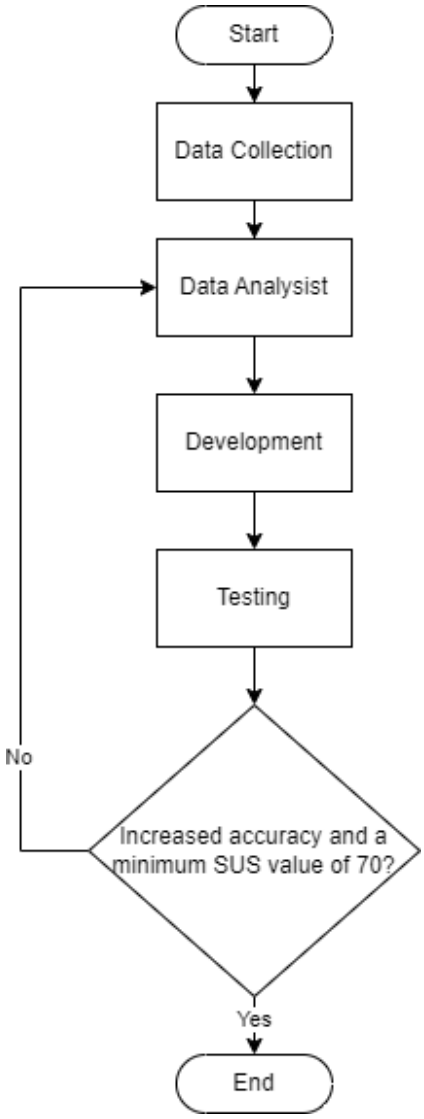

Figure 1. Research Stage

Figure 1 shows the stages carried out in this study from data collection to testing.

1. Data Collection
   The data used in this research was collected from various sources such as Lombok tourism websites, Google Maps, interviews, and others. The data collected includes geolocation data, tourist category data, and data related to tourist areas. The data is then selected according to existing data from the tourism office related to data on tourist areas on the island of Lombok.
2. Data Analysis
   At this stage, an analysis is carried out related to the data requirements used in the development of this system based on user needs.
3. Development
   At this stage, system development is carried out starting from designing the map that will be used to integrating geolocation data on the Mapbox using the available API. The system developed will be implemented on a website so that it can be accessed from anywhere and only requires a browser to access it
4. Testing
   Testing is done in several ways, namely by testing increased accuracy, usability, and a black box. Accuracy improvement testing is carried out using a confusion matrix, where in the confusion matrix the equation used to calculate accuracy is as follows:

$$Accuracy = \frac{TP + TN}{TP + FP + FN + TN} \quad (1)$$

TP is a true positive, which in this study is if the data on the map is considered correct and indeed appropriate. FP is a False Positive, which in this study is if the location is considered correct according to what is on the map but it does not match. FN is a False Negative where the data on the map is considered inappropriate, but it is appropriate. And finally, TN or True negative, where the data is considered inappropriate and truly inappropriate. The next test is usability testing. Usability testing is a testing concept that uses a usability scale to determine the extent to which the system developed can be accepted by users [19]. The equation used to find the test value is as follows:

$$Testing\ Score = \frac{Respondents'\ Total\ Score}{Number\ of\ Respondents} \quad (2)$$

The test scores are then categorized into 6 categories which can be seen in Table 1.

Table 1. Test Value Category

Grade	Minimum Score	Maximum Score	Percent
A	80.3	100	Percent >90%
B	74	80.2	70%<= percentile < 90 %
C	68	73.9	40%<= percentile < 70 %
D	51	67.9	20%<= percentile < 40 %
F	0	50.9	<20%

The usability level of a system is then measured in the context of the level of user acceptance of the system (acceptability range) to assess whether the system is acceptable to users or not [20]. The range can be seen in Figure 2.

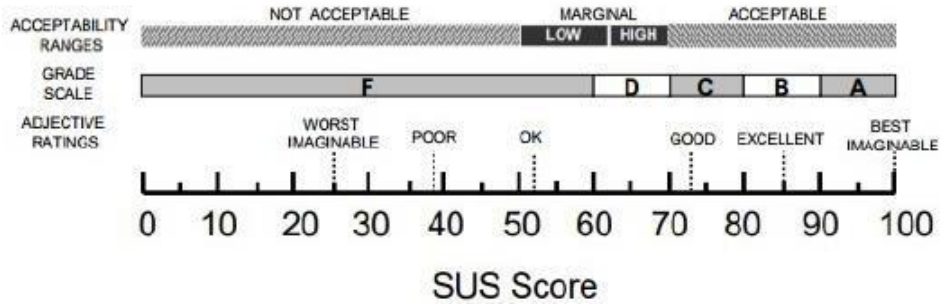

Figure 2. Acceptability Range

Figure 2 shows that if the value obtained is more than equal to 70 then the system is acceptable. In addition to testing related to system acceptance to users, testing was also carried out on the features made and whether they were following the needs or not. The test method used is a black box. Black box testing is testing that is done to ensure that the features developed are in line with expectations when they are developed [21]. The research will be declared complete if it is successful in increasing the accuracy value and the SUS Score is at a minimum of 70. However, if the accuracy does not increase or the SUS score is below 70 then the process will be repeated starting from the data analysis stage.

Results and Discussions

In this research, there are several stages of research used, namely data collection, analysis, development, and testing.

Data Collection

The data used in this research is geolocation data and other data related to tourist areas. Data sources in this research are from various sources such as Google Maps, tourism websites, and others. Examples of data used in this study can be seen in Table 2.

Table 2. Sample Research Data

No	Name of Tourist Area	Latitude	Longitude
1	Pink Beach	-8.85402	116.5622
2	Senggigi Beach	-8.47864	116.0376
3	Tanjung Ann	-8.90914	116.3212
4	Merese Hill	-8.91373	116.319
5	Kuta Beach	-8.89288	116.2826
6	Malimbu	-8.44165	116.0381
7	Sesaot	-8.50997	116.2356
8	Islamic Center	-8.57983	116.1006
9	Etc		

Table 2 shows an example of the data used in this research. Apart from the geolocation data shown in Table 2. There are also other data such as descriptions of tourist areas, tips that need to be considered, transportation that can be used, and others.

Analysis

In this system, there are two categories of users, namely admins and the general public. Based on the analysis of user needs, several functional requirements are obtained that are needed by both categories of users. The functional requirements can be seen in Table 3.

Table 3. Functional Requirements

User	Functional Requirements
Admin	1. Manage Tourism Area Data 2. Manage article data 3. Manage Gallery Data
People	1. View tourist area data both through maps and individual pages 2. View articles and galleries

From Table 3, it is found that the admin can manage and the public can only see it. From the table of functional requirements, the data needed in this research is tourist area data (including geolocation), article data, and gallery data. the data is then processed so that it can be entered into the system later.

Development

This stage starts with designing the map to be used. The map that will be used can be seen in Figure 3.

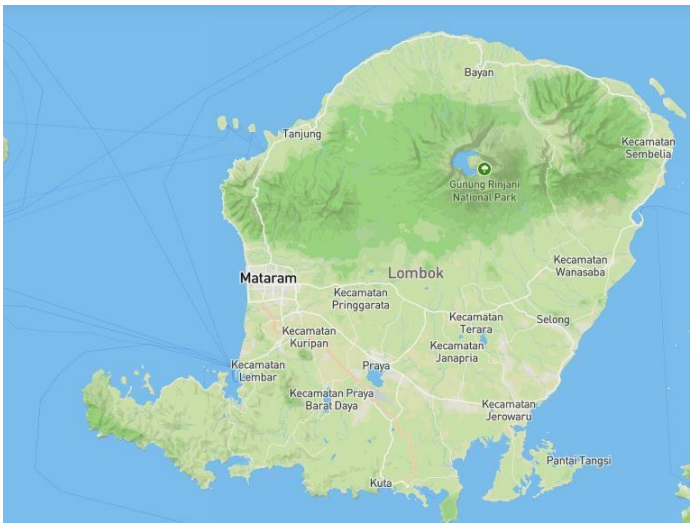

Figure 3. Map Design

Figure 3 shows the map design that will be used in the development of this system. After the design stage, we continued with the application development stage and incorporated geolocation data on Mapbox using API. The results can be seen in Figure 4.

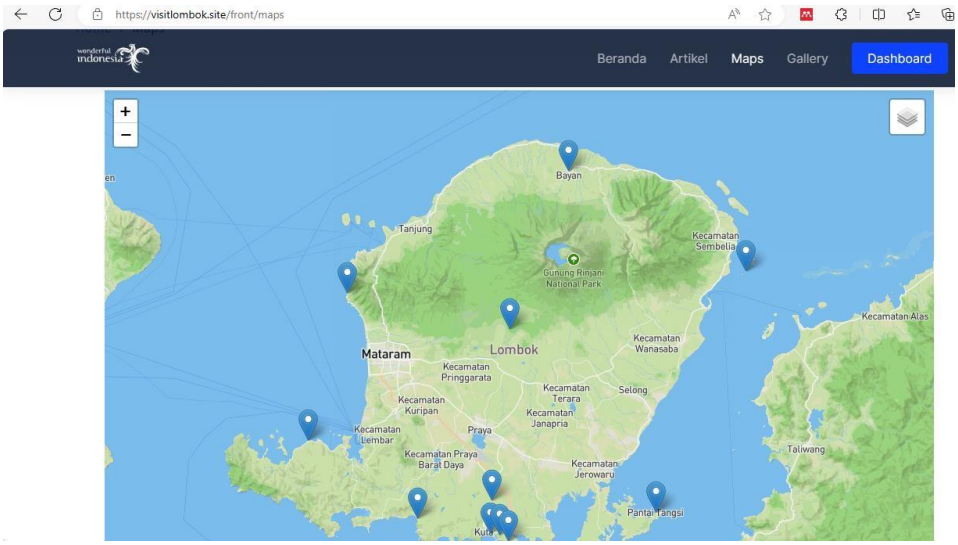

Figure 4. App View

Figure 4 Shows a map that has been given a pin related to the tourist area. The results of the data incorporation that has been implemented can be seen in Figure 5.

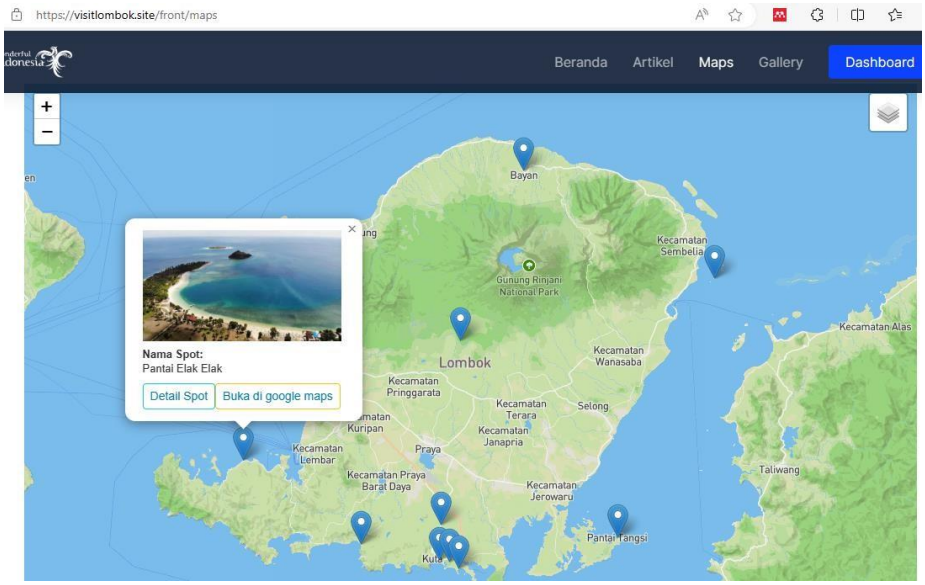

Figure 5. Map View of Data Incorporation Results

Figure 5 shows that there is a tourist area detail menu which if opened will display detailed information related to the tourist area and there is also integration with Google Maps which can provide directions to users to get to the location of the tourist area.

Testing

Testing is done to determine the accuracy obtained from the mapping system that applies data incorporation compared to G Maps. In addition, usability testing is also carried out to find out whether the system developed can be accepted by users and testing is also carried out using black box to ensure the system developed is as expected. The geolocation data accuracy test can be seen in Table 4.

Table 4. Accuracy Testing

No	Name of Tourist Area	G Maps	Confusion Matrix Category	Map Incorporation Data	Confusion Matrix Category
1	Pink Beach	√	TP	√	TP
2	Elak Beach	√	TP	√	TP
3	Circuit Motor Cross 459 Lantan	√	TP	√	TP
4	Selong Belanak	√	TP	√	TP
	.....	.....	.....	.....	.....
31	Sesaot	√	TP	√	TP
32	Merese Hill	√	TP	√	TP
33	Tanjung Poki	X	FP	√	TP
34	Pancor Kopong	X	FP	√	TP
35	Jeruk Manis	X	FP	√	TP
36	Benang Kelambu	√	TP	√	TP
37	Batu Payung	√	TP	√	TP

Table 4 shows that from the 37-test data used, it was found that for Google Maps there were 3 areas with FP values and 34 areas with TP values so the accuracy results obtained using equation 1 were 92%. Meanwhile, the results of incorporating geolocation data between Google Maps and Mapbox obtained a value of 37 TP, which shows an accuracy result of 100%. This shows that

there is an increase of 8% from the implementation of data incorporation. The next test is usability testing. Usability testing was carried out by creating a questionnaire with 10 statements. each statement is symbolized in the form S1-S10. The calculation table used can be seen in Table 5.

Table 5. Usability Testing Calculation

Respondents	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Total	Total x 2.5
Respondents 1	3	3	4	3	3	3	3	3	3	4	32	80
Respondents 2	4	4	4	4	2	4	3	4	4	4	37	92.5
Respondents 3	2	3	2	3	4	4	3	4	3	4	32	80
Respondents 4	4	3	3	4	4	3	2	4	3	3	33	82.5
.....	...	...	...	...	...	...	...	...	...	...	...	...
Respondents 55	3	4	3	3	4	3	2	4	2	3	31	77.5
Respondents 56	4	3	2	3	3	3	4	4	3	4	33	82.5
Respondents 57	3	4	3	3	2	4	2	3	2	3	29	72.5

Table 5 shows that the respondents used in this usability test were 57 respondents with 10 statements. From the test results obtained a value of 81 which means that the system developed is acceptable or feasible. Next, there is black box testing. This test was carried out using 16 scenarios. The results can be seen in Table 6.

Table 6. Black Box

Form	Scenario	Expected results	Description
Home Page	Display the Main Page	main page displayed	Appropriate
Article	The system displays the article	Article Displayed	Appropriate
Maps	The system displays a map of Lombok Island	Map displayed	Appropriate
	The pin of the tourist location area appears on the map	Pins appear	Appropriate
	information related to tourist areas appears	The selected tourist area information is successfully displayed	Appropriate
	Connected to G Maps	connected with G Maps	Appropriate
Galery	Displaying a Gallery of Images of Tourist Areas	Successfully displayed the tourist area image	Appropriate
Tourist Areas	Adding tourist area data	successfully added tourist area data	Appropriate
	Changing tourist area data	successfully change tourist area data	Appropriate
	Delete tourist area data	successfully delete tourist area data	Appropriate
Article Master	Adding Article Data	successfully add article data	Appropriate
	Change article data	successfully change the article	Appropriate

Form	Scenario	Expected results	Description
	Delete article data	successfully archive articles	Appropriate
Master Gallery	Adding Gallery Data	successfully add gallery data	Appropriate
	Changing Gallery Data	successfully change gallery data	Appropriate
	Delete gallery data	successfully delete gallery data	Appropriate

Table 6 shows that all the features developed have run according to expectations.

Conclusion

Based on the research that has been done. A comprehensive mapping system with the incorporation of geolocation data on Mapbox for the tourist area of Lombok Island was successfully developed. The incorporation of data increases the accuracy of the previous mapping system by 8%. In addition, the developed system also received a score of 81 for usability testing which indicates that the developed system can be said to be feasible. Based on the black box testing that has been done, the developed system shows results as expected.

The suggestion for future research is that this system is developed again by adding several features that are integrated with several data sources that allow data retrieval in real-time and the data managed is more numerous, precise, and accurate.

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