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# Promotion of Purbalingga Tourism Object Using Augmented Reality Location Based Service & Virtual Reality 360<sup>0</sup> Based on Android

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**Abstract** - One of the technologies that can be used as an attraction in Purbalingga Regency is Augmented Reality (AR) merging virtual objects with real objects, where those objects can be seen in real-time. And using the Location-Based Service (LBS) method, this method is a service with the main parameters being the position and location of the user. LBS Location Based Service will be enhanced with Google Maps and GPS (Global Positioning System) to find its user position and information about several locations to be visited. Virtual Reality (VR) brings users can interact in a virtual world environment simulated by a computer, so that users feel they are inside. The appearance of the Image object using 360<sup>0</sup> panoramic so that it can display images definitely and not cut and can look around the image. Application creation is done by Multimedia Development Life Cycle (MDLC) and Unity3D. The application has been successfully operated on the Android operating system with minimum specifications of 2GB RAM and KitKat version 4.4 OS. The results of the study have been conducted through a questionnaire to 15 respondents with 15 questions earned. The total value of the frequency of each question gets a score of 1,009 or a percentage of eligibility of 89,68% starting that the application is well worth using. Based on the black-box test, the application has been running properly and can display Location Based Service and 360<sup>0</sup> panoramic and its information.

**Keywords** - augmented reality, virtual reality, location-based service, panoramic 360<sup>0</sup>, android

## I. INTRODUCTION

Purbalingga Regency is a district in Central Java Province that is attractive to be visited by the public and tourists. Tourism potential can improve the economy of a region or district and have an important influence on regional development. The natural beauty and the many tourism objects in Purbalingga Regency are interesting potentials to visit, such as water baths, cultural tourism, agro-tourism, natural tourism, historical tourism, and religious tourism. Delivering information through

catalogs makes the public and tourists not all able to get information easily because tourists have to come and visit the tourism object directly [1]. The information made by the local tourism office is very limited because the wider community cannot get tourism information, so it must be supported by promotional media and the introduction of tourism objects through various media, one of which is by using digital-based information media. Previous research has discussed the application of AR (Augmented Reality) of Purbalingga tourism objects using the catalog [2] and the implementation of Visual Media 360<sup>0</sup> on the Android Platform for the Promotion of second Vehicle Sales [3]. The application of this method has successfully demonstrated its effectiveness and is very beneficial for the editors and readers. New things were also done for smartphone device users, such as AR technology in the form of LBS (Location Based Service) to find locations and provide information in the form of directions needed by users and mobile-based VR (Virtual Reality) technology 360<sup>0</sup>. Android that can be used by the community easily.

Based on these problems, an Android mobile-based application will be designed by implementation AR and VR technology which makes it easier for users to interact with the environment in the virtual world that can be simulated by a computer, so that users feel they are in the environment the real one.

Android is the newest mobile smartphone operating system today. The android operating system itself is very open, making it easier for creators to create their applications [4].

The detailed explanation of AR is the combination of virtual objects with real objects where we can see these objects in real-time [5], which is integrated with POI (Point of Interest) data to display the position of an object's location in the form of icons or symbols in reality from a smartphone camera. This application is designed using the LBS method, which is a service whose main

parameters are the position and location of the user [6] and it will be enhanced with Google Maps and GPS (Global Positioning System) to find the user's position and information about several locations to be visited. Location data is displayed based on the longitude and latitude of the user's destination [7].

VR explanation is an interface technology between humans and machines that can make users feel like they are in a real environment including sight, hearing, movement, and other actions. VR also allows users to observe a virtual environment and feel like they are in that place [8] and Panoramic 360° is a technique of displaying borderless and seamless photos so that they can see the surroundings of the image. Unlike Photogrammetry, 360° panoramic do not produce 3D objects. The use of 360° panoramic can make an image visible with a wide viewing angle with the help of a VR headset to display the image [3], for example with Google Cardboard developed by Google with a cardboard material that can be folded and uses a smartphone screen. An example of its use is attached to a stereoscopic head or this is called by providing a separate image for each eye. These rides are mostly used for gaming but are also used in other applications. Google Cardboard allows users to see objects in 3D and as real as they are so interesting [9].

For application design using Unity3D which is commonly used for game development. Unity is commonly used for processing 2D and 3D objects. Unity is also equipped with an Integrated IDE (Integrated Development Environment) which no longer requires additional software such as Ms. Visual C++ or Delphi because Unity already has a code editor and compiler. The advantage that Unity has is a multiplatform engine that can be implemented on Mac, Windows, Android, IOS, WII, and even PS 3 operating systems [10].

For the creation of AR and VR applications, Unity 3D is supported by several additional software such as AR toolkit and Vuforia. AR toolkit itself involves a virtual image into the real world. AR toolkit does this by tracking video, real camera locations and using

calculations by adjusting the marker pattern in real-time [11]. Vuforia is an SDK (Software Development Kit) intended for making AR, Vuforia itself uses computer vision technology to recognize and track markers on 3-dimensional or 2-dimensional objects in real-time [8]. For the overall design using Adobe Photoshop, digital photo processing software is in great demand by designers. Because the features provided for processing a photo are very easy to understand, making Adobe Photoshop is in great demand by designers [12].

In this study, this research aims to design an application that can help tourists find out some tourist objects and can be used by the community to enjoy tourism objects in Purbalingga Regency such as nature tourism, swimming pools, culture, and mountains which are then implemented on a smartphone entitled Application Augmented Reality Location Based Service & Virtual Reality 360° Tourism Objects in Purbalingga Regency based on Android. When doing this research using the black box method and compatibility test to find out the application is running clearly.

## 5 II. METHOD

The system development method which used in this research is the MDLC (Multimedia Development Life Cycle) through on the system in a sequential and structured manner with stages: Concept, Design, Material Collecting, Assembly, Testing, and Distribution. If one of the steps has not been completed then it will not be able to continue to the next step. This method has the purpose and functions as a guideline for designing the system very efficiently as it resolves the system in a structured manner for quality results [13].

### A. Concept

The first stage that must be done by a creator is a concept that is useful for determining the goals of making an application that must be achieved. The concepts in this study are presented in Table I.

TABLE I  
CONCEPT

3	Title	Purpose	User	Object	Input	Output
	Promotion of Purbalingga Tourism Object Using AR Location Based Service & VR 360° Based On Android	Make interesting application to promote tourism object which located in Purbalingga regency in virtually	Public	Photos of tourist objects	Text and pictures	Text and 360° panoramic photos

**B. Design**

At this step, the design for developing this application is explained, namely VTOC (Visual Table of Contents) and interface design. VTOC is a diagram that contains modules in the system as well as numbers and names, and the essences will be detailed in the overview diagram and diagram details. The VTOC from AR LBS and VR Panoramic 360<sup>0</sup> Purbalingga Tourism Object is explained as follows:

- The Main Menu Module has four menu buttons, namely the Augmented Reality Menu, Virtual Reality Menu, Guide Menu, and About Menu.
- The Augmented Reality menu has a location button that displays the POI location from the GPS which is packaged interestingly with AR technology displayed from the user's camera, the location menu for tourist attractions consists of some information, the name of the location, and the distance, and the back button. The back menu functions to return to the original menu, the about button contains about the author, the cross button is used to exit and back to the main menu.
- The Virtual Reality menu displays VR technology which is attractively packaged and displayed from the user's smartphone, there is a VR menu, location name, virtual reality display of tourist objects, and a back button. Menu returns (back) has the function to return to the start menu.
- The About menu displays an overview of the application and the author. There is a back button on the about page which is used to go to the main menu.

- The guide menu is a display part that contains an explanation of how to operate the AR & VR application of Purbalingga Tourism Object. The back menu has the function to return to the start menu.

User Interface (UI) design is the initial design or design of the system and user interface design will be used as a guideline for the appearance of the system to be made [14] can be seen in Fig.1.

Fig.1 Show the Basic Design UI Augmented Reality and Virtual Reality, it can be explained that user interface design contains 4 menu buttons namely Augmented Reality, Virtual Reality, Guide and Information, Cross or exit. Where the guide button and information contain instructions on how to use the application, the Augmented Reality button displays POI the location of the packed GPS interesting with technology AR displayed from the user's camera, the menu of the location of the tourist attraction consists of some information, location name and distance, and the back button. Menu back serves to return the initial to the menu, the button about contains out the author, the cross button is used to exit back to the main menu. the next Is the Virtual Reality button there displays technology (VR) that is packed with interesting and displayed from the user's smartphone, menu VR there, location name, virtual reality display of tourist attractions, and back button. The menu returns to function to return to the main menu.

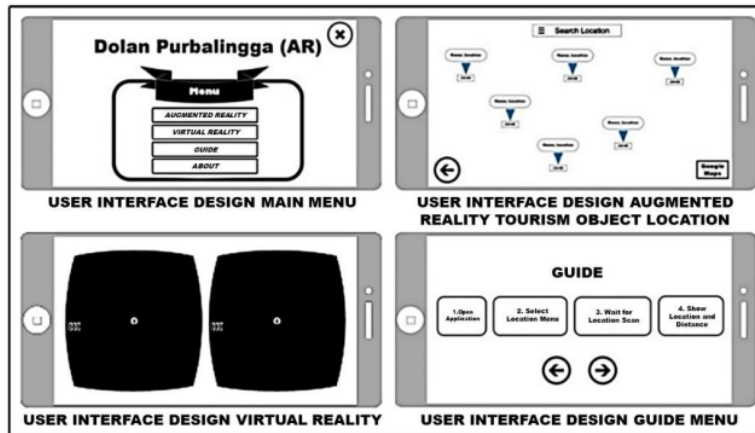


Fig. 1 Basic design UI Augmented Reality & Virtual Reality



### C. Material Collecting

In this research the technique to collecting data used 2 techniques there are observations and interviews. Observation is needed to see firsthand the situation of a tourist attraction, by taking pictures of tourism objects to be used as materials needed, while interviews are needed to obtain information related to tourism in Purbalingga Regency with related parties, and the results obtained are related to information made by the tourism office only. limited to a catalog that makes the public and tourists not all of them able to get information easily, the delivery of this information is only done if the tourists who come to visit one of the attractions in Purbalingga Regency. This information is very limited because the wider community cannot get tourism information, so it must be supported by media promotion and the introduction of tourism objects through various media, one of which is using digital-based information media.

### D. Assembly

The design of this application uses the UML (Unified Modeling Language) method which uses a set of diagrams to model the system. UML has the utility to describe the process of object-oriented design and analysis. UML makes it easy for developers to do visual modeling or not make narrative but dominate the image as the emphasis. The following is a HIPO Diagram (Hierarchy, Input, Process, Output) Fig. 2, Use Case Diagram shown in Fig.3 and The Overview of the Diagram can be seen in Table II.

Fig.2 show The HIPO Diagram (Hierarchy, Input, Process, Output) is a system designer to systematically display the entire process in an application is explained as follows:

- Module 0.0 The Main Menu Module has four menu buttons: Augmented Reality Menu, Virtual Reality Menu, Guide Menu, and About Menu.
- Module 1.0 Augmented Reality Module Displays POI location from GPS which is packaged attractively with AR technology displayed from the user's camera, Augmented Reality menu consists of some information, location name, distance, and back button. The Back menu serves to return to the main menu.
- Module 1.1 AR View Camera view is active, GPS is active and AR view contains: user camera background, several POI markers for tourist

attraction locations, text for tourist attraction locations, a distance of tourist attraction locations from the user, back button, and AR text.

- Module 2.0 The Virtual Reality module displays VR technology that is attractively packaged and displayed from the user's smartphone, there is a VR menu, location name, virtual reality display of tourist objects, and a back button. Menu back (back) has a function to return to the initial menu.
- Module 2.1 VR Panoramic 360° Display of Tourist Attractions The display and motion on the marker show panoramic photos of 360° tourist attractions and there is a back button to return to the choice of the ministry of tourism.
- Display Guide Module 3.0 Guide and information containing: Background, guide text and information, and back button.
- Module 4.0 About Display contains Background, Text, application and author information, and back button.

Fig.3 shows the use case diagram explains what a user can be done to run the application [15]. The users can choose 2 (two) applications, next the user is addressed with 4 options, Augmented Reality, Virtual Reality, Guide, and About, if the user selects the guide button it will be directed to the guide and information display, if the user selects the about button it will be directed to the view about the application, then if the user selects the Augmented button, it will proceed to the AR display of the location of the tourist attraction, then the user is intended to select the location of the tourist object he wants to go to, the application proceeds to identify the location through the camera, if the location identification is valid it will display the location of the tourist attraction with the POI marker, distance, and information.

If the user selects the Virtual Reality button, the application will proceed to display the tourist attraction VR display, in the tourist attraction VR display there are photos 360° panoramic and information on tourist attractions that users can enjoy.

Overview Diagram or summary diagram is a diagram that describes are series of inputs, processes, and outputs that have the main functions and references of the program. The Overview of the diagram can be seen in Table II.

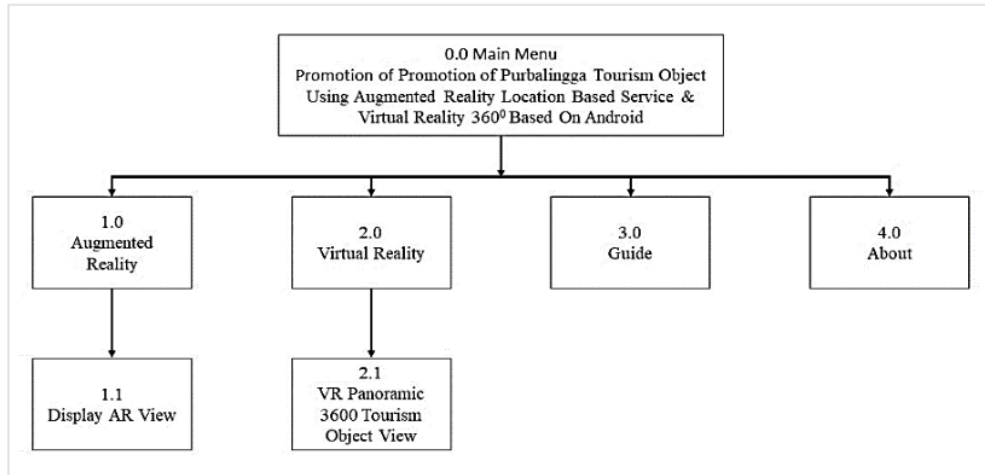


Fig. 2 HIPO diagram

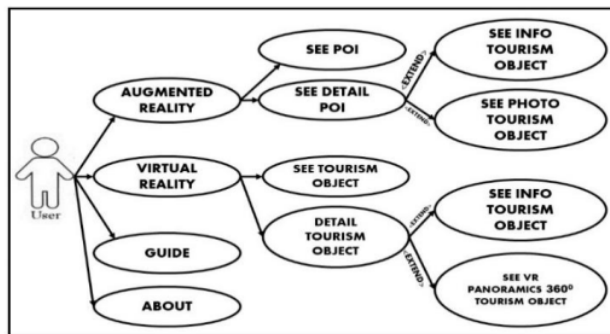


Fig 3. Use case diagram

TABLE II  
OVERVIEW DIAGRAM AR & VR

No	Input	Process	Output
1	Select the AR Menu button	-Display the location -Display the <i>AR View</i> -Turn on the camera	-Display the location of the tourism object -Display the POI tourism object -Display the <i>AR View</i>
2	Select the VR Menu button	Display about several Options VR Attractions	Display of several VR tourism object
3	Select the tourism object	View 360° VR Panoramic Tourism Objects	VR Panoramic 360° Tourism Object View
4	Select the Guidance and Information button	Shown the Guidance and Information	Display about Guidance and Information
5	Select the About button	Shown About	Displays About
6	Select the Name Location	Give detailed information about tourism object	Display the detailed information about tourism object
7	Select the back button (←)	Back to the previous page	Display the previous page
8	Select the Exit button (X)	Exit the Application	To exit from the application

### III.RESULT AND DISCUSSION

#### A. Display Application AR & VR

The home menu display consists of five buttons, there is the Augmented Reality menu, the Virtual Reality menu, Guide Menu, About and Cross menu to exit. Where the augmented reality menu button will lead to the AR display section of the tourist object and the menu and virtual reality button will lead to the VR tourism object shown in Fig.4. Display of AR and POI tourist objects, consisting of some information, location names and distances, if we touch the location name, detailed information on the location of the tourist attraction will appear, besides that there is a searching location, google maps button, and back button Where google maps are used to display location maps, the menu returns to return to the initial menu as shown in Fig.5. The display that appears after selecting the maps button to see the map of the location of a tourist attraction from google maps and there is a back button to return to the AR page shown in Fig.6. 360° panoramic VR views of selected tourist objects, display 360° panoramic photos and there is a back button to other tourist attraction options shown in Fig. 7.

#### B. Testing

Testing uses the black box method which will override the system mechanism and pay attention to the output generated from the input when it is executed.

This black box test is used to determine the function of the AR LBS & VR Panoramic 360° application, whether the performance is as expected. Blackbox testing can be seen in Table III.

Based on black-box testing, it was found that all buttons function properly, AR LBS & VR Panoramic 360° works well, as well as the market also works well.

The compatibility test is carried out by installing a AR & VR application on several versions of Android as shown in Table IV.

This research used a questionnaire from respondents to collect data and then processed it into information. Respondents who were involved were 15 people. Respondent measurement was carried out using a Likert scale that was initiated by Rensis Likert with a maximum score used as the basis for assessing the question points in the questionnaire [16]. The feasibility category is based on Table V. The results of the feasibility test for interactive media by users of the AR & VR application in this study were obtained as in Table VI.



Fig. 4 Home menu display



Fig. 5 AR LBS display

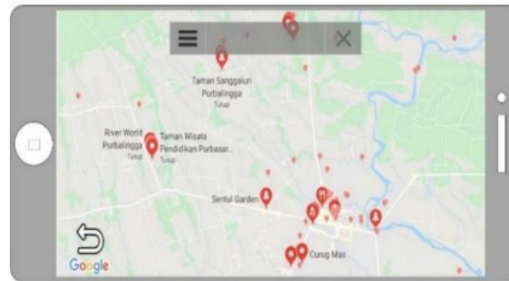


Fig. 6 Display page to view map



Fig. 7 Display VR tourism object

TABLE III  
BLACK-BOX TESTING

No	Page	Tested	Action	The Results are Expected	The Result
1	Main Menu	Button Menu AR	Touch	Switch Page	Ok
		Button Menu VR	Touch	Switch Page	Ok
		Button Guide	Touch	Switch Page	Ok
		Button About	Touch	Switch Page	Ok
2	AR Menu	Camera against marker	Point the Camera	POI Tourism Object Appears	Ok
		Google maps	Touch	The Map Shows the Location	Ok
		Location Name	Touch	Show Detail Information	Ok
3	VR Menu	Button Menu VR	Direct Marker	Several Option Appears VR Tourism Objec name	Ok
4	VR View	VR View	Panoramic VR 360°	Panoramic VR 360° according to the marker movement	Ok

TABLE IV  
COMPATIBILITY TEST

No	Device Name	Android Version	The Result
1	Samsung Galaxy TAB 3	4.0	The application runs smoothly
2	Galaxy Note 1	5.1	The application runs smoothly
3	Oppo F5	7.1	The application runs smoothly

TABLE V  
FEASIBILITY CATEGORY

Answer Score	Percentage	Information
1	0 – 20 %	Very Ineligible (VI)
2	21 – 40 %	Ineligible (I)
3	41 – 60 %	Eligible Enough (EE)
4	61 – 80 %	Eligible (E)
5	81 – 100 %	Very Eligible (VE)

TABLE VI  
THE RESULTS OF DUE DILIGENCE

No	Question	VE	E	EE	I	VI
1	AR & VR application appearance is very interesting	9	3	2		1
2	The writing can be read clearly	5	5	3	1	1
3	Color matching composition	14	1			
4	Can be used easily	9	6			
5	The Application usage guide is clear	5	7	2	1	
6	The menu is not confusing	13	2			
7	Sound effects according to the application		15			
8	Attractive button design	6	8	1		
9	Pause (loading) is appropriate	2	7	4	2	
10	The location of the tourist attraction according to google maps	13	2			
11	The 360° panoramic photo view is not blurry	9	5	1		
12	The navigation marker is functioning normally	12	3			
13	Markers move according to our movements	13	2			
14	AR & VR application provides interesting information about tourism objects in Purbalingga Regency	13	1		1	
15	AR & VR applications are suitable for tourism promotion media	15				
	<b>Total</b>	<b>138</b>	<b>67</b>	<b>13</b>	<b>5</b>	<b>2</b>



Each question is answered with a Likert scale by giving points 1 to 5, where scale 1 = Very Ineligible (VI), scale 2 = Ineligible (I), scale 3 = Simply Eligible Enough (EE) scale 4 = Eligible (E), scale 5 = Very Eligible (VE).

The maximum score is is symbolized by the letter X generated from the highest score on the Likert scale, namely Very Eligible with a score of 5 multiplied by the number of items or  $X = 5 \times 15 = 75$ ., The expected score is symbolized by the letter Y the maximum score multiplied by the number of respondents, namely  $Y = 75 \times 15 = 1,125$ . Respondent Assessment Formula for AR and VR applications is based on the data obtained in TABLE VI. With 15 respondents and 15 questions using formula for finding the frequency value of each question (1) is as follows [17]:

$$f = Tn \times Pn \quad (1)$$

f =The total value of the frequency of each question

Tn = The total number of respondents

Pn = Likert scale score selection

Meanwhile, to get the percentage results of the feasibility of AR and VR applications, it can be formulated using The total value of the frequency of each question and the expected score with (2) [18].

$$P = \left( \frac{f}{Y} \times 100\% \right) \quad (2)$$

f =The total value of the frequency of each question

P = Percentage of eligibility

Y = Expected score

After being explained by using the formulas (1) and (2), then it can be applied using the respondent's data in Table VI as follows :

$$f = (138 \times 5) + (67 \times 4) + (13 \times 3) + (5 \times 2) + (2 \times 1)$$

$$f = 690 + 268 + 39 + 10 + 2 = 1009$$

$$P = \left( \frac{1009}{1125} \times 100\% \right)$$

$$\text{Percentage of eligibility} = 89.68\%$$

Researchers conducted testing on 15 respondents which are 7 females and 8 males. Before filling in the user questionnaire, the respondent must use the AR and VR application, generally for 10 minutes. The total value of the frequency of each question gets a score 1009 or the percentage of eligibility was 89.68%. The total score is included in the Very Eligible Category which means that the application is considered successful and works properly. The presentation of the scale the percentage of the total score [16] in detail can be described as Fig. 8.

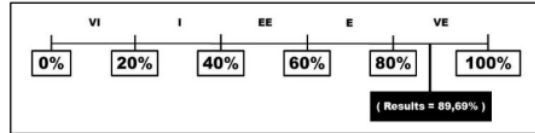


Fig. 8 Scale Category Feasibility Test Results from Respondents

### C. Distribution

The application of Augmented Reality Location Based Service & Virtual Reality Panoramic 360° Tourism Object of Purbalingga based on Android which has been tested is then disseminated to all communities through social media, tourism websites, brochure promotions, and in the play store.

## IV. CONCLUSION

The conclusion from this research of Augmented Reality Location Based Service & Virtual Reality Panoramic 360° Tourism Object of Purbalingga based on Android using the black box method, the results show that this application succeeds in displaying Augmented Reality Location Based Service & Virtual Reality Panoramic 360° on a smartphone and questionnaire testing that is almost 90 % think this augmented reality & virtual reality application is successful. The test that has been carried out is expected to become an application that can help the general public and tourists to find out the location of tourism objects in Purbalingga Regency which are packaged interestingly.

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