

MOBILE GPS-AUGMENTED REALITY SYSTEM FOR TOUR GUIDE (CASE STUDY : KEDIRI CITY)

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ABSTRACT

Kediri is one of the cities in East Java which has a rapid progress in development. One of Growing Sectors is tourism. Tourism guide, general information sites, which include supporting information such as culinary. Tourism guide from the tour guide as well as information from the web can be a solution. Development of augmented reality technology in mobile applications can be an alternative for tourist guide. The information is displayed in the form of 3D virtual tourist building. Application Guide Tourism Kediri utilizes GPS to determine the user's location and displays 3D travel objects in the direction of the wind against the user's location. The test results of the application show that the application is easy to use by users, allows users to go to the location of tourist attractions and culinary and can be introduced to the public society.

Index Terms—Augmented Reality, Tour Guide, GPS, 3D Tourist Building

1. INTRODUCTION

Kediri City is a city in East Java province and the third largest city in East Java after Surabaya and Malang by population. Kediri city has an area of 63.40 km²[1]. Kediri also have rapid progress in development. It is a growing tourism sector. Many sights can be visited [2]. Information on the travel or tour guide, generally contain information sites, which include supporting information such as culinary. Tourism guide from the tour guide as well as information from the web can be a solution for users.

Development of augmented reality (AR) in mobile applications, as an alternative for displaying a tourist attraction in the form of virtual 3D. This application utilizes GPS to determine the user's location and displays 3D objects travel in the direction of the wind against the user's location.

In previous studies, Fadilah make "Android-Based Augmented Reality App for Knowing Public Facilities" to apply augmented reality to find out information on public facilities in Surabaya by displaying information in the form of 2D [3]. These public facilities such as shopping malls, atm, banks, restaurants, hospitals and so on. This application utilizes GPS to determine the user's position. The application will display the nearest public facility information by pointing the camera towards public facilities. This application is very useful, when the user is traveling, the user will get the information public facilities nearby. The other research is Augmented Reality on research conducted by Abas, entitled "Application of Augmented Reality as a Promotion Historic Buildings in Semarang" [4]. It applied AR technology to promote the historic buildings in the city of Semarang.

In this study, combining two previous studies, to guide tourism Kediri city, using AR technology to promote tourism in Kediri-based 3D models. The application also uses GPS to determine the user's location. 3D tourism objects will be displayed in the

direction of the wind against the user's location.

The purpose of introducing tours in Kediri using virtual guide app uses Augmented Reality technology.

2. BASIC THEORY

2.1 Augmented Reality

Augmented Reality (AR) is a technology that combines the two-dimensional or three-dimensional virtual object into a real three-dimensional environment and then projecting the virtual objects in real time [5]. System (AR) work based on the detection of the image and the image used is the marker. The principle works is actually quite simple. Camera that has been calibrated will detect a given marker, then after marker recognizing and marking patterns, the webcam will calculate whether the marker according to a database owned. If not, then the marker information will not be processed, but where appropriate, the marker information will be used to render and display 3D objects or animations that have been made previously. The method developed AR currently there are two, namely Marker-Based Tracking and Markerless Augmented Reality.

1. Marker Based Tracking



Figure 1. Example of AR Marker Based Tracking [6]

Figure 1 is a view of an AR Marker-Based Tracking method. Presentation of AR uses a pictorial paper that is used as a detection to display the virtual object, the image is an object of the house.

2. Markerless Augmented Reality

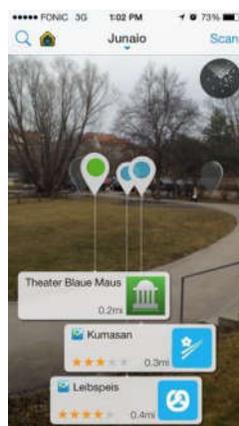


Figure 2. Example of Markerless Augmented Reality [7]

Figure 2 is a view of Augmented Reality Markerless method. Presentation of AR is no longer using a marker (paper media) to display the virtual object. The picture is AR Markerless based on location (coordinates of a point).

2.2 Metaio SDK

Metaio is one of the SDK to build Augmented Reality applications based on mobile and desktop. With this tool, manufacture and development of AR easier. Metaio SDK is a library support for the development of AR marker and Markerless which has many features making it easier for developers to develop applications based AR [8].

3. SYSTEM DESIGN

Tour Guide Application for Kediri City Based on Mobile Augmented Reality is an application that provides information and a list of culinary travel list in Kediri, with the route to the tourist sites and culinary. There are Augmented Reality features that users can view the tour in 3D by pointing the camera in a certain direction. This direction in accordance with

the direction of the wind from the tourist locations on the user's position. The mobile application as a client application that is used by a user when visiting Kediri. Server application as a data provider and culinary attractions. There is a web service as a data provider in the form of JSON.

Kediri has many tourist attractions, but there are six sites were created in 3D, they are:

- Simpang Lima Gumul
- Candi Surawana
- Candi Tegowangi
- Air Terjun Dholo
- Petilasan Sri Aji Jayabaya
- Hutan Lindung Ubalan

The design of the system includes designing 3D modeling and designing system application, shown in Figure 3.



Figure 3 : System Design

In general, the flow of this system are as follows:

- Users install the application on android device
- A data connection and GPS are required to run this application. A data connection is used to retrieve tour data and culinary data of the server.
- When users open the app there will be three features, namely: AR, list of tours, culinary list
- If the user selects the AR feature the user can view the tour in 3D by pointing the camera in a certain direction. This direction is in accordance with the direction of the wind from the tourist locations on the user's position.
- If the user selects a list of travel, it will show a list of tourist information. Users can select one of the tours to see the details of tours and travel routes to get to the tourist destination.
- If the user selects a list of culinary, it will show a list of culinary information. Users can select one to view detailed culinary and travel route to get to the culinary place.

3.1 Modeling 3D

3D modeling software designed using 3DS Max is a three-dimensional software to create three-dimensional object so that it look realistic.

a. Simpang Lima Gumul



Figure 4. 3D Simpang Lima Gumul

Figure 4 is a crossroads that became the meeting point of five roads. At this intersection area, a beautiful monument is built with architectural design that is inspired by L'Archde Triomphe monument in Paris. The monument is known as Simpang Lima Gumul monument and become a tourist icon in Kediri that are always crowded.

b. Surawana Temple



Figure 5. 3D Surowono Temple

Figure 5 is a 3D Surowono temple is a temple building as a historical relic of King Wengker purgatory, which is a subordinate king of the kingdom of Majapahit.

c. Tegowangi Temple



Figure 6. 3D Tegowangi Temple

Figure 6 is a 3D Tegowangi temple, it is a place in Bhre donation. In the Negarakertagama book, explained that Bhre Matahun died in 1310 C (1388 F), it is predicted that the temple was built in 1400 at the time of Majapahit, because a king donation was 12 years after the king's death with Srada ceremony.

d. Dolo Waterfall



Figure 7. 3D Dolo Waterfall

Figure 7 is a Dolo waterfall located in the eastern slopes of Mount Wilis (2.850m) with an altitude of 1800 m above sea level. Spill water is divided into three sections where the most high is about 90 m and below about 2-5 m. Poured water discharge is not too big, but interesting enough to be enjoyed.

e. Petilasan Sri Aji Jayabaya



Figure 8. Petilasan Jayabaya

Figure 8 is Petilasan Jayabaya, it is a place of king meditation or petilasan of Kediri kingdom, he was king Jayabaya.

f. Ubalan Protected Forest

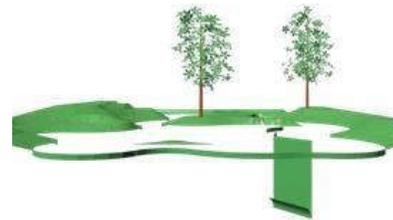


Figure 9. Ubalan

Figure 9 is Ubalan, It is protected forest for traveling in the form of natural protected areas with different types of forest trees. This area provides a swimming pool, fishing pond, camping, and others.

3.2 Augmented Reality (AR) Features Design

AR features are designed using Metaio SDK as a library using the eclipse to support the AR Markerless Technology. In this SDK, there are several methods of presentation of AR but one will be used is the example of Location Based AR. The AR development is modified from Metaio SDK so it only need to add required data for POI (Point Of Interest) AR. These data form the coordinates of the location of tourist attractions. Here are the stages of the design manufacture of augmented reality applications for Kediri travel guides.

- Importing Metaio sdk into Eclipse
Metaio SDK is used as a library to support the creation of AR in this application. In the application project in Eclipse, select properties and metaio sdk added to the Library as in figure 10.

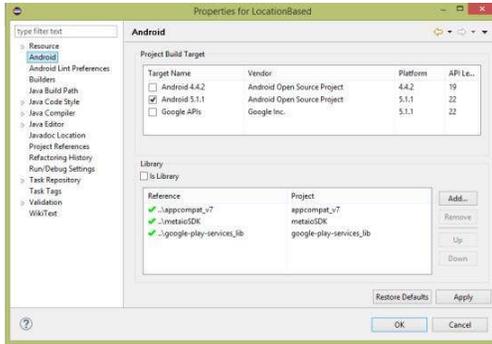


Figure 10. Importing Metaio sdk into Eclipse

- Collecting location coordinates data
Location coordinates are used as sensors for AR Markerless on this application. For displaying travel AR based on location, it required coordinates of the location of the existing tours in Kediri.
- Integrating coordinate data with sights 3D
This stage is the stage to integrate the acquired coordinate data in Google Maps with 3D tourism objects. At the library Metaio, it already provided features for the manufacture of AR based on this location. Features that are available is to show the 3D virtual objects based on location and it can display distance information from the user to the actual location. The last stage is the import .obj file.

3.3 Web Service Design

Web Service is created to save tourism information and culinary data in Kediri City. Creating web service need MySQL as database and JSON programming.

4. TEST RESULT AND ANALYSIS

The application is tested using some parameters as follows:

1. Features Testing

User side as client

- Home Menu
- Augmented Reality Menu
- Tourism List and Tourism Detail Menu
- Culinary List and Culinary Detail Menu

Server side :

- Tourism List Page
- Culinary List Page

2. Accuracy of tourism AR application to certain location

3. Application testing for different devices/smartphones
4. Analysis by questionnaire for traveler/user

4.1 Testing Results of Application Features

1. Home Menu



Figure 11. Home

Figure 11 shows main menu of application. On this menu, there are some features such as: Augmented Reality, Tourism List and Culinary List.

2. Augmented Reality Menu



Figure 12. AR menu

Figure 12 shows AR menu that visualize Kediri Tourism AR.

3. Tourism List and Tourism Detail Menu

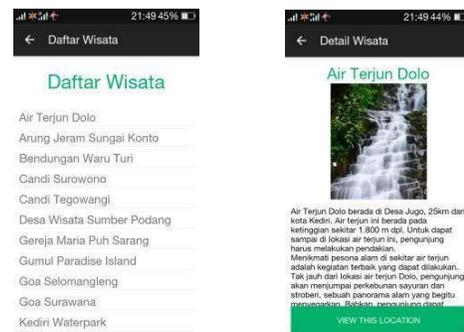


Figure 13. Tourism List and Tourism Detail Menu

Figure 13 shows Tourism List and Tourism Detail Menu. Tourism List menu is a feature that inform about some tourism objects in Kediri City. Tourism Detail Menu gives short description about the tourism object. "View this location" button is a button that has been connected with GPS system, so user can find route toward tourism object location.

4. Culinary List and Detail Culinary Menu

Figure 14 shows Culinary List Menu that informs user about some culinary objects in Kediri City. And Culinary Detail Menu gives a short description about detail culinary. "View

this location” button is a button that has been connected with gps, so user can find a route toward culinary object location.

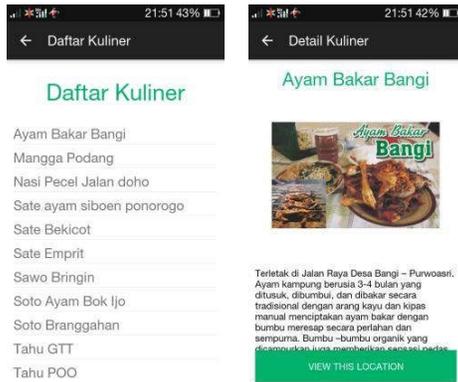


Figure 14. Culinary List and Culinary Detail Menu

Server Side:

a. Tourism List Page

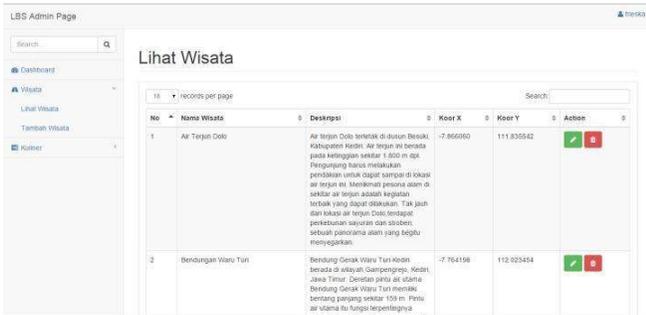


Figure 15. Tourism List Page

Figure 15 shows tourism list page that informs users about tourism list that has been added into database. There are green and red buttons on right side page, that is used to update and to delete data.

b. Culinary List Page

Figure 16 is a view page displays a list of culinary cuisine that has been added to the database. There are green and red buttons on the right are used to modify and delete data that has been added.

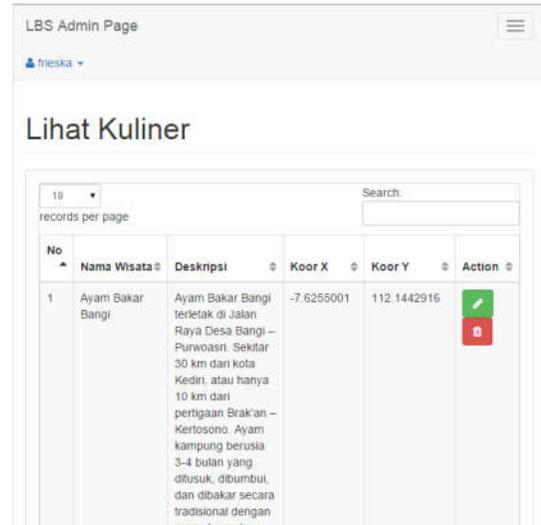


Figure 16. Culinary Page

4.2 Accuracy Test of AR with real location

This experiment aims to determine the ability of AR applications in displays in appropriate locations. The trial test was conducted at two central locations as an experiment, namely in the area of Simpang Lima travel Gumul (SLG) and tourist locations of Surawana Temple. The purpose of this test is to test the ability of AR applications in displays correctly. Here is a table of test results accuracy AR to tourist sites.

Table 1 : The Results of Distance Analysis Test

User Location		SLG	Surawana Temple
Distance	Surawana Temple	20.1 km	1.6 km
	Tegowangi Temple	15.1 km	6.4 km
	Petilasan Jayabaya	4.5 km	15.6 km
	Ubalan	12.2 km	16.9 km
	Dolo Waterfall	25.6 km	44.2 km
	SLG	5 m	18.8 km

To read the table is as follows, suppose a user's location in SLG, then the distance between SLG and Petilasan Jayabaya is 4.5 km, while the user eg in Surawana then the distance between Surawana and Petilasan Jayabaya is 15.6 km. From the table, it appears that the accuracy of the information provided is going well. Indeed most tourist locations are in the area SLG so the distance is getting closer when tested in the SLG than tested when were in the area Surawana travel. Tegowangi temple is the only travel that is close to Surawana with a distance of 6.4 km.

This result test can also be analyzed that the accuracy of the distance information on these two different locations. The accuracy of the information displayed on the AR region when

Simpang Lima Gumul is 5 meters, whereas in the Surawana is 1.6 kilometers.

4.3 Analysis of Users

To analyze the level of satisfaction of users of this system, it is carried out questionnaires to 20 respondents obtained by showing the application to some visitors in Simpang Lima Gumul and some students as well as students who generally liked activity traveled. The questionnaire asks some questions that describe the application when it was run by the user.

Table 2. Questionnaire Results

Mobile Augmented Reality Based Tour Guide Application			
NO	Description	Yes	No
1	AR Interface is interesting and easy to understand	20	
2	AR models are similar with the original ones	19	1
3	The application gives useful information	20	
4	The applications can add interest to visit Kediri	20	
5	The application is <i>user friendly</i>	20	
	Total	99	1
	Percentage	99%	1%

Questionnaire results in the table above can be seen among other information:

1. The number of respondents as many as 20 people.
2. Respondents who voted yes (all respondents) is as much as 99 and has a percentage of 99%.
3. Respondents who opted not (all respondents) is as much as one and have a percentage of 1%.
4. Respondents responded yes as much as 99%, so it can be concluded that the application is easy and useful to the user and can help to guide user to Kediri City Tourism Objects.

5. SUMMARY

From the analysis of the test result from the applications in the previous chapter, it can be concluded as follows:

1. Application Guide Augmented Reality Based Tourism has an attractive appearance and easy to use.
2. Information provided by the application was informative so that it can help the user to the major tourist sites.
3. The application can add interest to the public to visit the sights in Kediri.
4. The augmented reality application is not accompanied by sound (sound) because the library/metaio SDK does not support audio.

6. REFERENCES

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