The Design of 3D Virtual Reality Animation of Javan Rhino for Educational Media of Endangered Animals in Indonesia

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Abstract

Indonesia is one of the largest archipelagic countries in the world. Indonesia has very rich biodiversity but is facing serious threats. Many endemic species are threatened with extinction due to factors such as climate change, habitat loss, illegal trade and poaching. This research highlights the urgent need for education about endangered animals, with a focus on the Javan Rhinoceros (Rhinoceros Sondaicus) which is categorized as Critically Endangered by the International Union for Conservation of Nature (IUCN). This research was created for Animalium, a research facility under the National Research and Innovation Agency (BRIN), which still lacks interactive Virtual Reality media for education. The main aim of this research is to design a 3D VR animation about the Javan Rhino to increase education and awareness about its conservation. Interviews with educators at Animalium revealed the need for such a medium to prevent damage to physical replicas and to engage visitors, especially children, in a more immersive and interactive learning experience. Observations showed that there were no 3D VR-based educational tools in the facility. The implementation of VR technology has the potential to significantly increase visitor engagement and experiences regarding the conservation of endangered species, in line with Sustainable Development Goals (SDGs) related to terrestrial ecosystems. This research highlights the potential of VR to provide immersive and interactive educational experiences, increase public awareness, and support wildlife conservation efforts, especially the Javan Rhino. The result of this design is an Unreal Engine project file that can be used in Animalium to create an immersive and interactive educational experience, increase public awareness, and support wildlife conservation efforts, especially the Javan Rhino.

Keywords: Virtual Reality, Javan Rhino, 3D Animation, Interactive Education, Indonesian Biodiversity.

I. INTRODUCTION

Indonesia, as one of the largest archipelagic countries in the world, has a very rich biodiversity, unfortunately this natural wealth is currently facing serious threats. Many animal species endemic to Indonesia are at risk of extinction due to a number of factors such as climate change, habitat loss, illegal trade and poaching. This is an urgent and alarming problem that requires serious attention and innovative solutions [1]. Based on data from the International Union for Conservation of Nature (IUCN), there are 1,217 endangered animal species in Indonesia as of October 4, 2022, equivalent to 2.94% of the world's total of 41,338 endangered animal species [2].

In Indonesia, one of the endangered animals is the Javan rhino or with the Latin name Rhinoceros sondaicus [3]. The Javan rhino has been red-listed as Critically Endangered since 2019 by the International Union for Conservation of Nature and Natural Resources (IUCN), an international organization dedicated to the conservation of natural resources. The Javan rhino, or Rhinoceros sondaicus, is one of the wildlife species that is a priority species for urgent conservation [4]. The Javan

rhino is one of two rhino species whose habitat is only in Indonesia, with the current population distribution limited to the southwestern peninsula of Java Island, in the Ujung Kulon National Park (TNUK) area and this one-horned rhino is also one of the least populated large mammals in the world so, this is of particular concern to the government, in this case, the Directorate General of Natural Resources and Ecosystem Conservation (KSDAE), Ministry of Environment and Forestry, Ujung Kulon National Park (TNUK), partners, and experts [4].

Therefore, there is a need for education about endangered animals in Indonesia, especially about mammals in Indonesia, namely the Javan rhino. The initial mediation in this design was made for Animalium, which is one of the research facilities owned by the National Research and Innovation Agency (BRIN) in the form of an educational tourist spot about wild animals that are researched by researchers, also cared for and displayed to visitors as learning materials. Then this design is made for Animalium which aims to provide a new and interactive in-depth educational experience about the

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endangered Javan rhino, and convey an important message about preserving animals so that they do not become extinct. But in that case at Animalium there is still no Virtual Reality media as educational media. This Virtual Reality media is a solution to the problem in Animalium against the prone to damage to the replica animal statues on display at Animalium when held by small children because of curiosity, this is based on the results of the author's interview with one of the educational partners from Animalium.

In the design of this study, researchers designed a 3D animation of Javan rhino Virtual Reality (VR) for educational media about the endangered Javan rhino in Indonesia which is planned at Animalium to add new educational mediation and add insight into the endangered Javan rhino.

Based on the results of interviews with one of the educational guides from Animalium, it is also one of the problems that is trying to be overcome, namely providing an education and experience to the public about the importance of preserving and protecting endangered animals. Then based on the results of direct observation at Animalium, there is also no 3D Virtual Reality-based educational media so that this research can add new experiences at Animalium.

In addition to these problems, there are other problems, namely, the behavior of children visitors. Children because of their high curiosity resulted in holding the replica animal statues on display that should not be touched, which caused damage to the replica animal statues. This is a problem because the animal replica statue is an asset owned by Animalium from the results of BRIN (National Research and Innovation Agency) research which has a nominal price that is not cheap. This was emphasized by one of the guide officers at Animalium based on the results of interviews conducted by the author.

Apart from the educational context, in the context of the development of tourist destinations in Indonesia, virtual reality technology has the potential to improve the visitor experience, where research results show that presence in virtual reality positively affects visitors' perceived enjoyment [5]. In the current context, Virtual Reality (VR) technology is a tool that has significant potential to enhance the visitor experience [6]. Through VR, it is possible to create virtual environments that allow users to learn more about the habitats of endangered animals, understand the various threats posed by such species, and support ongoing conservation efforts.

However, the implementation of Virtual Reality (VR) in the context of endangered animals and endangered animal education in Indonesia is still rarely found [7], [8]. This is also evidenced by the results of an interview with one of the educational guides at Animalium who stated that the use of Virtual Reality (VR) as a medium for endangered animal education is still rare and from the observation of studies with similar topics is also still rarely found.

With Virtual Reality (VR) technology, users can experience the delivery of information in an in-depth and interesting way. Virtual Reality (VR) allows users to fully engage in a digital environment that provides a direct and immersive experience [9]. This is in line with previous research, which allows users to use it anywhere and anytime

[10]. Users can interact in real time through the utilization of various sensors, allowing every action performed by the user to be accurately replicated in the virtual world of the latest Journal [11]. With its potential, virtual reality can be an effective learning tool, replacing theoretical approaches with hands-on visualizations that enrich the learning process. In addition, the application of virtual worlds can also be used as a practicum platform, providing a simulated environment that is easier to prepare practically [11]. This is in line with previous research which states that Virtual Reality gets a positive response regarding the introduction of Virtual Reality-based fauna [12]. Then by combining it with an animation can be one way to provide an effective education, this is in line with the results of previous research [13], [14], [15].

Based on the exposure of the data above, this study aims to create an educational media by creating an endangered Javan rhino habitat in the Virtual Reality world that makes realism as if entering the Javan rhino habitat with the target audience of children to parents. Research is considered to have an urgency where the results of the study can contribute to the knowledge that educates children and the public about the extinction of animals that are happening now, as well as building public awareness of the problem of threatened animal steps in Indonesia. Also added with this 3D Virtual Reality-based design can increase new and interactive experiences to people who visit Animalium. This research also aims to support SDGS (Sustainable Development Goals) goal number 15 related to terrestrial ecosystems, where the goal is to protect, restore and increase the sustainable use of terrestrial ecosystems, manage forests sustainably, stop desertification, restore land degradation, and stop biodiversity loss. It should be noted that this VR experience can only be run on a computer or laptop with Meta Quest 2.

II. RESEARCH METHODOLOGY

The design method used is the pipeline method, which was chosen because it allows a structured and efficient workflow from the concept stage to the final implementation. The animation pipeline method is divided into three [16]:

A. Pre-Production Stage
The Pre-production stage is the initial phase in animation creation, where preparations are made before starting the production process. This preparation includes determining ideas, themes, concepts, character designs, and creating storyboards to guide the production process. In the context of this research, this stage involves in-depth research on endangered animals in Indonesia, collection of visual references, and planning of animal concepts and designs that will be implemented in a virtual reality environment.

B. Production Stage
The Production Stage is the execution stage of the animation creation process, which involves creating characters, backgrounds, and animations in accordance with the concepts and plans that have been set previously. In this

research, the production stage includes creating a 3D model of the endangered Javan rhino, creating a realistic Javan rhino habitat and environment, and creating animations that describe the behavior and interactions of the Javan rhino.

C. Post-Production Stage

The post-production stage is the final stage of the animation creation process, where sound elements, sound effects, and rendering processes are added to improve the visual and audio quality of the animation that has been created. In the context of this research, the post-production stage involves the incorporation of the Javan rhino's voice, the addition of environmental and habitat sound effects, and the rendering process to create a realistic visual experience in a virtual reality environment. The design stages are depicted in the Figure 1 below.
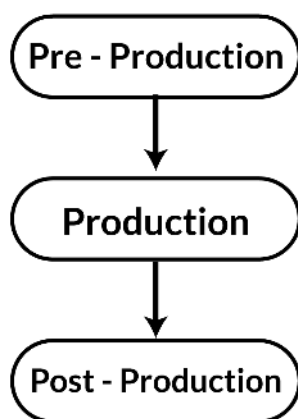

Figure 1. Pipeline Animation Method

III. RESULT AND DISCUSSION

1. Pre-Production

Moodboard, in this design to create a 3D model of the Javan Rhino and also the environment of the Javan Rhino habitat has a mood, tone and looks in accordance with the Javan Rhino and its natural habitat (Figure 2). Detailed and realistic images of the Javan Rhino are the main focus of this moodboard, where the Javan Rhino is represented in various poses and activities, such as walking, standing, or eating. Details of the Javan Rhino's anatomy and fur texture are clearly displayed to enhance the realism and visual beauty. Meanwhile, the moodboard also includes images of natural environments similar to the Javan Rhino's native habitat in Ujung Kulon National Park (TNUK). The vast forest scenery becomes the ideal backdrop for the virtual environment of the Javan Rhino. Details such as local flora, ground relief, and natural diversity were taken into consideration to create an authentic and appealing environment.

Figure 2. Moodboard

Key Visual, In the design of the 3D Virtual Reality Animation of the Javanese Rhino, there is aa key visual that is used consistently for the purposes of the work and supporting media, namely a Javanese Rhino. This Javanese Rhino is the key visual in this design because it is the main subject of discussion.

Color Concept, Developing the color concept, the color of the Javan Rhino was also carefully considered to reflect the authenticity and uniqueness of the species. The skin color chosen must match the original color of the Javan Rhino, with a touch of gray or dark brown dominating. In addition to the development of color concepts for the design of the Javan Rhino virtual reality environment, the color palette is inspired by the natural beauty and uniqueness of the Javan Rhino's native habitat. Natural colors such as leaf green and earthy brown, were chosen to create an authentic and natural atmosphere in the tropical forest environment of Ujung Kulon National Park. Thus, this color concept not only reflects the natural beauty and ambience of the Javan Rhino's native habitat, but also respects the authenticity and uniqueness of this protected species.

Typography, In this design, the use of typography is an important element to achieve effective visual communication. The font chosen should be consistent with the brand identity and design theme to create a unified look. Understanding the characteristics and basic principles of typography, as well as considering the design context and visual communication objectives, are key factors in choosing effective typography. The following are the fonts used in the design of this 3D Virtual Reality Animation of Javan Rhinos is Lato. This font is the font used in the design of the 3D animation of the Javan Rhino Virtual Reality and supporting media for this work, Lato font was chosen for your design because of its excellent suitability with the design theme to be conveyed. With clean, modern, and easy-to-read letterforms, Lato ensures text can be clearly understood by users in a variety of animated and informational visual contexts.

Imagery Concept, In this design, the concept of imagery relates to the use of specific and meaningful images or visuals to convey the desired message or atmosphere in this design. For the first Visual Looks, which is in the form of 3D Javan Rhinos, the results that want to be displayed are realist visuals, namely the visuals of the original Javan Rhinos themselves (Figure 3). which are made into 4 Javan Rhinos, namely, female Javan Rhinos, males, and children. Which aims to highlight the uniqueness and beauty of this protected species that can be observed in the virtual world. The concept of the

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visual of the Javanese Rhino 3D Model is to have a realist shape and texture with the original Javanese Rhino. The making of the Javanese Rhino 3D Model goes through several stages to achieve the same realism as the original Javanese Rhino, namely, 3D Modeling, Javanese Rhinos which have unique characteristics, namely having thick skin and Javanese Rhino skin shaped like armor. Then female and male Javanese Rhinos have differences, namely male Javanese Rhinos have small horns but female Javanese Rhinos do not have horns. Then at the next stage is texturing, where the texture and shading process is carried out on the 3D model of the Javan Rhino which will provide realistic colors, patterns and textures that involve mixing and adjusting various textures and materials to achieve visuals that match the original Javan Rhino. For the second visual looks in the form of a Javan Rhino habitat or environment made for virtual (Figure 4). The creation of the Javan Rhino habitat visual looks relates to specific and meaningful visuals to convey the desired message or atmosphere in the virtual habitat of the Javan Rhino which includes the use of images or visuals from the original habitat of the Javan Rhino, forest trees and plants to create a natural and authentic atmosphere. The conceptual visuals of the Javan Rhino habitat include a vast and alluring image of a tropical forest landscape rich in life. With huge towering trees and lush foliage, as well as diverse shrubbery, the background feels alive and colorful. In creating the Javan Rhino habitat, assets were taken from various tree models from the Unreal Engine Marketplace. Then the arrangement and creation of landforms were carried out to adjust for the Javan Rhino habitat in the virtual world. The third visual looks is in the opening scene before entering the Javan rhino habitat using the same keywords, namely realistic (Figure 5). Where the background preparation is adjusted to the surrounding environment of Javan Rhinos, namely forests of trees and short plants. In making this opening scene, it is done through the storyboard process first and then executed to be used as an opening animation.

Figure 3. Visual Looks 1

Figure 4. Visual Looks 2

Figure 5. Visual Looks 3

Logo, the logo is made as a product identity, especially in the internal search system, and is used as part of supporting media, which will be used as a key visual product that is built, namely animated videos in the form of VR media. In the logo section there is an illustration of the Javanese Rhino (Figure 6). This Javanese Rhino is depicted as the main symbol of the design, namely the Javanese Rhino. The logo illustration is given a grayish brown color to give the appearance of the characteristics of the Javanese Rhino. Then there are several layers on his body because it is a characteristic of the Javanese Rhino. All elements in the logo are designed to create visual balance and harmony. The Javan Rhino illustration is placed in the right proportion inside the circle, creating a clear focus and a sense of unity. The background of the logo uses a green color that symbolizes nature. The green color creates a fresh atmosphere, blending in with the environmental theme.

Figure 6. Logo

Audio Concept, the audio concept for this design draws from natural or forest sounds that are adapted to the design, not only adding realism but also creating an immersive atmosphere that supports the overall user experience. The integration of environmental sounds such as forest noises, wind chimes, and bird chirps provides an additional dimension to the virtual experience in the Javan Rhino habitat, helping users feel a sense of presence and life there. In addition, an educational narration explaining the Javan Rhino was implemented in the Virtual Reality opener and in the habitat to explain information on the information board provided. This narration uses a female AI voice, because according to a Stanford professor, female voices are more easily accepted and liked by everyone than male voices, because the human brain is naturally more receptive to female voices.

System Flowchart, in designing the Javan Rhino Virtual Reality 3D animation, users are led through a series of structured steps (Figure 7). Initially, they are greeted by the main menu featuring a red start button, to begin the experience by pressing the button. After choosing to start, users will be taken to an opening scene featuring a short animation to introduce the Javan Rhino. After that, they will enter the virtual world of the Javan Rhino habitat using a VR device, where they can explore a 3D environment that presents the natural habitat of the Javan Rhino. During the exploration, users can interact with info boards in the environment, with sensors activating a narrator's voice to explain related information. After listening to the information, they can continue their exploration of the Javan Rhino habitat, enjoying interacting with the surroundings and seeing the Javan Rhinos. Finally, when users are satisfied with their exploration, they can choose to exit the experience and return to the main menu or directly exit the app at their convenience.
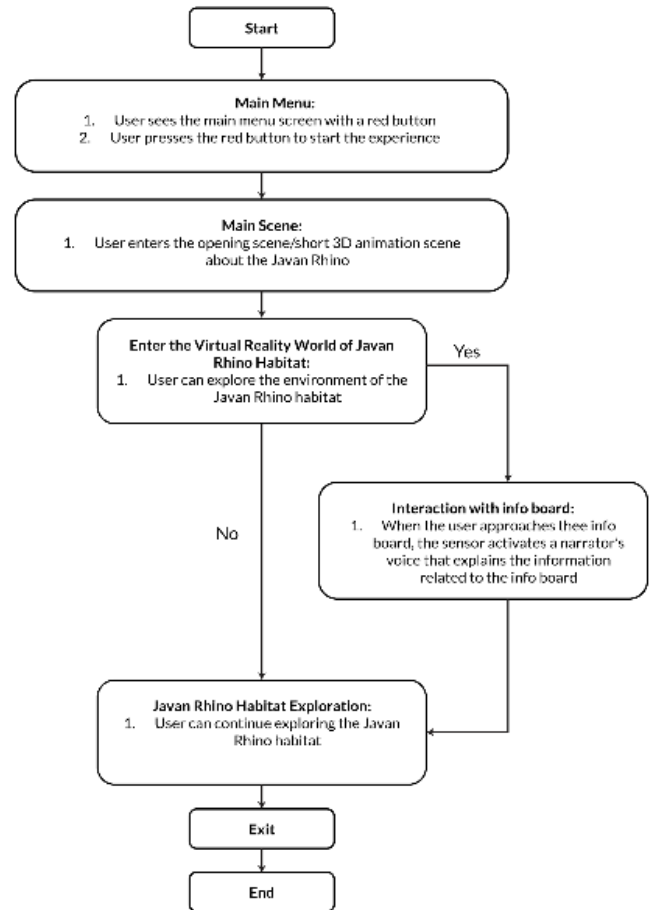

Figure 7. System Flowchart

Scenario/Script, the following Table 1 are the scripts used in this design:

Table 1. Script

Scene	VFX	Script
1	Transition effect, camera moves forward	In the middle of a peaceful forest there is a rare species of animal, namely.......
2	Camera approaches the Javan Rhino	Javanese Rhino. a rhino that is only one-horned
3	Camera follows the Javan Rhino highlighting from the side	This species of rhino is a rare and highly protected species.
4	Camera following a Javan Rhino highlighting from the side	The Javan rhino is endangered due to illegal logging and poachers.
5	Camera following a Javan Rhino highlighting from the side	Therefore, we must protect the existence of the Javan Rhino.

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Scene	VFX	Script
6	Camera following a Javan Rhino highlighting from the side, transition effect	So that this special species, the Javan Rhino, does not become extinct from its place. and Welcome to the habitat of the Javan Rhino.

Storyboard, Storyboarding is made to provide visualization when animating the opening scene in Javan Rhino virtual reality (Figure 8).
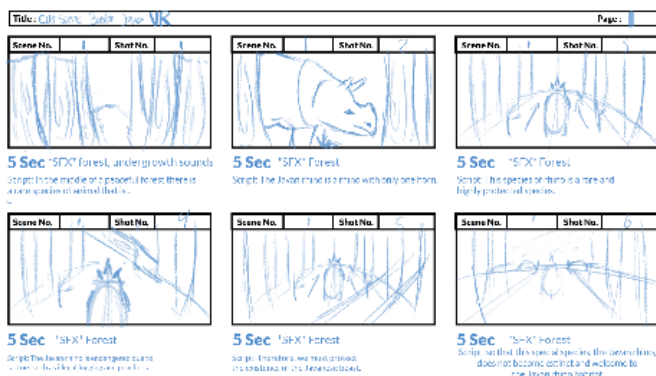

Figure 8. Storyboard

Animated Storyboard/Pre visualization, the following is a visual of the rendering of the opening 3D VIrtual reality animation of the Javan rhino (Figure 9).

Figure 9. Animated Storyboard/Pre-Visualization

2. Production

Asset/Modelling Object, At the stage of making assets in 3D animation Virtual reality Javan rhino, the first thing to do is 3D modeling of Javan Rhinos, the process begins with the formation of basic shapes that are adjusted to the reference shape of the Javan rhino (Figure 10). after that the model is put into the sculpting space in Blender to sculpt more complex details. Then the next stage will be baking normal maps to transfer geometry details into textures, producing the illusion of detail without increasing the number of polygons. Modeling is differentiated between males and females, with males having small horns and females without horns. then to ensure weightlessness when animated it is necessary to recheck the topology. then each part is given a UV setting for texturing. Then the modeling stage is also carried out on the information board and the start button. then the next stage is the creation of the environment for the Javan rhino habitat, with the selection of tree assets, plants, and using references from Ujung Kulon National Park which is the habitat of Javan Rhinos. assets are taken from the unreal engine marketplace and selected for suitability to the environment. Soil formation was done naturally and the arrangement of trees, plants, and rocks was done to create a natural look.
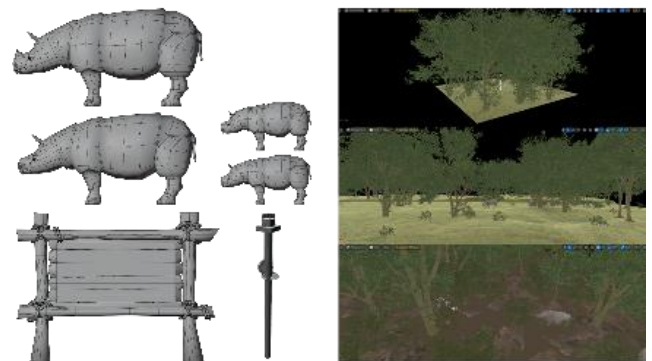

Figure 10. 3D Modelling

Asset Texturing, at this stage, texture is given to objects and Javanese rhinos which is done in the Blender application, where the texture is adjusted to the concept (Figure 11). For Javanese rhinos, basic colors are given first, then various textures are applied according to the skin of Javanese rhinos, using stencil techniques with photos or images as textures. this process is divided into 3 parts: textures for male Javanese rhinos, which look more masculine, for female Javanese rhinos that look more feminine, and for small Javanese rhinos / children who still have delicate skin. Then for the creation of the start button texture in Virtual reality is done in Unreal Engine with the addition of basic materials and giving red color to increase visual appeal and make it easier for users to identify the button. while the texture of the info board, is done in the blender application by adjusting to the environment around the Javan Rhino habitat, using wood and rope textures. The contents of the info board are given a paper texture to enhance the realistic impression.

Figure 11. Texturing

Animations, the process of making animation work starts from adding bones to the Javan Rhino 3D model which aims to be able to move the Javan Rhino 3D model (Figure 12). Then do Weight Paint, which is a process where users give weight to parts of the bones to the mesh / parts of the Javan Rhino, such as the legs, body, head. Then after that just enter the animation stage, where the Javan Rhino will be made a movement, idle, walking, eating. The animation of the Javanese Rhino movement is made customized based on the original Javanese Rhino. Understanding animation theory is very helpful in making this animation process. Then after animating it will be exported into an .FBX file to be inserted into the Unreal Engine which can later be seen through the Virtual Reality tool. Then the next animation process is the process of animating an Opening Scene before entering the Javan Rhino habitat virtually using the Unreal Engine application. Where first the camera is needed and then enter the Javanese Rhino that we have created and then we animate the camera following according to the storyboard flow.

Figure 12. Animations

Lighting, in creating the Javan Rhino habitat environment in Unreal Engine, the lighting process plays a key role in creating an immersive and realistic atmosphere (Figure 13). Here is a description of the lighting process used, after placing the main light source, such as Directional Light, which provides consistent main lighting and light direction throughout the environment, the next step is to apply the Exponential Height Fog technique to create a realistic fog effect, which expands the view and gives depth to the environment. Sky Atmosphere and Skylight were used to create a dynamic sky and lighting system that adapts to changes in time and atmospheric conditions, creating a natural atmosphere that changes with time. In addition, the application of Sky Sphere provides a realistic background and adds depth to the view of the environment. The Volumetric Cloud technique was also used to add a dynamic and realistic volumetric cloud effect, giving an extra dimension to the sky and atmosphere of the environment. With the use of this combination of light sources and lighting techniques, the Javan Rhino habitat environment in Unreal Engine is given immersive lighting and an immersive atmosphere.

Figure 13. Lighting

Enhancements for Virtual Reality compatibility, at the Virtual Reality compatibility enhancement stage, it is the stage where the author makes edits in Unreal Engine which aims to provide functions and interactivity to the project so that the work functions properly when used using VR devices (Figure 14). There are several things that need to be given a function and editing, among others: Javan Rhino, the first thing to do is import the 3D model of the Javan Rhino that has been made in the form of an FBX file into Unreal Engine. Then after that the second step is to create a blueprint that developed to control the Javan Rhino's movement within the virtual environment, scripting the Rhino to traverse in random directions to simulate natural behavior. The Blueprint utilizes Unreal Engine's visual scripting system to handle pathfinding and movement logic, ensuring the Javan Rhino navigates dynamically and realistically.
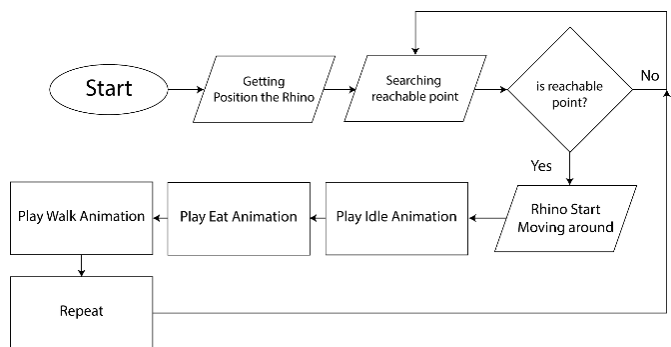

Figure 14. Flowchart of Javan Rhino Moving Around

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Then next, it is necessary to unify the animations that have been made, namely, silence, walking, eating by making an animation montage to ensure that the transition between animations feels smooth and natural. In the last stage, an animation blueprint is created that is responsible for applying these animations to the Javan Rhino in the VR Environment. By going through these stages in refinement for VR compatibility, it can ensure that the Javan Rhino model can function properly in a VR environment and provide an immersive and realistic experience for VR users.

Start Button in the Main Menu, In the main start button section placed on the main menu, a special function is designed using a blueprint when the user uses the VR device controller and presses the button, this function will be activated and automatically start a short animation that aims to start a short animation that introduces the Javan Rhino. This short animation acts as a prologue that leads users to the main experience, which is exploring the habitat of Javan Rhinos. Then in the short animation or opening scene, it is necessary to create a special blueprint that functions as a transition to the Javan Rhino habitat after the animation has finished playing. This blueprint serves as a link that directs users from the opening scene to the main experience of interacting with the Javan Rhino habitat. Thus, after users finish watching the short animation, they will be directly transferred to the VR environment of the Javan Rhino habitat, creating a memorable and smooth impression of exploring the work. With detailed settings and focusing on the user experience, this function increases the level of user engagement and immersion in exploring the Javan Rhino VR animation work.

Setting menu pop up user interface/user experience, is designed to enchance user convenience and improve overall interaction within virtual reality environment (Figure 15). When a button is pressed on the meta quest 2 controller, settings pop up menu will appear to user hand. This menu contains three buttons, reset camera to reset user camera and making the camera is correctly aligned. Restart button, is to enable user restart the experience to main menu. Exit button, is give user the option to exit the virtual reality. To create this settings pop-up menu, several stages were undertaken. The initial design was created in Adobe Illustrator, ensuring that the visual style and elements matched the overall theme of the VR environment. This step focused on creating an intuitive and aesthetically pleasing interface. After the design was finalized, it was imported into Unreal Engine, where the functionality was added. This involved programming the interactive elements, such as the button responses, and integrating the menu with the VR system to respond appropriately to the Meta Quest 2 controller inputs.
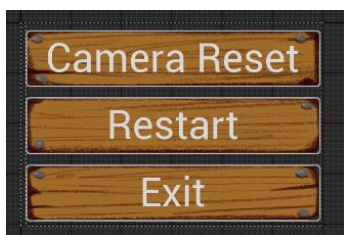

Figure 15. UI/UX Setting Menu

Info Board, to enrich the user experience and make the interaction with information more dynamic and interactive, a blueprint is needed on the info board that functions as a sound player that is directly connected to the info board containing information about the Javan Rhino (Figure 16). The Blueprint utilizes proximity triggers and audio components within Unreal Engine. When the user enters the designated proximity zone, the system triggers the audio playback of a narrator's voice, providing an auditory explanation of the information displayed on the board. This integration involves setting up collision detection to recognize user presence and scripting the audio playback functions to ensure seamless and synchronized operation
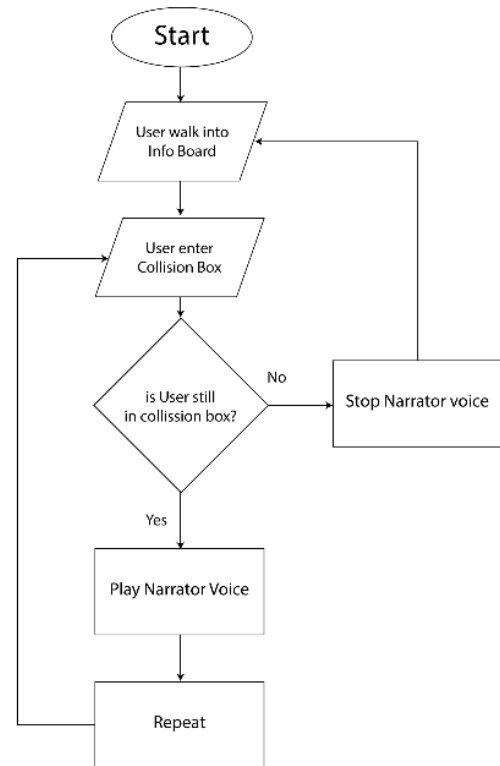

Figure 16. Flowchart of Infoboard

With this system, user interaction with the info board becomes more interactive and fun. Users can get more complete and in-depth information about Javan Rhinos without having to actively read. The narrator's voice that plays automatically when users approach the info board creates an immersive and comfortable experience for users, and increases their level of engagement and understanding of the information content presented.

3. Post Production
Compositing, editing dan Audio, In the compositing and editing stage, which aims to declare all animation and visual elements to match the concept and storyboard that has been compiled previously. This process involves keyframe adjustments to the short animation in the opening scene of the Javan Rhino with the predetermined storyline, thus creating a consistent and expected visual experience. Once the animation

and visuals were refined, the next step was the addition of audio to enhance the depth and immersion of the VR experience. The forest environment audio is taken from freely available sources without copyright, ensuring the authenticity of the Javan Rhino habitat environment. In addition, narrator audio is added to the opening scene to introduce Javan Rhinos to users at the beginning of the VR experience. Furthermore, narrator audio is also applied to the info board to provide further information about the Javan Rhino to users. The importance of audio in VR experience cannot be ignored, therefore, the author uses an AI voice created with a special script that has been prepared beforehand. The AI voice uses a female voice, this is stated by a Standford professor that, female voices are easier for everyone to accept and like, than male voices because the human brain naturally accepts female voices more easily. In this way, the audio produced matches the needs and vision of the work, ensuring that the message to be conveyed can be received clearly and effectively by the user. Thus, the combination of compositing, editing, and adding audio provides an additional layer in creating an immersive and memorable VR experience for users.

4. Result

The user acceptance test on the Javan Rhino virtual reality involves users directly testing how the developed virtual reality works and providing feedback on the design. This evaluation is conducted by users through a questionnaire as shown in Table 2 below.

Table 2. User Acceptance Test

No	Score	UAT				
		Q1	Q2	Q3	Q4	Q5
1	Very good	9	7	8	8	7
2	Good	1	3	2	2	3
3	Enough					
4	Not Good					
Total		10 People				
Score		98%	94%	96%	96%	94%
Average		4.9	4.7	4.8	4.8	4.7

5. Discussion

Final Artwork of the main work in the form of a 3D Virtual Reality animation that provides an interactive and in-depth experience of the Javanese Rhino which is the main target of this design due to the endangerment of the Javanese Rhino. By using VR media as an educational medium, users are invited to explore the Javan Rhino habitat virtually and gain a deep understanding of the threats faced by the species, namely the Javan Rhino. Through a combination of realistic visualization, informative narrative and interactive with the environment. This work not only conveys the message of the importance of preserving the Javan Rhino, but also inspires users to take action in the protection of nature and endangered animals. Thus, this 3D Virtual Reality Animation is not only a work of art, but also a powerful educational tool in the effort to preserve biodiversity in Indonesia, especially the Javan Rhino.

This study shows that the use of Virtual Reality as an effective educational medium for endangered animals is in line with previous research. It also offers a solution to the problem of damage to physical replicas in the Animalium and enriches visitors' learning experience. This indicates that using 3D animated Virtual Reality can attract interest, with interactive visualizations that are more immersive than the book method. The results of this study contribute to the modification of interactive education theory, emphasize the potential of VR technology as a key tool in endangered animal education, and open up opportunities for further research on the long-term impact of using VR in conservation education.

IV. CONCLUSIONS

In this research, a 3D Virtual Reality Animation for Animalium has been designed and developed with a focus on educating endangered Javan Rhinos in Indonesia. The scientific conclusions generated based on the results of this study include several important things as follows: First, VR application development successfully designed and developed a VR application that allows Animalium visitors to experience firsthand the habitat and challenges faced by Javan rhinos. This application is expected to provide an in-depth educational experience and increase public awareness about the importance of preserving endangered animals, especially the Javan Rhino. Second, the implementation of the research objectives was successfully realized through this VR application, which is expected to be an effective means of supporting the research objectives, namely increasing public understanding and awareness of endangered Javan rhinos, as well as supporting efforts to conserve these animals. Third, although this VR application can provide an immersive experience, it needs to be recognized that there are still some limitations in this research. One of them is the limited resources and time that limit the development of additional features in the application. Finally, in developing this VR application, the author has considered various design factors, including user needs, educational goals, and the potential use of VR technology to enhance the visitor experience. As such, the developed 3D animated Virtual Reality application is expected to positively impact animal conservation efforts in Indonesia and provide innovative educational opportunities for Animalium visitors. Nonetheless, it is important to remember that this application has room for long-term development and evaluation to ensure its effectiveness in meeting educational and conservation goals.

Based on the results of research and design that has been done, the author has several suggestions that are expected to be useful for further research. Some suggestions given by the author are: Further development of this VR application is needed, including the addition of new features that can enrich the visitor experience and increase the effectiveness in conveying important messages about endangered animal conservation. Additionally, exploring the potential for this

project to be adapted for mobile devices in the future would allow for more flexible usage and broader accessibility. It is expected to conduct educational campaigns more widely, both through social media and public events, to increase public awareness about the problem of animal extinction and the importance of environmental conservation. Hopefully, it can establish cooperation with related parties, such as conservation organizations, local governments, or non-governmental organizations, to increase the effectiveness of endangered animal conservation efforts.

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