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Website-Based Virtual Reality Tour Design for Wildlife Park Exploration and Education

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ABSTRACT

Tourism encompasses a wide range of travel-related activities and is supported by facilities and services provided by local communities, visitors, governments, local authorities, and business stakeholders. Garut is home to many attractive tourist destinations, one of which is a wildlife park. A wildlife park is a man-made facility where animals are kept and cared for. The only wildlife park in Garut is Cikembulan Wildlife Park. Cikembulan Wildlife Park serves as a conservation center with hundreds of animal species and functions as an educational destination for students, university researchers, and the general public. Currently, the introduction and promotion of the wildlife park primarily rely on social media platforms containing text and photographs. However, these platforms do not provide an immersive user experience. Consequently, Virtual Reality (VR) technology has emerged as a solution that offers a more immersive experience, enabling visitors to explore and experience the wildlife park virtually as if they were physically present at the location. Therefore, this study aims to design and develop a website-based Wildlife Park Introduction Platform utilizing Virtual Reality Tour technology. The development process follows the Multimedia Development Life Cycle (MDLC) methodology. MDLC is considered an appropriate method for designing and developing applications that integrate images, audio, video, animation, and other multimedia elements. The outcome of this research is a website-based Virtual Reality platform for introducing and promoting the wildlife park. The VR website features 360-degree panoramic images, interactive hotspots, multimedia animations in the form of audio and video, and an integrated chatbot feature. Evaluation using the usability testing method produced an average score of 4.58 across the five assessed aspects on a five-point Likert scale. This result falls within the "Very Good/Strongly Agree" category, indicating that the Virtual Reality Tour website for Cikembulan Wildlife Park is feasible and suitable for use.

1. INTRODUCTION

Tourism is one of the major economic sectors of a country [2]. It encompasses a wide range of tourism-related activities and is supported by facilities and services provided by local communities, visitors, governments, local authorities, and business stakeholders [3]. According to Bank Indonesia (BI), tourism is one of the sectors with the greatest potential to attract foreign investment into Indonesia. Data indicate that international tourist

arrivals in Indonesia reached 927.75 thousand in January 2024, an increase of 16.19% from the previous period [4]. Meanwhile, in Garut Regency, tourism statistics for December 2023 recorded no international tourist arrivals, while domestic tourist visits reached 393,502 [5]. Garut Regency offers numerous tourism attractions, including rich biodiversity, authentic and unique local cultures, natural beauty, and historical heritage sites [6]. Among its notable tourist destinations is a wildlife park. A wildlife park, also known as a zoological park, is a facility established to preserve and maintain the welfare of living creatures for educational, conservation, preservation, and research purposes [7].

The only wildlife park located in Garut is Cikembulan Wildlife Park. This conservation facility houses hundreds of animal species and serves as an educational destination for students, university researchers, and the general public [8]. Based on interviews and field observations, promotional and informational activities for the wildlife park have primarily relied on social media platforms containing text and photographs. However, these platforms do not provide an immersive user experience, and much of the information is disseminated through word-of-mouth communication among previous visitors. In addition, Cikembulan Wildlife Park does not have an official website, which limits access to information. Therefore, a Virtual Reality Tour website was developed to introduce and promote the wildlife park. To attract more tourists and encourage visits to tourism destinations, the development of Virtual Reality (VR) technology has become an effective approach for enhancing destination promotion and awareness [9]. VR is a technology that enables users to experience a computer-generated environment as if they were physically present within a virtual world [10]. This technology can be utilized to promote tourist destinations, educational environments, public facilities, and various other applications [11].

Several previous studies have investigated the implementation of Virtual Reality (VR) technology [12][10][13][14][15]. In terms of development methodologies, some studies employed the Multimedia Development Life Cycle (MDLC) method [12][10][13], while others used Scrum [14] and Extreme Programming (XP) [15]. The studies conducted by [10] and [13] presented tourism destinations through web-based 360-degree panoramic images, location maps, and supplementary information in the form of text and static images. Meanwhile, studies [12], [14], and [15] implemented VR technology on Android platforms using 360-degree visualizations of tourism destinations. However, these studies [12][10][13][14][15] did not incorporate animated features such as sound effects, interactive hotspots, detailed information associated with each panoramic image, or chatbot functionality.

Therefore, this study aims to design and develop a website-based Wildlife Park Introduction Platform utilizing Virtual Reality Tour technology. The proposed Virtual Reality Tour website presents 360-degree panoramic images, interactive hotspots, multimedia animations, including audio and video, and an integrated chatbot. The Multimedia Development Life Cycle (MDLC) method is employed throughout the design and development process. According to Luther and Sutopo, MDLC consists of six stages: concept, design, material collecting, assembly, testing, and distribution [16]. MDLC is considered an appropriate methodology for designing and developing applications that integrate multimedia elements, including images, audio, video, animation, and other interactive components [1].

2. RESEARCH METHODOLOGY

2.1. Research Framework

In the system design and development process, several stages of activity are carried out. The research framework presented below is a diagram illustrating the overall logical flow of the research process. The stages involved are described as follows.

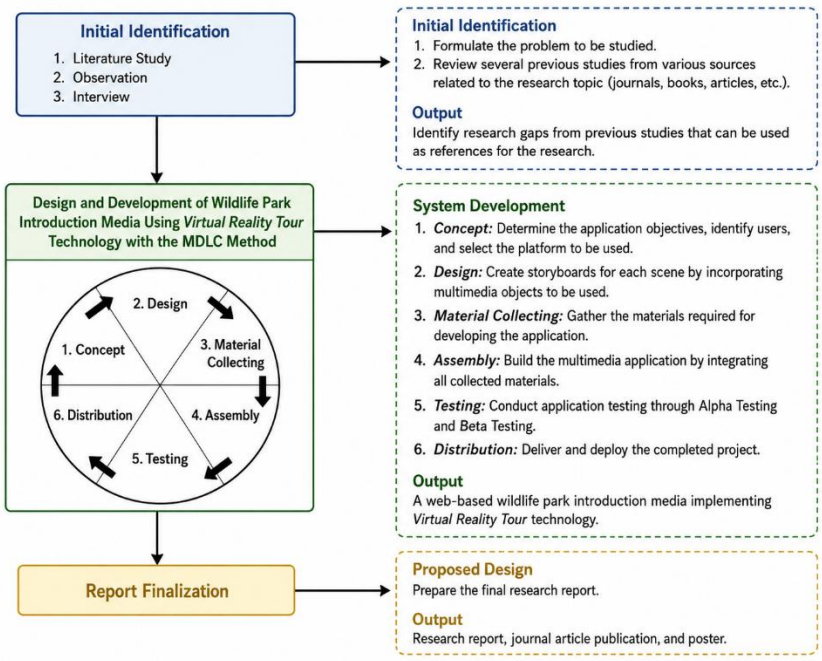

Figure 1. Research Framework

The research framework illustrates the overall flow of the study. The process begins with the initial identification phase, which includes preliminary identification, interviews, and field observations. The next stage involves designing and developing the Cikembulan Wildlife Park Virtual Reality Tour website using the Multimedia Development Life Cycle (MDLC) method. This stage results in the development of a website-based Wildlife Park Introduction Platform utilizing Virtual Reality Tour technology. The final stage is report finalization, which produces the research report, a journal article, and a research poster.

2.2. Work Breakdown Structure (WBS)

The Work Breakdown Structure (WBS) describes the project implementation procedure by decomposing the objectives, the development stages based on the selected system development methodology, and the tasks to be completed at each stage in accordance with the Multimedia Development Life Cycle (MDLC). The WBS diagram is presented below.

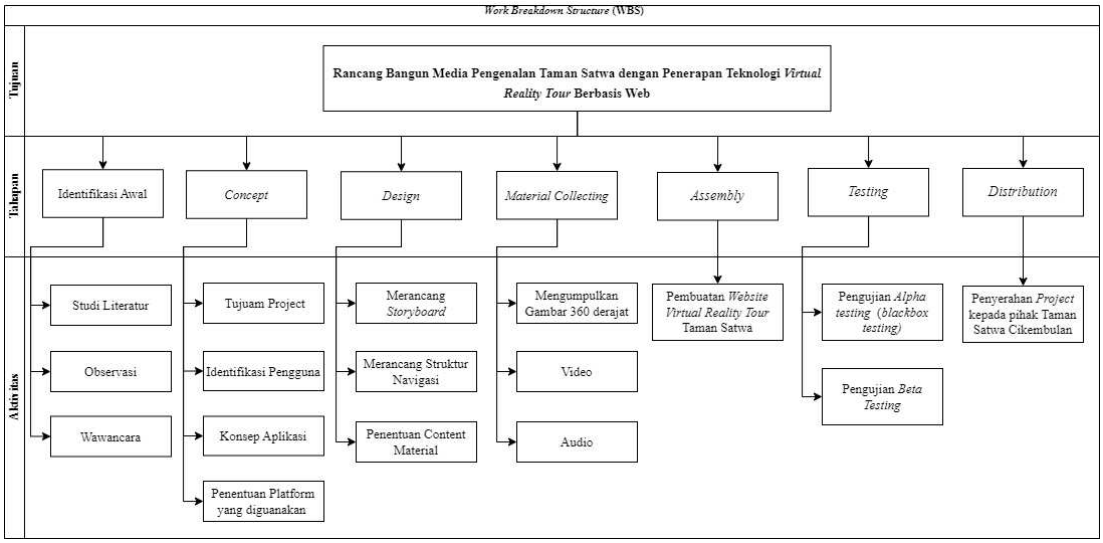

Figure 1. *Work Breakdown Structure*

The explanation of the Work Breakdown Structure (WBS) shown in Figure 2 is as follows:

1. Initial Identification Phase
   The first stage of the WBS is the initial identification phase. At this stage, a literature review is conducted to gather references from previous studies discussing the application of Virtual Reality (VR) technology for tourism promotion and destination introduction, as well as other relevant sources. Subsequently, interviews and field observations are conducted to obtain firsthand information and directly observe conditions at Cikembulan Wildlife Park in Garut.
2. Concept Phase
   The second stage is the Concept phase. This stage involves defining the overall project concept, including identifying the problem, determining the project objectives, specifying the target users, and selecting the hardware and software required to develop the web-based Virtual Reality Tour as a wildlife park introduction platform.
3. Design Phase
   The third stage is the Design phase. Activities at this stage include developing storyboards to describe each scene and the multimedia objects that will be incorporated into the system. In addition, a navigation structure is designed to facilitate user interaction and improve usability within the VR website.
4. Material Collecting Phase
   The fourth stage is Material Collecting. This phase involves gathering all materials required for the project, including capturing 360-degree panoramic images, recording audio, and producing videos needed for the development of the website-based VR Wildlife Park Introduction Platform.
5. Assembly Phase
   The fifth stage is Assembly. During this phase, the Virtual Reality Tour website is developed by integrating all multimedia materials and resources collected in the previous stage into a complete, functional system.
6. Testing Phase
   The sixth stage is Testing. At this stage, the application undergoes Alpha Testing using the Black Box Testing method to ensure that all system functions operate correctly according to their intended specifications. Furthermore, Beta Testing involves end users of the Virtual Reality Tour website to evaluate system functionality and usability. This evaluation is performed through questionnaires distributed to respondents to assess the feasibility and effectiveness of the VR website.
7. Distribution Phase
   The final stage is Distribution. After successfully completing testing, the Virtual Reality Tour website for Cikembulan Wildlife Park is ready for deployment, use, and dissemination to the intended users.

3. RESULT AND DISCUSSION

3.1 Results

The results can be presented using subsections, which may be further divided into multiple groups if necessary. Research findings may also be illustrated through figures, graphs, tables, or other representations that help readers easily understand the outcomes

In developing the Virtual Reality Tour website to introduce the wildlife park, the Multimedia Development Life Cycle (MDLC) method was employed. This method consists of six stages: concept, design, material collecting, assembly, testing, and distribution.

3.1.1. Initial Identification

This stage includes a literature review, interviews, and field observations. The literature review was conducted to examine previous studies relevant to the proposed research. Subsequently, interviews were conducted with representatives of Cikembulan Wildlife Park, followed by direct field observations to gather information and identify the requirements for developing the Virtual Reality Tour website.

3.1.2. Concept

At this stage, the project concept, objectives, target users, system requirements, and development tools are determined. This phase also involves analyzing the resources required to develop the Virtual Reality Tour website and selecting the hardware and software to be used during implementation.

1. Project Concept
   The project concept for the development of the Virtual Reality Tour website for the wildlife park introduction is presented in Table 1.

Table 1. Project Concept

Name	Description
Title	Design and Development of Wildlife Park Introduction Media Using Web-Based Virtual Reality Tour Technology
Users	Tourists and visitors.
Features	Displays 360-degree object images, animation features (sound and video), hotspot features, and a location map of tourist attractions.
Images	Images, backgrounds, and buttons in .jpg and .png formats.
Interactivity	Main menu, content title, home, information, contact, panorama, location, play, pause, zoom in, zoom out, and exit buttons used to leave the page.
Virtual Object	The virtual object produced is a 360-degree panoramic photograph.
Platform Used	Web platform developed using HTML (HyperText Markup Language).
Input	System inputs include images, videos, text, and maps.
Output	A Virtual Reality Tour website featuring 360-degree images, static images, and location maps.

2. Project Objectives
   The objective of the Wildlife Park Introduction Platform, which utilizes Virtual Reality Tour technology, is to attract more visitors to Cikembulan Wildlife Park in Garut and to promote the tourist destination more effectively.
3. User Identification
   The intended users of the Virtual Reality Tour website are tourists and members of the general public who are interested in visiting Cikembulan Wildlife Park.
4. Hardware and Software Requirements
   a. Hardware
      1) Intel Core i3 Processor;
      2) 4 GB RAM and 145 GB SSD.
   b. Software
      The software utilized in the development of this application includes:
      1) 3DVista is used to create the Virtual Tour by integrating 360-degree panoramic images;
      2) Balsamiq Mockups, used for storyboard design and interface prototyping;
      3) Visual Studio Code is used as the source code editor.

3.1.3. Design

At the design stage, the storyboard and system navigation structure are developed based on the activities defined in the Work Breakdown Structure (WBS), continuing from the previous phase.

1. Storyboard Design

Table 2. Storyboard Design

No.	Scene	Content	Description
1	Scene 1	Home Page	Displays the Home, Information, Gallery, Contact, Maps, and VR menus.
2	Scene 2	Information Page	Contains information about the Wildlife Park tourist attraction.
3	Scene 3	VR Content Page	Parking area. This page includes general information about Cikembulan Wildlife Park, location, panorama list, gallery, contact information, background sound controls, and zoom features.
4	Scene 4	VR Content Page (Information Menu)	Contains general information about Cikembulan Wildlife Park.
5	Scene 5	VR Content Page (Location)	Directs users to the Google Maps location of Cikembulan Wildlife Park.
6	Scene 6	VR Content Page (Gallery)	Displays photographs of animals in the wildlife park.
7	Scene 7	VR Content Page (Panorama List)	Displays a list of panorama locations within Cikembulan Wildlife Park.
...	...	...	...
40	Scene 40	VR Content Page	Area in front of the exit gate.

2. Navigation Structure Design

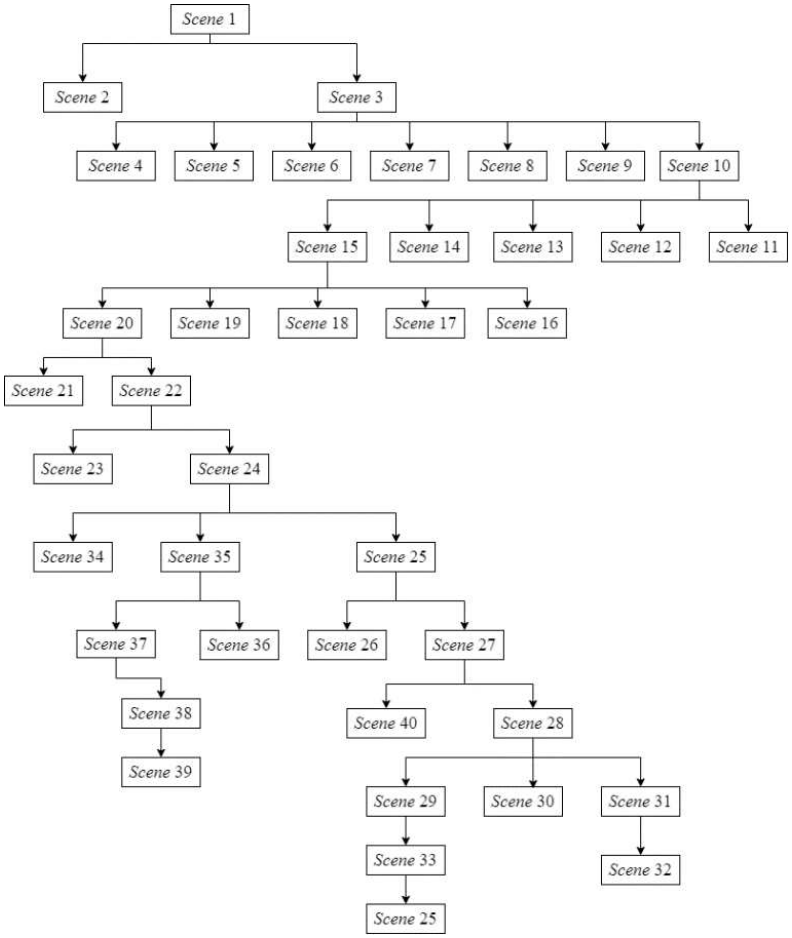

Figure 3. Application Navigation Structure

3.1.4. Material Collecting

In developing the Virtual Reality (VR) website, supporting materials such as static images, 360-degree images, videos, text, and audio are required. These materials must be collected and prepared during this stage before being integrated into the application.

1. **S**tatic Images
   The collected static images are photographs in *.png* and *.jpg* formats required for the development of the Wildlife Park VR website.
2. 360-Degree Images
   The 360-degree images were captured from various observation points throughout the Cikembulan Wildlife Park. These images serve as the primary visual content for the Virtual Reality Tour.
3. Videos
   The video materials were obtained through direct recording in *.mp4* format with a file size of 39.6 MB. Additional video content was collected from the official Instagram account of Cikembulan Wildlife Park in *.mp4* format with a file size of 18.9 MB.
4. Text
   Text data consists of descriptions, informational content, and other textual materials used throughout the application. Several font types, such as Times New Roman, Vivaldi, and Chiller, were utilized with appropriate font sizes and colors to improve readability and visual appearance.
5. Audio
   Audio files used in the development of the VR website were collected in *.mp4* format and utilized as background music (background sound) for the application. The audio resources were obtained from online sources via the YouTube Audio Library (https://studio.youtube.com/channel/UCt32tQWDkFMi0IVGUdviweg/music).

3.1.5. Assembly

The Assembly stage involves integrating and developing all materials collected in the previous stage, based on the storyboard and navigation structure designed earlier.

1. Website Development
   The website was developed using HTML (HyperText Markup Language) and implemented through the Visual Studio Code text editor. In addition to HTML, CSS (Cascading Style Sheets) was used to manage and enhance the visual appearance, layout, and responsiveness of the website pages.

Gambar 2. Home Page Display

2. Home Page Development
   The Home Page serves as the initial interface of the Cikembulan Wildlife Park Virtual Reality (VR) website. This page provides visitors with general information about Cikembulan Wildlife Park, including tourism activities, contact information, and a location map. These features help tourists easily access important information about the tourist attraction before exploring the Virtual Reality Tour.
3. Virtual Reality Tour Development

The Virtual Reality Tour was developed using 3DVista software to create interactive 360-degree virtual environments. The panoramic scenes were processed and connected through hotspots to enable seamless navigation between locations. After the virtual tour was completed, it was integrated into the website to allow users to explore Cikembulan Wildlife Park through an immersive web-based Virtual Reality experience.

Gambar 3. *Virtual Tour* Taman Satwa Cikembulan

The figure illustrates the main interface of the Cikembulan Wildlife Park Virtual Tour. This page contains several features, including the Information menu, Panorama List, Location, Photo Album, Developer Profile, VR Box, and other supporting menus designed to enhance user interaction and navigation within the virtual tour environment.

3.1.6. Testing

The testing phase was subsequently conducted on the website through two types of evaluations: Alpha Testing and Beta Testing. Alpha Testing was performed using the Black Box Testing method. The purpose of Alpha Testing is to ensure that the application functions properly and meets the system's intended requirements and objectives [17].

Table 3. Results of Alpha Testing

Test Data	Test Item	Expected Result	Conclusion
Home Button	Display the Home page	Page displayed successfully	Passed
Information Button	Display information page	Page displayed successfully	Passed
Gallery Button	Display photo gallery	Page displayed successfully	Passed
Testimonial Button	Display testimonial section	Page displayed successfully	Passed
Contact Button	Display contact section	Page displayed successfully	Passed
View VR Button	Navigate to the 360-degree Virtual Tour	Page displayed successfully	Passed
Read More Button	Display information page	Page displayed successfully	Passed
Arrow Button	Display previous and next slides	Image displayed successfully	Passed
VR Content (Information Button)	Display information page	Page displayed successfully	Passed
VR Content (Panorama Button)	Display panorama list page	Page displayed successfully	Passed
VR Content (Album Button)	Display photo album page	Page displayed successfully	Passed

Test Data	Test Item	Expected Result	Conclusion
VR Content (Location Button)	Redirect to Google Maps	Page displayed successfully	Passed
VR Content (Sound Button)	Play and stop background music	Audio played successfully	Passed
VR Content (Profile Button)	Display developer profile	Image displayed successfully	Passed
Parking Area Navigation Button	Navigate to the Entrance Gate 360-degree VR image	Image displayed successfully	Passed
Entrance Gate Navigation Button	Display Entrance Gate 360-degree VR image	Image displayed successfully	Passed
Entrance Gate 2 Navigation Button	Display the 360-degree VR image before the ticket counter	Image displayed successfully	Passed
Bird Area 1 Navigation Button	Display Bird Area 1 360-degree VR image	Image displayed successfully	Passed
Bird Area 2 Navigation Button	Display Bird Area 2 360-degree VR image	Image displayed successfully	Passed
Bird Area 3 Navigation Button	Display Bird Area 3 360-degree VR image	Image displayed successfully	Passed
Orangutan Area Navigation Button	Display Orangutan Area 360-degree VR image	Image displayed successfully	Passed
Entrance Area 1 Navigation Button	Display Entrance Area 1 360-degree VR image	Image displayed successfully	Passed
Bird Area 4 Navigation Button	Display Bird Area 4 360-degree VR image	Image displayed successfully	Passed
Animal Enclosure Navigation Button	Display Animal Enclosure Area 360-degree VR image	Image displayed successfully	Passed
Playground Area 1 Navigation Button	Display Playground Area 1 360-degree VR image	Image displayed successfully	Passed
Peacock and Bird Enclosure Navigation Button	Display Peacock and Bird Enclosure Area 360-degree VR image	Image displayed successfully	Passed
Fish Pond Navigation Button	Display Fish Pond Area 360-degree VR image	Image displayed successfully	Passed
Storage Area Navigation Button	Display Storage Area 360-degree VR image	Image displayed successfully	Passed
Bridge Area Navigation Button	Display Bridge Area 360-degree VR image	Image displayed successfully	Passed
Snake Enclosure Navigation Button	Display Snake Enclosure Area 360-degree VR image	Image displayed successfully	Passed
Central Area Navigation Button	Display Central Area 360-degree VR image	Image displayed successfully	Passed
Cafeteria Navigation Button	Display Cafeteria Area 360-degree VR image	Image displayed successfully	Passed
Siamang Gibbon Enclosure Navigation Button	Display Siamang Gibbon Enclosure Area 360-degree VR image	Image displayed successfully	Passed
Playground Area 2 Navigation Button	Display Playground Area 2 360-degree VR image	Image displayed successfully	Passed
Gazebo Navigation Button	Display Gazebo Area 360-degree VR image	Image displayed successfully	Passed
Playground Area 3 Navigation Button	Display Playground Area 3 360-degree VR image	Image displayed successfully	Passed
Playground Area 4 Navigation Button	Display Playground Area 4 360-degree VR image	Image displayed successfully	Passed
Playground Area 5 Navigation Button	Display Playground Area 5 360-degree VR image	Image displayed successfully	Passed
Joglo Area 1 Navigation Button	Display Joglo Area 1 360-degree VR image	Image displayed successfully	Passed
Cat House Navigation Button	Display Cat House Area 360-degree VR image	Image displayed successfully	Passed
Tiger and Lion Enclosure Navigation Button	Display Tiger and Lion Enclosure Area 360-degree VR image	Image displayed successfully	Passed
Bear Enclosure Navigation Button	Display Bear Enclosure Area 360-degree VR image	Image displayed successfully	Passed
Joglo Area 3 Navigation Button	Display Joglo Area 3 360-degree VR image	Image displayed successfully	Passed

Test Data	Test Item	Expected Result	Conclusion
Lion Enclosure Area 2 Navigation Button	Display Lion Enclosure Area 2 360-degree VR image	Image displayed successfully	Passed
Exit Gate Navigation Button	Display Exit Gate Area 360-degree VR image	Image displayed successfully	Passed

At this stage, Beta Testing was conducted through direct field evaluation in an objective manner [18], involving users of the Cikembulan Wildlife Park Virtual Reality Tour website. The beta testing process included seven respondents representing the wildlife park management team. The results of the evaluation are presented as follows:

Table 4. *Score Usability Test*

Usability Aspect	*Score*
Learnability	4.56
Efficiency	4.71
Memorability	4.85
Errors	4.49
Stratification	4.85

3.1.7. Distribution

At this stage, the Cikembulan Wildlife Park Virtual Reality Tour website is ready for deployment and public dissemination following successful completion of testing. The distribution phase is carried out by publishing the Virtual Reality Tour website on a hosted web server, making it accessible and ready for use by the intended users (https://tamansatwacikembulan.web.app/).

3.2. Discussion

This study resulted in the development of a Virtual Reality Tour website for Cikembulan Wildlife Park, intended for tourists and visitors who wish to visit the attraction and obtain information more easily. The Wildlife Park Introduction Platform, which utilizes website-based Virtual Reality Tour technology, was developed using the Multimedia Development Life Cycle (MDLC), a six-stage method. The first stage, Concept, focused on defining the overall concept of the VR website. The second stage, Design, involved developing the storyboard and navigation structure based on the established concept. The third stage, Material Collecting, involved gathering the resources required for the VR website, including 360-degree panoramic images, audio, text, and video. The fourth stage, Assembly, involved developing the VR website using 3DVista software and integrating all previously collected materials into a complete system. The fifth stage, Testing, was conducted to ensure the VR website functioned in line with the intended objectives and user requirements. Finally, the Distribution stage involved deploying and disseminating the VR website to end users.

The resulting VR website features 360-degree panoramic images, interactive hotspots, multimedia animations in audio and video, and an integrated chatbot. Given the research background, this study is important because Cikembulan Wildlife Park previously lacked a dedicated website and had not implemented Virtual Reality technology as a promotional and informational medium. Therefore, integrating these technologies into a Virtual Reality Tour website offers a more innovative way to introduce the wildlife park. The development of this Virtual Reality Tour website is expected to help tourists and the general public access information about Cikembulan Wildlife Park in a more accessible, engaging, and interactive way. Furthermore, the study contributes significantly to promoting and developing tourism at Cikembulan Wildlife Park. The evaluation results demonstrated that the Virtual Reality Tour website achieved a score of 94%, indicating that the system is highly feasible and suitable for practical use.

4. CONCLUSION

Based on the results of this study, it can be concluded that the research successfully designed and developed a wildlife park introduction website that provides tourism information using Virtual Reality technology. The

information is delivered as a Virtual Reality Tour enriched with textual content, static images, a location map, interactive hotspots embedded in each 360-degree panoramic image, and a chatbot. To further enhance the system, several srecommendations are proposed for future development. These include integrating Augmented Reality (AR) features and improving the User Interface (UI) design of the Virtual Reality Tour website. Such enhancements are expected to provide a more engaging, interactive, and visually appealing user experience in future implementations.

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