THE DEVELOPMENT OF BENGKULU CITY TOURISM APPLICATION BASED ON ANDROID SMARTPHONE USING AUGMENTED REALITY TECHNOLOGY

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ABSTRACT

The city of Bengkulu has many tourist attractions that function as a city attraction. But the number of tourist attractions is not followed by the development of supporting facilities such as facilities regarding tourist information and road guidance facilities to get to tourist attractions. This resulted in the difficulty of tourists coming from outside the city of Bengkulu to find tourist information and find the route. The purpose of this study is to implement augmented reality technology in order to help tourists in getting tourist information and get routes to tourist attractions. The augmented reality method used is the Markerless GPS Based method using the Wikitude SDK library, while the software development method used is the Somerville Version Waterfall. The coordinates of tourist attractions are used as markers in order to display tourist information and can show the route. Testing of the applications that are built is done by questionnaire and processed using a Likert Scale. The test results of 20 respondents showed that the attitude of respondents to the research carried out was very positive to help tourists in finding tourist attractions and information and also very positive value in order to facilitate tourists in finding the intended tourist location.

Keywords: Tourism, Likert Scale, Waterfall, Augmented Reality, Markerless, Coordinates, Wikitude SDK.

1. INTRODUCTION

1.1. Background

Bengkulu City has many tourist attractions which become its own attraction for tourists to come. Just like other cities in Indonesia, the Bengkulu City government also strives to manage its tourism as best as possible. This can be seen from the improvement and additional facilities in the area of tourist attractions to attract tourists.

Tours in the city of Bengkulu vary, ranging from natural tourism, history, culinary, and others. However, not all tourist attractions have facilities in the form of information about the tourist attractions. Many tourists find it difficult to get information about the tourist attractions they visit. Currently, to get information about tourist attractions, tourists must find out by hiring a tour guide. But that certainly will add to the travel costs of tourists. Besides that, there are also no tour guides in some tourist attractions.

Tourists from outside the Province of Bengkulu also have difficulty finding the route to the tourist attractions they want to visit. At present, the way to get information on the location of tourist attractions in the city of Bengkulu is to ask directly to the surrounding community or by looking at the directions. But at present, the existence of road directions to tourist attractions is still very rare.

The interactive presentation of Bengkulu City tourism information is an important thing to do to optimize the tourism promotion of Bengkulu City. Because based on the facts obtained from the results of the questionnaire, 62 respondents from a total of 75 people stated that they did not know about the tours in the city of Bengkulu. This is because the spread of tourist information carried out by the Bengkulu City Tourism Office is only through posters or billboards.

Therefore, it takes an application that can provide information about tourist attractions by implementing augmented reality technology. In addition, to provide route instructions, a Location Based Service (LBS) service is needed which is a service that can find the location of the device used [1]. With LBS, the position of tourists, the position of tourist attractions, and routes to tourist attractions can be known. This LBS service uses global positioning service (GPS) technology and cell-based location from Google.

Based on the problems that have been explained, it is necessary to build a Bengkulu City tourism application on Android-based smartphones by implementing augmented reality technology. This application can display information about tourist attractions in the city of Bengkulu and can also show the route to the destination of the destination that can be accessed anywhere and anytime by tourists.

1.2. Research purposes

The objectives to be achieved from the results of the application development are:

1. Can help tourists in finding tourist attractions and information on tourist attractions.
2. Can make it easier for tourists to search the destination.

2. CONTENTS OF RESEARCH

2.1. Multimedia

Multimedia consists of two words, Multi and Media. Multi means many, multiple, or diverse, while media means intermediaries or connectors. Multimedia is a combination of images, sounds, writing, animation, and videos that are delivered through computer media or electronic equipment digitally. Multimedia makes reading activities dynamic by giving a new dimension to each word. In conveying meaning, words in multimedia can be triggers that can be used to expand the scope of text when examining a particular topic. Many fields have applied multimedia concepts such as education, tourism, promotion, and others. Multimedia is divided into three types, namely:

A. Interactive Multimedia
   Users can control what and when multimedia elements can be sent or displayed.
B. Hyperactive Multimedia
   Hyperactive multimedia has a structure of elements related to users who can direct it. This means that hyperactive multimedia has links that can connect existing multimedia elements.
C. Linear Multimedia
   Linear multimedia means users only become spectators and enjoy multimedia products that are presented from beginning to end [2].

2.2. Augmented Reality

Augmented reality is a technology that can lift an object that was previously two-dimensional to become real, united with its environment [3]. Augmented reality technology can add real-world reality with elements of virtual objects that make the wall boundary between cyberspace and real as if nothing. Augmented reality (AR) is different from virtual reality which completely replaces vision, AR is just adding or completing reality in the real world.

Virtual objects display information that the user cannot receive with his own senses. This makes AR suitable to be used as a tool that can help the perception and interaction of users with the real world. Information displayed in cyberspace can help users carry out activities in the real world.

Augmented reality can be applied to all senses, including hearing, touch, smell, and others. Augmented reality can also be used in various fields such as health, military, manufacturing industry. Augmented reality has also been applied in devices that are used by many people such as mobile phones.

The method developed in augmented reality is currently divided into two methods, namely marker based tracking and markerless methods. The following is an explanation of both methods:

1) Marker Augmented Reality

This marker is usually a black and white square illustration with a thick black border and a white background. The computer can recognize the position and orientation of the marker object and create a 3D virtual world that is the point (0,0,0) and the axis consisting of X, Y and Z. Marker Based Tracking has long been developed since the 1980s and began to be developed in use of Augmented Reality.

2) Markerless Augmented Reality

One of the methods used in Augmented Reality that has so far developed is to use the Markeless Augmented Reality method. With this method, users no longer need to use a marker to display digital elements [4].

2.3. Global Positioning System (GPS)

GPS is not a tool name, but the name of a satellite-based global navigation system (GNSS = Global Navigation Satellite System) developed by the United States Department of Defense. The GPS system uses a satellite group called NAVSTAR (Navigational Satellite Timing and Ranging).

GPS satellites that surround the earth amount to 30 satellites. GPS satellites continually send information so that GPS devices can parse them, for example: GPS arrays that are still functioning properly, where all satellites are in the right orbit or satellite transmission lines, and transmission times. The receiver device will calculate its position with the time of sending the signal and several satellites in the array that are visible (unimpeded into space).

The receiver determines the time needed to receive each message and then calculates the distance from each satellite based on the information received. The distance on each satellite from the receiver, orbit, and trilateration calculations informs the receiving device about the current position. While three radio triangulation transmitters are sufficient to determine a reasonable location, there is a time factor that compares to the orbital satellite. This process takes up to several seconds for satellite signals to reach the earth [5].

2.4. Location Based Service

Location-based service (LBS) is a service based on the location of its geographical location provided to users [6]. LBS can find out where our position is, the position of friends, find the position of desired places such as hotels, ATMs, places of worship, gas stations, and others. Basically location search with LBS is the same as location search using ordinary map, it's just that LBS can provide additional information about the position of moving objects. LBS requires components that include 4

things, namely mobile devices, communication networks, positioning components, service and content providers.

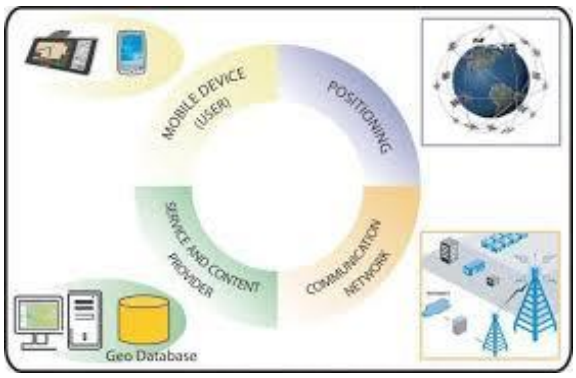

Image 1 Location Based Service Components

2.5. Stages of Research

The research stage is useful as a guide in carrying out the research process so that research can be carried out in a directed and systematic manner. The following is picture 2 which contains the stages of research in the research conducted:

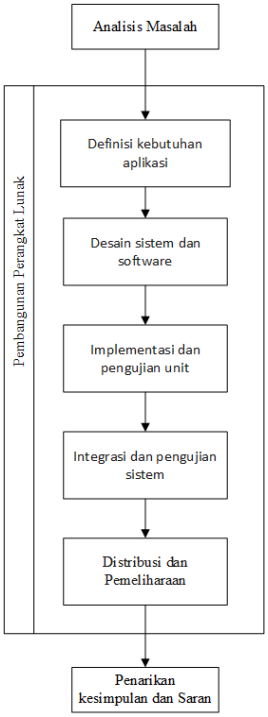

Image 2 Stages of Research

2.6. System Architecture

The system architecture aims to identify the architecture that will be built based on two mobile and web subsystems. The overall system architecture can be seen in image 3 below:

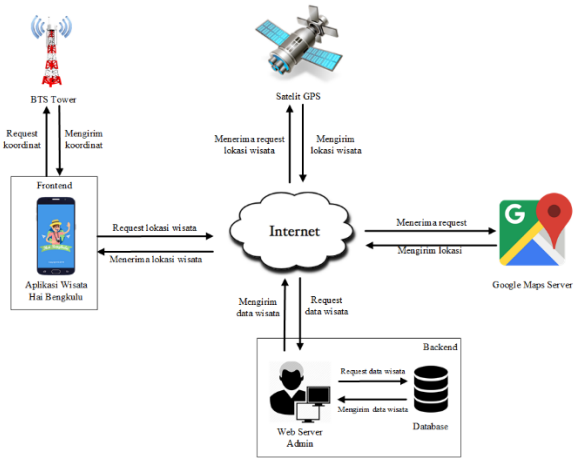

Image 3 System Architecture

2.7. Non Functional Requirement Analysis

Analysis of non-functional requirement is needed to determine the needs of the system being built [7]. This analysis is divided into three hardware requirements analysis, analysis of device requirements, and analysis of user needs.

The following is a non-functional hardware requirement specification which can be seen in table 1:

Table 1 SKPL Non-Functional Requirement

Kode SKPL	Deskripsi Kebutuhan
SKPL-NF-001	The system built must have hardware to run the application
SKPL-NF-002	The system built must have software to build and run applications
SKPL-NF-003	The system is used by tourists visiting the City of Bengkulu
SKPL-NF-004	The system can be run if the smartphone is connected to the internet

The minimum hardware specifications used to run applications that will be built can be seen in table 2 as follows:

Table 2 Hardware Requirements

No	Hardware	Specification
1	Memory	RAM 512 MB
2	Camera	2 MP
3	Screen Resolution	800 x 480

Analysis of software requirements from the system to be built can be seen in table 3 as follows:

Table 3 Software Requirements

No	Software	Specification
1	Windows Operating System	Windows 7
2	Development Tools	Android Studio, Wikitude SDK

3	Design Tools	Adobe Photoshop CS6
4	Android Operating System	Android v4.0 Ice Cream Sandwich

The user analysis can be seen in table 4 as follows:

Table 4 User Analysis

Classification	Information
Education Level	Can be used by various groups, such as ordinary people, students, teenagers, and others.
Reading Level	Can be used by various levels of education by reading intermediate levels, that is, either reading at a glance or selectively.
Typing Skills	Does not require high typing skills, which is about 10 words per minute.
Computer Literacy	*Moderate*
Task Experience	Can be used by users with medium smartphone usage experience, which is about 1 year usage.
System Experience	Can be used by users with a moderate smartphone usage experience, which is about 2 years or more.
Application Experience	Can be used on Android 4.0 or higher operating systems.
Native Language	Using one language, Indonesian.
User Other System	Can be run without the need to install other applications.

2.8. Functional Requirement Analysis

Analysis of functional requirements is what can be done by the application to be built. The following is a table of functional software requirements specifications.

SKPL Code	Requirement Description
SKPL-F-001	The system provides facilities for users to see augmented reality.
SKPL-F-002	The system provides facilities for users to get routes to tourist attractions.
SKPL-F-003	The system provides facilities for users to view tourist information.
SKPL-F-004	The system provides facilities for users to see about the application
SKPL-F-005	The system provides facilities for users to exit the application

A. Use Case Diagram

Use case diagram is a diagram to describe the relationships that occur between actors and activities. Use Case Diagrams are shown in Figures 4 and 5:

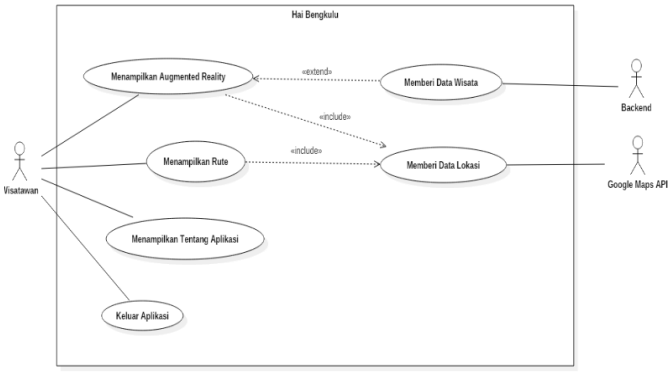

Image 4 Use Case Diagram Frontend

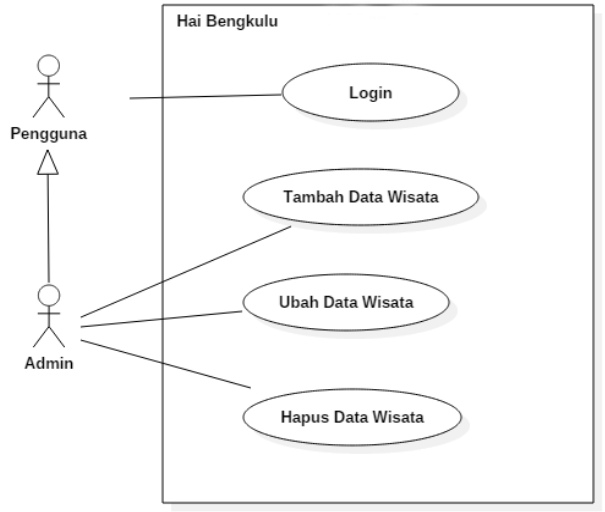

Image 5 Use Case Diagram Backend

B. Entity Relationship Diagram (ERD)

Entity realityhip diagram (ERD) is useful for modeling tourist data needs from applications that are built. ERD will explain the relationship between data in the database based on data base objects that have relationships between relations. The following is figure 6 which is the ERD of the system built:

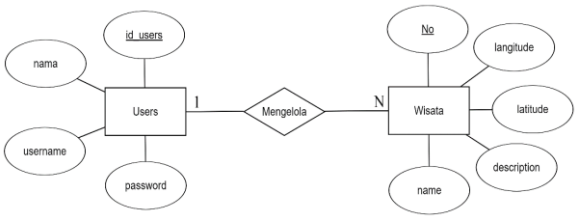

Image 6 Entity realitionship diagram (ERD)

2.9. System Testing

System testing is a stage that aims to determine the existence of errors and deficiencies in the application that has been built, so that it can be known if the system that is built has met the criteria and is in accordance with the objectives or not.

2.9.1. Blackbox Testing

Blackbox is an approach to be able to test in every function in a program so that it can run correctly [8]. The following is table 5 and table 6 which contains the blackbox testing scenario:

Table 5 Blackbox Frontend Testing Scenarios

Mobile Application Testing		
Test item	**Test Details**	**Test Type**
Augmented reality	AR marker appears	Black box
Rute	Show route to tourist attractions	Black box
Tentang	Appear description of the application	Black box
Info wisata	Show information about tourist attractions	Black box

Table 6 Blackbox Backend Testing Scenarios

Mobile Application Testing		
Test item	**Test item**	**Test item**
Login admin	Username	Black box
	Password	Black box
Tambah wisata	Nama wisata	Black box
	Longitude	Black box
	Latitude	Black box
	Deskripsi	Black box
Ubah wisata	Nama wisata	Black box
	Longitude	Black box
	Latitude	Black box
	Deskripsi	Black box
Hapus wisata	Hapus	Black box

2.9.1.1. Blackbox Test Results

The following is a table containing the results of blackbox testing:

A. Frontend

Table 7 Augmented Reality Testing

Cases and Test Results			
Input Data	**Expected**	**Observation**	**Conclusion**
Langitude : 102.250888 Latitude : -3.790281	Showing markers from View Tower tourist attractions	View Tower tourist markers can be displayed	Accepted

Table 8 Route Testing

Cases and Test Results			
Input Data	**Input Data**	**Input Data**	**Input Data**
Langitude : 102.305031 Latitude : -3.803073	Showing the route from the user's location to Lake Dendam Tak Sudah	The route to Lake Dendam Tak can already be displayed	Accepted

Table 9 Info Testing

Cases and Test Results			
Input Data	**Input Data**	**Input Data**	**Input Data**
Langitude : 102.250701 Latitude : -3.788694	Display information on tourist attractions Tugu Thomas Parr	Thomas Parr Monument tourist information is displayed	Accepted

B. Backend

Table 10 Pengujian Login Admin

Cases and Test Results			
Input Data	**Input Data**	**Input Data**	**Input Data**
Username : *admin* Password : *admin*	When login, the main page will appear	The main page is displayed	Accepted

Table 11 Test Data Delete

Cases and Test Results			
Input Data	**Input Data**	**Input Data**	**Input Data**
Data in the form of name, longitude, latitude and description	Display the confirmation message the data wants to be deleted	The selected tourist data is deleted from the database	Accepted

2.9.1.2. Conclusion of Blackbox Testing

Based on the results of the tests that have been carried out, it can be concluded that the functionality of the application that is built, whether it is a frontend or backend application, is in accordance with the original plan, which can display data, add, change or delete. Functionality has run optimally by producing the expected output.

2.9.2. Testing to Users

Testing of users is a test that is used to provide an assessment of applications that are built by conducting questionnaires and getting as many as 20 respondents. The purpose of this test is to find out whether the application built is in accordance with the expectations of the user or not. For the calculation, a Likert scale will be used. Likert scale assessment category can be seen in the following table:

Table 12 Answer Scale

Number	Information
5	Strongly agree
4	Agree
3	Doubtful
2	Disagree
1	Strongly Disagree

2.9.2.1. Calculation of Likert Scale

1. Determine the Score

The score determined is a minimum, maximum, median, quartile 1 and quartile score 3. Since the statement is divided into two, the maximum score that can be obtained is 20 and the minimum score that can be obtained is 4.

A. Determine the maximum total score

= (maximum score) * (number of respondents)
= 20 * 20 = 400

B. Determine the minimum total score

= (minimum score) * (number of respondents)
= 4 * 20 = 80

C. Determine the median value

= (maximum total score + minimum total score)/ 2
= (400 + 80) / 2 = 240

D. Determine the quartile value 1

= (minimum total score + median value) / 2
= (80 + 240) / 2 = 160

E. Determine the value of quartile 3

= (maximum total score + median value) / 2
= (400 + 240) / 2 = 320

2. Determine a score limit

The following is the score limit that can determine the attitude category of the respondent:

a. Very Positive attitude categories, namely areas that are limited by quartile 3 and maximal scores (quartile 3 ≤ x ≤ maximum score).
b. Positive attitude category, which is the area bounded by the median and third quartile (median ≤ x <quartile 3).
c. Negative Attitudes Category, which is the area limited by quartile 1 and median (quartile 1 ≤ x <median).
d. Very Negative Attitude Categories, namely areas that are limited by minimum scores and quartile 1 (minimum score ≤ x <quartile 1).

The score limit can be seen in the following 13 table:

Table 13 Score Limit

Category	Score
Very positive	$320 \leq x \leq 400$
Positive	$240 \leq x < 320$
Negative	$160 \leq x < 240$
Very Negative	$80 \leq x < 160$

Information: x = Total score

2.9.2.2. Respondent Response Results

Based on the total score obtained from the results of the questionnaire given to 20 respondents, a total score of 348 was obtained for the first goal statement and a score of 341 for the second goal statement. This means that the respondents' assessment of the application is very positive.

3. CLOSING

3.1. Conclusion

Based on the results of research, implementation and testing and discussion of this research and also referring to the research objectives, it can be concluded that :

1. Research that resulted in the Hai Bengkulu application can display tourist attractions in the city of Bengkulu along with information about the place of tourist based on location.
2. In the tests that have been carried out, then the results obtained that the application built can facilitate users in finding the location of the destination.

3.2. Suggestion

The development of this application is certainly still far from perfect. Therefore, further development is needed to improve the quality of the application. As for suggestions that can be done so that this application can be even better is:

1. Develop an application that can run on an operating system other than Android.
2. Add promotional videos for the introduction of each tourist attraction.
3. Providing tourist information through ways other than augmented reality.

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