Virtual reality application for educational interactive media “3 historical monuments of yogyakarta”

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Abstract. Virtual Reality (VR) technology is a technology that able to bring users to immerse into the virtual world. VR is one manifestation of the development of multimedia technologies that can serve as a means of education. Indonesia is a country that has a diversity of cultural and historical attractions. As well as the Special Region of Yogyakarta (DIY) which is famous for its temples and monuments as tourist attractions. Based on statistical data of tourism DIY 2015, the frequently visited historical monuments is Prambanan’s Temple Complex and “Kraton Ngayogyakarta” including “TuguJogja”. However, visitors or the public in general are less interested in reading a brochure to find out the history of the monument. Therefore, it takes historical educational media that is packed in a modern technology in the form of VR applications in order to attract the interest of the audience. This VR application was created using Luther's method with six stages. This VR application aims to simulate a virtual tour diorama monument with a 2D stereoscopic animated video presentation on the history of the monument. The realization of this VR application is created by using Tools named Unity3D and Google VR SDK.

1. Introduction

In this modern era, the progress of Information Technology continues to grow in Indonesia, especially the technology of delivering information through educational media. Educational media as a source of learning can provide a concrete picture so that the expected understanding of science can be presented in a more informative, real, and not only in the abstract picture. The rapid development of modern technology can make educational media become more varied, such as the use of Virtual Reality (VR) technology. VR refers to the concept that all objects seem to be explored like the original world [6]. In addition, VR technology has been developed as an interesting educational tool, especially historical education. Special Region of Yogyakarta (DIY) as one of the cultural and historical tourism destination has bequeathed the temple and monument buildings that attract tourists. Based on statistical data of DIY tourism[9], there are several monuments that often become tourist destination in Yogyakarta city that is “Kraton Ngayogyakarta Hadiningrat” complex (including “TuguJogja”) and Prambanan’s Temple. The number of tourist visits monuments show an average increase of about 12% per year since 2011. However, based on interviews with the interviewees as tourguide in Yogyakarta, stated that the increase in visits is not comparable with the concern and curiosity of visitors to the history of the monument. The lack of historical information media becomes one of the obstacles for visitors. Historical information media available on lyn in the form of brochures that contain a little material about history of the monument in DIY. Historical education media in the form of this
brochure is less varied and monotonous. It makes visitors less interested to read or learn about history so that the story of history is not well conveyed because it is considered boring and uninteresting. Therefore, it takes a modern technology approach to package historical information becomes more interesting. One form is in the form of VR applications specifically educational media of monuments. It aims to present historical information more interesting and informative, as well as useful as a medium of entertainment that can promote historic buildings in DIY. The objective of this project is to develop VR 3D application with focus to programming for mobile base application. Different with other paper which give user the experience of history in 2D animation with 360-degree environment [10].

2. Literature Review

2.1. Previous Research
Utilization of VR technology as a media of historical education can trigger the public's curiosity about the history of monuments in DIY. According to research conducted by Ardiyansyah, modern society makes smartphone as a tool to get some information [1]. The conclusion of his research also states that the use of virtual technology with smartphones can make historical information can be packaged and presented in more interesting. Mean while, according to research conducted by Bahar, the use of Virtual Reality (VR) technology on educational media can improve the experience of historical heritage education for the younger generation and society in general. His research also states that in the future VR technology can be used to preserve history [2].

2.2. Virtual Reality
Virtual Reality (VR) is a technology that allows users to pass the interaction in virtual environments simulated by computer (computer-simulated environment), a real emulated environment or imagination environment. Generally, Virtual Reality environment presents a visual experience on a computer screen or a stereoscopic viewer. Some simulations include additional information such as sound through speakers or headphones. Through headphones or speakers, users can feel and hear the realistic sound [2]. Virtual Reality also has four essential elements, they are Virtual World, Immersion, Sensory feedback, and Interactivity.

2.3. Android
Android is an operating system for a computer or a smartphone. Google Inc. fully builds Android and makes it open for anyone (opensource). Developers can use Android without the cost of a license from Google and Android can be built without restrictions. Android Software Development Kit (SDK) provides the tools and Application Programming Interface (API) which is necessary to begin developing applications on the Android platform. Development of android application uses the Java programming language [5].

2.4. Unity3D
Unity 3D is a constantly evolving game engine. Unity 3D is one of game engine with a source proprietary license, but for the development license is divided into two, they are free and paid. Unity does not restrict the publication of the application. Unity users with a free license can publish applications that have been created without having to pay license fees or royalties to unity. But the users of the free version are restricted for a few features that are reduced or negated the bonus modules/certain prefab [8].

2.5. SDK Google VR
According to the developers.google.com site, Google VR SDK for Unity works in the development of Virtual Reality applications for Android and iOS. Unity integrates with Google VR to make it easier for developers to build Day dream and Cardboard Android apps [4].
2.6. Luther Method
Luther defines methodology of multimedia development consists of six stages, the stages are concept, design, material collecting, assembly, testing, and distribution. Six of these stages can be carried out not sequentially but remain to be conducted in parallel with the advance stages of planning that concept and design [3].

3. Design and Realization
Virtual Reality Application for Educational Interactive Media “3 Historical Monuments of DI Yogyakarta” applying multimedia development method with Luther Model.

3.1. Concept
This project requires a good and mature planning process. This planning will provide an overview of the concept of application to be generated. The first three stages of concept, design, and collecting materials based on the Luther methodology will explain the planning part of the Virtual Reality application program for educational interactive media “3 historical monuments of DI Yogyakarta”. The first stage in Luther's methodology is the concept stage. This concept stage begins with the identification of problems through data observation and interview with Special Region of Yogyakarta tour guide. After the problems underlying this project have been established, the concept was made to initiate the design and development process of Virtual Reality application for educational interactive media "3 historical monuments of DI Yogyakarta".

3.2. Design
In order to make the design of this application program is clearer than the visualization of the program and the object to be used described on the storyboard. Figure 1 is an example of some of the scenes that exist on the storyboard of this Virtual Reality application. The next step after the design phase of the Luther methodology is the collecting material stage. This stage contains a table explaining the asset requirements for making this Virtual Reality application.

![Figure1. Storyboard of Virtual Reality Application page four](image-url)
3.3. Assembly

After the design stage of Virtual Reality application has been completed, the next stage is the realization of the Virtual Reality application program. The realization part of the program is the same as the assembly stage of Luther's methodology used. In this assembly stage there are two software used in development process. They are Adobe Premier Pro CS6 and Unity3D+Google VR SDK.

3.4. Stereoscopic Display

Animation as set used for virtual reality applications that must be in the form of stereoscopic display. The stereoscopic display is a visualization technique used to create a perception of depth in the user's eyes so that visual information can feel immersive [7]. Therefore, the animation assets obtained from the animation team must go through the editing process to be made into a stereoscopic display.

Technically, the process of converting an animated video into a stereoscopic view is by inserting 2 pieces of the same animated video into a single screen. The animated video that the author uses has a resolution of 1920x1080 pixels. Then the width of the second animation scale is changed to half from 100% to 50%. Each video is placed on the right and left. Screen division aims to adjust the perception of the view according to the right eye and left eye. Furthermore, the animated video is rendered using the same initial resolution of 1920x1080 pixels with the .mp4 format. After rendering, the animated video is ready to be imported into the VR application project.

3.5. Implementation of Display

Each scene creation uses the Gvr Viewer Main object placed on the hierarchy except in the splash screen and application instruction scenes. The Gvr Viewer Main object will work for the implementation of aside-by-side rendering view on the viewer screen. Next is the implementation of the assets needed to the scene. Some scenes have different hierarchy panels. In scenes that include 3D objects, layout settings are required to match the design of the simulation arena. Each 3D object comes with a delimiter or is called a Collider. The function of the Collider is to limit the movement of players to not pass the object.

Another requirement that supports the simulation atmosphere is the existence of Audio Backsound which can be heard when the application is run. In addition to the button is also required the Audio Button. The audio implementation uses Audio Source and Audio Listeners components. It only takes one Audio Listeners in one scene. As for Audio Source depends on the amount of audio used in a scene. Implementation of stereoscopic animated video assets is not the same as implementing audio assets.

On the platform android unity version 5.5 videos can only be presented in full screen. Video scan be accessed only from the Streaming Assets folder and use special scripts for video full screen play back on the mobile device screen. Another way of presenting an animated video history on this application is through a link to an online video player application that is Youtube. The animated video presented on the online Youtube app can be enjoyed with a 360 degree scope.

4. Discussion

The next stage is the testing phase or application testing phase. The purpose of testing is to ensure that the designed and built functions are working properly. In the event of an error or deficiency it will be immediately known and corrected after this test is completed.

4.1. Alpha Testing

Testing alpha related object and script functionality based on concepts that have been made. Functionalities include the technique of visualization, the use of objects, navigation buttons between scenes, and scripts that support the course of the application. Testing is conducted independently by playing the application thoroughly. The author ensures that every scene and object function has been
running properly and correctly. This test is conducted 2 times. The first test is conducted to look for errors in the application. The second test to make sure the error is resolved properly so that the application is ready to enter the beta testing stage. From the results of alpha testing that has been done, it can be concluded that all components tested in the Virtual Reality Application for interactive educational media “3 historical monuments DI Yogyakarta” there are several functions that must be improved. The error of the function must be fixed in order to run properly and correctly. Improvements made areas follows.

4.1.1. Object Functionalities In Scene
When testing on some scenes there is an error in the functionality of the objector scene. Errors that occur include the error of the scene sequence on the list of scenes in build and the error of writing the scene name in the goal scene column. The test is conducted twice to correct the wrong function or not appropriate. The first test found a discrepancy in the function of scene displacement. Scene moves not on purpose of expected scene. This error has been fixed and the button function for scene movement has been run properly and correctly. In the second alpha test no more errors are found. All functions in each scene have been running well and correctly in accordance with expectations.

4.1.2. Script Function
For testing the script takes 2 times testing. When the first test is conducted, the author finds an error in the collider object or boundary wall involved in the script ‘NamaRuang.cs’, the dividing wall is supposed to function as an activator for the room name and the closing wall of the museum arena. However, this wall has not entered into the script that is inputted on the object inspector panel so that the wall cannot be an activator and the player cannot pass through the dividing wall. In addition too the errors that occur that the output of the audio button function on the auto click function does not match the expectations because every second audio button sounds. After an improvement on the error then the test to the two functions of the wall as an activator and audio button function is running well and correctly. The second test also has not found any errors.

4.2. Distribution of Virtual Reality Application
After going through the testing stages, the virtual reality application is ready to enter the distribution stage according to Luther's methodology. At this stage of distribution is done packing application products. The end result of this multimedia product is an application file with .Apk extension. The file can be paired on a mobile device with an Android operating system that has a minimum version of Jellybean4.2 and has agyroscope sensor. Furthermore, this application will be packed using storage media in the form of Compact Disk (CD).

5. Conclusion
Based on the work of Virtual Reality Application for Educational Interactive Media “3Historical Monuments of DI Yogyakarta” which has been completed, then obtained some points of conclusion is there search project successfully designed and developed a Virtual Reality Application for interactive educational media “3Historical Monuments DI Yogyakarta” by applying Luther model multimedia development method with 6 stages. The final result of this research is Virtual Reality Application with extension. Apk and size of this application that is equal to 136MB.

Techniques used in the design process of this VR application include stereoscopic video display techniques using Adobe Premiere Pro CS6, first person shooter (FPS) technique as user point of view, and side-by-side rendering techniques for head mounted use Virtual reality display using the Google VRSDK version1.03 and Unity 3D version 5.5.

The use of virtual reality applications is supported with hardware supporting applications in the form of Mobile operating system Android version of Jellybean 4.2 and above and has agyroscope sensor, Headset Virtual Reality and Bluetooth Controller.
Based on alpha testing, has been conducted 2 times testing to complete the application properly and correctly. Testing is conducted for 2 pieces of aspect that is object functionality and script function aspect.

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