E-Learning Application of Tarsier with Virtual Reality using Android Platform

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Abstract. Spectral Tarsier is a primitive primate that can only be found in the province of North Sulawesi. To study these primates can be used an e-learning application with Augmented Reality technology that uses a marker to confronted the camera computer to interact with three dimensions Tarsier object. But that application only shows tarsier object in three dimensions without habitat and requires a lot of resources because it runs on a Personal Computer. The same technology can be shown three dimensions' objects is Virtual Reality to excess can make the user like venturing into the virtual world with Android platform that requires fewer resources. So, put on Virtual Reality technology using the Android platform that can make users not only to view and interact with the tarsiers but also the habitat. The results of this research indicate that the user can learn the Tarsier and habitat with good. Thus, the use of Virtual Reality technology in the e-learning application of tarsiers can help people to see, know, and learn about Spectral Tarsier.

1. Introduction

Tarsier is one of the smallest primates found on several islands in Indonesia. Tarsier has several types namely, Bancanus Tarsier, Spectral Tarsius, Pygmy Tarsier, and others. Spectral Tarsier can be found in the provinces of North Sulawesi. Their habitat is a secondary forest with trees that are small and medium. They can be found in tree cavities and voids are formed ushered dense bamboo trees. Tarsier is carnivores by eating insects.

Virtual Reality is a technology that allows users to interact with the artificial environment simulated by computer. It can give a real impression. It is widely used in the fields of healthcare, automotive, education, and others. One example application in the field of education is Sea World VR2 created by eiNpictures. This application allows users to be a diver in a sea that full of marine creatures and make the user know about a sea creature [4]. Tools to develop the Virtual Reality-based application is Unity and Blender. Virtual Reality can be run on Android smartphone supported by Gyroscope Censor and Magnetic Field Censor. Users may use additional tools such as VR Headset and Gamepad.

E-learning of Tarsier can be done by using existing application. *Aplikasi Pembelajaran Satwa Langka* (Endangered Species Learning Application) is one of e-learning application of tarsier with

Augmented Reality technology [11]. The Application displays in three dimensions' object by using marker faced the camera computer to interact so three dimensions' tarsier object superimposed onto the real world. The weakness of the application is not shown the habitat tarsier and need a special marker to interact. The same technology can be shown three dimensions' objects is Virtual Reality. The Virtual Reality advantages than the Augmented Reality is making the user like venturing into the virtual world. To overcome the weakness of e-learning application that will be constructed e-learning application with Virtual Reality using Android Platform. This application not only shows the Tarsier but also its habitat and can interact with the virtual environment so users seemed to get into the virtual world.

Based on the description above, that can be seen on an opportunity to develop e-learning application of Tarsier with Virtual Reality using Android platform to introduce and provide information about Tarsier. Android Platform was chosen because it provides the resources needed. This application can help people to see, know, and learn about Spectral Tarsier.

The formulated research question is "how to develop e-learning application of Tarsier with Virtual Reality using Android platform that can help people to see, know, and learn about Spectral Tarsier?". In this regard, the research objectives are as follows:
1. Provide information and knowledge to the public about Spectral Tarsier and its habitat.
2. To develop an e-learning application of Tarsier with Virtual Reality using Android Platform.

2. Literature Review

2.1. Tarsier
Tarsiers first appeared in the Eocene era and known as "living fossils". This primate can rotate the head at an angle of 180º and jumps. Generally, family's tarsier has a characteristic body covered with thick hair and smooth, big eyes and big ears. For Tarsier found in Sulawesi, have distinctive characteristics that their white hair behind the ears, while the lid hair gray [7].

2.2. Virtual Reality
Virtual Reality is the computer-generated simulation of a 3D model environment, which seems very real to the person experiencing it, using the special electronic equipment. The objective is to achieve a strong sense of being present in the virtual Environment [8]. VR environment generally present a visual experience that is displayed on a computer screen or through a stereoscopic viewer, but some simulations include additional information by sensing results [11]. The user can interact with the Virtual Reality environment through the use of standard input tools such as a keyboard, mouse, and others.

Augmented Reality (AR) is a variation of Virtual Environments (VE), or known as Virtual Reality (VR). Augmented reality is an attempt to combine the real world and the virtual world in real-time in 3D model created by the computer so that the boundary between two worlds become thin [6].

Virtual Reality and Augmented Reality has a fundamental difference that is from the input to the console being used. At the Virtual Reality all the input data are pre-programmed, whereas, in Augmented Reality, the input is derived from the surrounding environment on the console [1]. Another difference is the Virtual Reality allows users joined in a virtual environment as a whole, whereas Augmented Reality allows users see the real environment with virtual objects which added to or incorporated into the real environment [6].

2.2.1. Component of Virtual Reality.
A VR system is made up of 2 major subsystems, the hardware and software. The hardware can be further divided into computer or VR engine and I/O devices, while the software can be divided into application software and database as illustrated below [2].

2.2.2.   Virtual Reality Works. Virtual Reality basically works in two ways namely stereoscopic 3D viewing and head tracking [8]. Stereoscopic 3D viewing is separating display screen into two parts with two dimensions' image of each for the left eye and right eye so as to give the illusion of three dimensions view. Head Tracking is a process to detect a pose and head movement.

2.2.3.   Types of Virtual Reality. Types of Virtual Reality can be classified into three main categories namely non-immersive, immersive, and semi-immersive [2]. Immersive System is the type that will be used. This type can provide the highest level of immersion so that user will feel like be part of the virtual environment. This uses Head Mounted Display (HMD) as the main tool and complementary tools are tracking devices, data gloves, and other.

2.2.4.   Methods of Virtual Reality. Methods of Virtual Reality can be divided into four namely simulation, avatar, projectors, and desktop [9]. Simulation-based Virtual Reality is the methods that will be used. This method provides a simulation to the user with virtual reality.

2.3.   Tools to Develop Virtual Reality
There are two software tools to develop Virtual Reality. Those tools are Blender and Unity. Blender is an application that supports the creation of modelling, rigging, animation, and other [3]. Unity is a game engine that can manage multiple data such as three dimensions' objects, sound, texture, and other [10].

2.4.   Similar Application
The following are e-learning application using Virtual Reality technology. *Aplikasi Pembelajaran Satwa Langka* (Endangered Species Learning Application) is an application that uses a type of semi-immersive system and runs on the computer by using a marker that faced the camera computer to interact with an object [11]. Sea World VR2 is a mobile application that uses a type of immersive system to allow the user to be a diver in a sea that full of marine creatures [4]. VR Safari is a mobile application and uses a type of immersive system that delivers an environment of safari park to the user as in the car [5].

3. Proposed Virtual Reality Design

3.1. Analysis of Similar Application
The following table will only show the comparison between Virtual Reality application by eiNpictures, Tumboimbela, and Chai.

Table 1. The Comparison of *Aplikasi Pembelajaran Satwa Langka* (Endangered Species Learning Application), Sea World VR2, and VR Safari [11] [4] [5].

		Endangered Species learning Application	Sea World VR2	VR Safari
I.	**Type of *Virtual Reality***	Semi-immersive (Augmented Reality)	Immersive	Immersive
II.	**Operating System**	Windows	Android	Android
III.	**Language**	Indonesian	English	English
IV.	**Helping Tools**	Webcam and marker	Headset VR and Gamepad	Headset VR and Gamepad
V. Feature				
a. 3D Object		√	√	√
b. Virtual environment		√	√	√
c. Animation		√	√	√
d. Information		√	-	-
e. Feed the object		-	-	-

| f. Change time condition	-	-	-
g. Explore the world	-	√	√

3.2. Requirement Specification
The following are the features that will be developed on the e-learning application of tarsier.
1.   The Application can show Spectral Tarsier and its habitat in 3D model along with information.
2.   The User can explore the virtual world with a Gamepad.
3.   The User can change time condition of virtual world so that the application can show Spectral Tarsier activity based on time of day or night.
4.   The Application can provide a button to feed the Spectral Tarsier.
5.   The User can control the Tarsier objects such as jumping, eating, sleeping, and a voice with buttons on the Gamepad.

3.3. Design Modeling
There are four use cases of e-learning application of Tarsier. Figure 3 depicts those use case in use case diagram. There is only one actor that is a user.
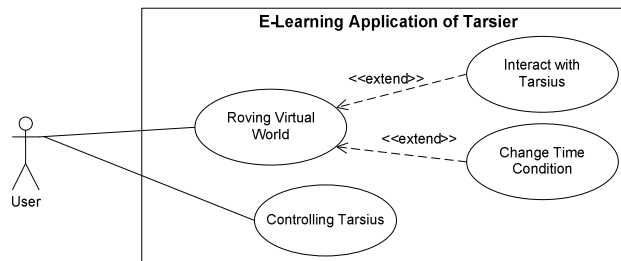
Figure 1. Use Case Diagram

3.4. Function for the Application Development
To develop the application require a lot of function. The following is a list of function that is most needed.

Table 2. Function Needed For Application Development.

Function Name	Information
Head Tracking	Detecting head movements and shows the object in the direction of the angle from the head.
Input Gamepad	Set the input buttons are derived from gamepad devices.
Stereoscopic	Setting the display screen Android smartphone into two parts.
Change Condition	Changing the conditions of the time from the virtual environment to daytime into a night and vice versa.
Tarsier Activities	Determining the activities that can do of Tarsier object based on the time condition.
Avoid User	Regulate the movement of Tarsier object to the user.
Feed	Regulate the movement of Tarsier object when user feeds the Tarsier.
User Movement	Regulate the movement or displacement of the user when the user is walking in a virtual environment.
Tarsier Animation	Set the animation of objects Tarsier based on input by the gamepad.

3.5. Animation Controller and Design Map of Virtual World
The following are animation diagram of Tarsier object and virtual world design map for the future will be explored by the user. Figure 4 depict Tarsier object can do in the virtual world. Figure 6 is a design map of Virtual World.
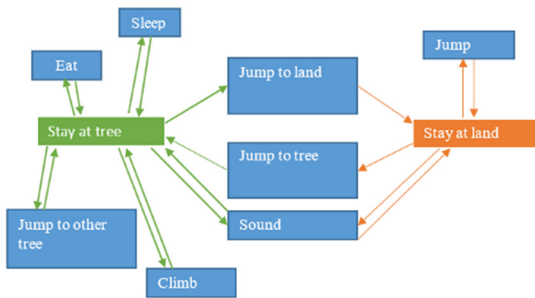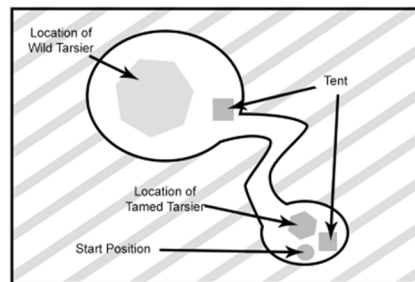
Figure 2. Animation Controller

Figure 3. Map of virtual world

4. Implementation and Testing

4.1. Technology for the Application Development
Supporting software for this application is as follows.

Table 3. Software Required For Application Development.

Programming	Unity 5.3.3
3D Object	Blender v2.71
Animation	Blender v2.71
Image Editing	Adobe Photoshop CS6
Modeling	Microsoft Office Visio 2007

4.2. Implementation of Application
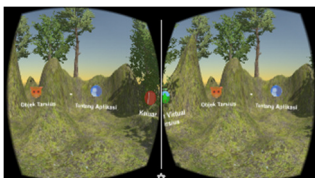The following will depict the application interfaces.
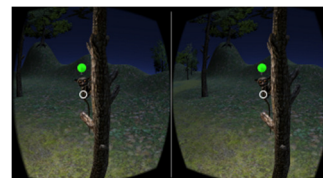

Figure 4. Main Menu Display

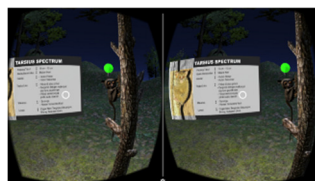**Figure 5.** Tarsier and Environment Display

Figure 6. Spectral Tarsier Information Display

Figure 7. Menu of Tarsier Object Display

Before running this application, connect the Gamepad to the smartphone first. The following is an explanation of the use of the application after running.
1. Enter the smartphone into a VR Headset and user wearing VR Headset.
2. The menu selection is done by looking at the menu item and pressing the A button on the Gamepad or button provided by VR Headset.
3. For virtual world tarsier menu, Buttons used in Gamepad are the A button to interact with objects and Analog button to walk.
4. Before entering into the virtual world tarsier, the application will provide information about objects that can interact with the user.
5. For tarsier object menu, the buttons used in Gamepad are the A button to sleep, B button to eat, X button to jump, Y button to sound, and Start button to return to the main menu.

4.3. Testing
The following are the specifications used in the test.
1. Smartphone with Intel Atom Z3560 processor, 2 GB RAM, and Android 5.0 operating system.
2. Headset VR-type RITECH REIM 2 and Gamepad-type Ipega PG-9028.
    The testing process was based on requirements specification. The following points were the tests performed by the user on the application.
1. Application showing Spectral Tarsier and its habitat in 3D model along with information.
2. User exploring the virtual world.
3. User changed time condition be during the day or night.
4. User fed the Tarsier by using the feed menu displayed when the user pressed the A button on an object.
5. User controlled the Tarsier object like jumping (X button), eating (B button), sleeping (A button), and making sound (Y button).

5. Conclusion
After the development processes that has been done, the developed application is able to help the people who want to see, know, and learn Spectral Tarsier with criteria:
1. Showing Spectral Tarsier and its surroundings in 3D model with information.
2. Interacting with Tarsier (e.g. feeding) and virtual world (e.g. changing time condition, exploring).
3. Making the users feel as if they are on the real habitat of Tarsier.
4. Running well on an Android smartphone that has gyroscope and magnetic field censor.
5. Receiving inputs from the Gamepad such as walking, choosing navigation, and controlling Tarsier.

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