Research Article

Metaverse Tourism Development: Accessible Tourism Banyak Island Aceh Using Immersive Technology Based on Mixed Reality

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Abstract: Tourism has entered a new era with the advent of the Metaverse, leading to the emergence of a concept known as Metaverse Tourism. Metaverse tourism offers a new dimension to traveling, enabling virtual 3Sixty tours. However, ease of access presents its own challenges when it comes to Accessible Tourism, where tourism should be enjoyable for everyone, including those with limited mobility such as people with disabilities and the elderly. Banyak Island, a collection of islands located in Aceh Singkil Regency, Aceh, is one of the renowned tourist destinations in Aceh due to its natural beauty. It is approximately a 3-4 hour drive from the Aceh Singkil Port crossing. Unfortunately, the beauty of this tourist area is not easily accessible to tourists due to limited access to the location. Immersive Technology, which is closely related to the Metaverse, can bridge this gap by combining the real world with the virtual world in real-time. Mixed Reality (MR) technology can provide a virtual 3D representation 3Sixty of real objects embedded in the physical environment to its users. The urgency of this research lies in developing the MR Application of Banyak Island Aceh, which is expected to be a gateway to Metaverse Tourism. This would allow more people to discover the natural potential of Banyak Island Aceh and could serve as a means to improve the community's economy. The objective of this research is to implement accessibility tourism on Banyak Island Aceh, allowing anyone to virtually visit the island in 3D, including people with limited mobility, without worrying about travel routes and safety during the journey. This study follows the MDLC (Multimedia Development Life Cycle) methodology.

Keywords: Accessible Tourism, Banyak Island Aceh, Development, Metaverse Tourism, Mixed Reality

Introduction

Tourism has entered a new era with the rise of the Metaverse, leading to the emergence of the concept of Metaverse Tourism. Metaverse tourism offers a new nuance in traveling, where travel can be done virtually 3Sixty (Andriana and Damayanti, 2023). Metaverse tourism has begun to be developed in various countries using AR, VR, MR and Extended Reality (XR) technology. Metaverse tourism technology in Indonesia is relatively new, especially those using Mixed Reality technology, even though with the abundant and beautiful tourism potential in Indonesia, metaverse tourism can be a technological breakthrough that can introduce the tourism potential of Indonesia, so that the world does not only know Bali (Buhalis and Karatay, 2022). Accessible dtourism presents unique challenges, as it must accommodate individuals with limited mobility, including people with disabilities, the elderly, those with temporary health conditions, and caregivers of children using wheelchairs. Unfortunately, Accessible Tourism is very rare and even expensive today. This is because there are still many studies that only discuss the code of ethics or merely the concept of accessible tourism rather than

discussing technology that can be a solution to these limitations (Darcy *et al.*, 2020).

Banyak Island Aceh is a collection of islands located in Aceh Singkil Regency, Aceh. Some of the notable islands include Palambak Island Tendero-Peiró *et al.* (2024), Asok Island, Panjang Island, Malelo Island, Sikandang Island, Biawak Island, and Lambudung Island. Pulau Banyak is renowned for its exotic beaches, pristine white sands, and breathtaking sunsets and sunrises. These natural attractions make it one of the most popular tourist destinations in Aceh. However, access to the islands is limited to sea routes via ferry and traditional ship transportation, which can be challenging for tourists. Recognizing the potential of Banyak Island as a tourism destination, there have been efforts to develop it into a maritime tourism area (Terebukh *et al.*, 2021). Despite its natural beauty, the limited access to Banyak Island remains a significant challenge (Rosalina *et al.*, 2023). The ferry schedule is only available twice a week, which often does not align with the travel plans of tourists. This has led to the exploration of alternative solutions, such as virtual tourism using immersive technology, to make the islands more accessible to a wider audience. With ongoing development efforts and the introduction of innovative solutions like Mixed Reality (MR) technology, Banyak Island has the potential to become a leading tourism destination in Aceh (Subarkah *et al.*, 2020). This would not only boost the local economy but also promote sustainable tourism practices that benefit both tourists and the local community (Ozdemir, 2021).

Immersive Technology is closely related to Metaverse, where this technology can combine the real world with the virtual world in real time. One part of immersive technology is Mixed Reality (MR) (Chen, 2024). MR can provide a virtual 3D representation of 3Sixty of real objects embedded in the physical environment to its users. This mixed reality-based immersive technology can be a breakthrough in the world of tourism because it can be an alternative that offers real-world representation to tourists who want to travel but have constraints with the circumstances or track of the tour (Narin, 2021).

Materials

The materials employed in this research encompass both hardware and software components essential for the development of the MR Banyak Island application. The hardware utilized included a GoPro Max 360 Camera and a drone, which facilitated the capture of 360-degree images and aerial views of Banyak Island. Additionally, the Meta VR Oculus Quest 2 headset was used for testing immersive applications. The software tools comprised Unreal Engine, which was deployed for constructing the mixed reality environment, and Meta Horizon, which facilitated screen sharing during the testing phase. Furthermore, 3D modeling tools such as

Blender and 3ds Max were employed for the design of virtual assets. Additional resources included audio and video editing software for processing multimedia content, as well as Google Forms and Microsoft Excel or SPSS for survey distribution and data analysis. Collectively, these materials contributed to the creation of a realistic, accessible, and interactive virtual tourism experience tailored for users with limited mobility.

Methods

This research uses the MDLC (Multimedia Development Life Cycle) method. The MDLC is specifically designed for the creation and development of multimedia projects. It includes specific stages that cater to the unique requirements of multimedia, such as planning, content development, and testing of multimedia elements. As illustrated in Figure 1, the MDLC method consists of six key stages: concept, design, material collecting, assembly, testing, and distribution.
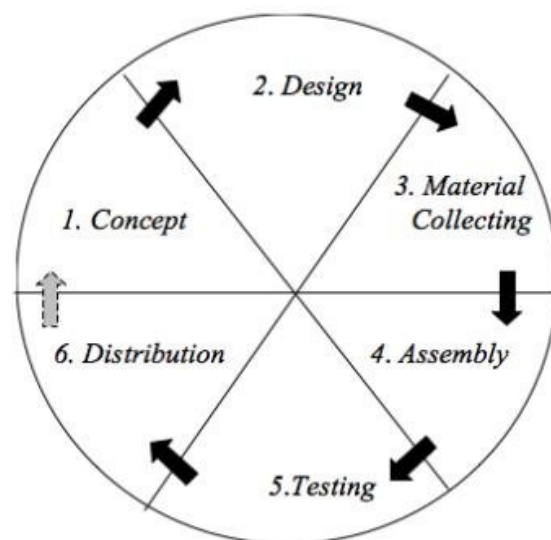

Fig. 1: MDLC Method

Concept

The following are details of the concept developed in this research. As shown in Table 1, it includes key components such as objectives, target users, and multimedia elements (audio, video, and 3D images) designed to support virtual 3Sixty tours of Banyak Island for users with limited mobility.

Data Collection

1. Literature Review: Conduct a comprehensive review of existing literature on Metaverse Tourism, Accessible Tourism, and Mixed Reality technologies. This includes academic journals, conference papers, and industry reports.
2. Surveys and Questionnaires: Develop and distribute surveys to tourists, local residents, and stakeholders

to gather insights on their experiences and expectations regarding Metaverse Tourism and Accessible Tourism on Banyak Island Aceh.

3. Interviews: Conduct semi-structured interviews with tourism experts, local government officials, and representatives from organizations involved in tourism and accessibility. These interviews will provide qualitative data on the challenges and opportunities of implementing Metaverse Tourism and Accessible Tourism.

4. Observations: Perform on-site observations to understand the current state of tourism infrastructure and accessibility on Banyak Island Aceh. This includes assessing the availability and condition of transportation, accommodations, and tourist attractions (Diva, 2023).

5. Focus Groups: Organize focus group discussions with people with disabilities and other stakeholders to gather detailed feedback on their needs and preferences for accessible tourism experiences.

Table 1: Research Concept Details Table

| Concept Category	Concept Description
Title	Banyak Island Mixed Reality Application (MR Banyak Island)
Multimedia Type	Banyak Island Aceh Information Media based on Mixed Reality with the concept of Immersive Technology
Objective	Realizing accessible tourism in Banyak Island Aceh, so that anyone can visit virtually in 3D with the 3Sixty concept to Banyak Island Aceh, including people with limited mobility (in this case, individuals with disabilities, the elderly, and others) without having to worry about travel routes and safety during the journey
Target	Tourist
Audio	Backsound, dubbing, and audio effect, with audio format (*.wav, dan *.mp3)
Video	Video content in *.mp4 format
Image	Using 3D images

Data Analysis

1. Content Analysis: Analyze the qualitative data from interviews and focus groups using content analysis techniques to identify common themes, patterns, and insights.

2. Statistical Analysis: Use statistical methods to analyze the quantitative data from surveys and questionnaires. This includes descriptive statistics, correlation analysis, and regression analysis to identify relationships between variables (Kotronoulas *et al.*, 2023).

3. Comparative Analysis: Compare the findings from the literature review, surveys, interviews, and observations to identify gaps and opportunities in the current tourism and accessibility practices on Banyak Island Aceh.

4. Triangulation: Employ triangulation by cross-verifying data from multiple sources (literature review, surveys, interviews, observations) to ensure the reliability and validity of the findings.

5. Case Studies: Develop case studies of successful Metaverse Tourism and Accessible Tourism implementations in other regions to draw lessons and best practices that can be applied to Banyak Island Aceh (Gaberli, 2019).

Design

The design uses a PCG (Procedural Content Generation) algorithm to create virtual environments. As shown in Figure 2, this supports the development of immersive features in the MR Banyak Island application (Diansyah *et al.*, 2019).
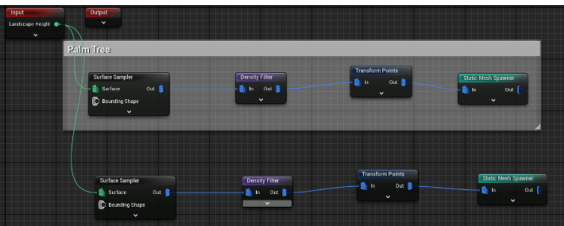

Fig. 2: PCG Algorithm

Material Collecting

At this stage, 3Sixty (360^0) data collection was carried out which was obtained directly from Banyak Island Aceh. This research was supported by research members from tourism, namely DocTrip and GoPulau Banyak. The 3Sixty data was obtained using a GoPro Max 360 Camera and Drone (Buhalis *et al.*, 2023).

Assembly

At this stage, make a creation to develop the Banyak Island Mixed Reality Application, one of which includes making a feature for the location of objects to remain on the ground and their location is made randomly (Kleftodimos *et al.*, 2023).
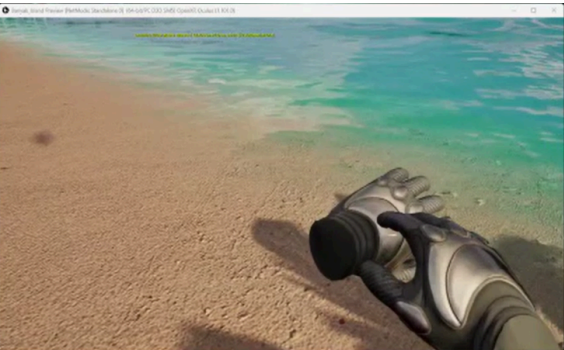
Fig. 3: Land and Sand Graph Material

As shown in Figure 3, land and sand graph materials found in MR Banyak Island. Upon closer inspection, it is evident that numerous land and sand graph materials

need to be created for MR Banyak Island to function as intended.

Testing

The testing phase is an alpha test. This alpha test is carried out for application features and marker features, such as testing whether the buttons work or not, testing whether the holographic frame is clearly visible or not, to testing whether hand gestures are recognized by Meta VR Oculus Quest 2 or not (Wang *et al.*, 2024).

Distribution

At this stage, the Banyak Island Mixed Reality Application is distributed via the Google Play Store or App Store.

Results and Discussion

Immersive technology is one of the technologies that creates a simulation experience that feels real for its users. Immersive technology consists of 3 types, namely AR (Augmented Reality), VR (Virtual Reality), and MR (Mixed Reality). Through this immersive technology, a special application was created that maps the 3D shape of Banyak Island Aceh (Han *et al.*, 2017). The 3D shape of Banyak Island Aceh is expected to be a simulation that makes it seem like its users can feel directly present on Banyak Island Aceh. This 3D simulation of Banyak Island Aceh is specifically made to support Tourism Accessibility that can be enjoyed by anyone, even for those with special mobility, such as people with disabilities, the elderly and so on (Achillas *et al.*, 2024). For users, especially those with limited mobility, sensory feedback is the solution offered at MR Banyak Island. Sensory feedback is something that can connect users with Meta VR Oculus Quest 2. As shown in Figure 4, this feature helps users experience the environment more naturally and responsively.
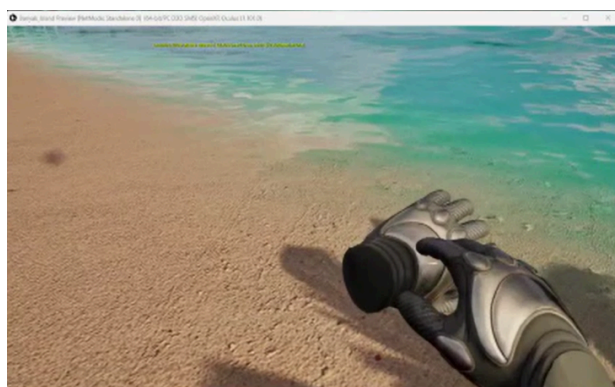

Fig. 4: Sensory Feedback in MR Banyak Island

In addition to sensory feedback, one of the important things about MR Banyak Island is the UI or User Interface. As shown in Figure 5, the initial UI display provides access to features and navigation within the virtual environment.
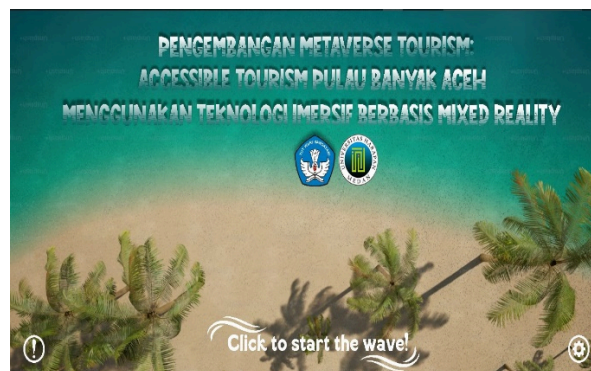

Fig. 5: Initial UI View of MR Banyak Island

The initial UI display of the MR Banyak Island above is made according to the title of this research grant. In addition to the title, the initial UI display of the MR Banyak Island also contains information on the DRTPM logo (as the grant provider to the Research Team) and also the Universitas Harapan Medan logo (as the Institution of the Research Team) (Nst *et al.*, 2020). "Click to start the wave" is a button that functions to take users to see the menus available in the MR Banyak Island. As shown in Figure 6, this menu provides entry to different island levels within the application.
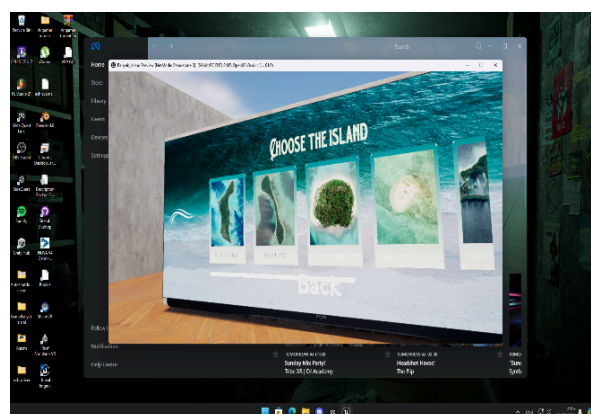
Fig. 6: Menu in MR Banyak Island

The menu in MR Banyak Island above consists of 7 levels, namely: Palambak Island Level, Asok Island Level, Panjang Island Level, Malelo Island Level, Sikandang Island Level, Biawak Island Level, and Lambudung Island Level (Rahmadi *et al.*, 2022). When each level is clicked, it will take the user to visit in 3D the 7 islands in Banyak Island Aceh. The assets used in MR Banyak Island are illustrated in Figure 7, providing a detailed view of the virtual components included in the application.
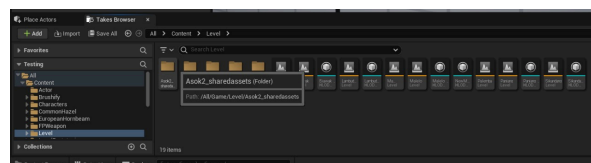

Fig. 7: Assets in MR Banyak Island

The assets of MR Banyak Island above are only the contents of the outliner level. If you look at the image above, there are still many more parts of the MR Banyak Island outliner, such as content, brushify, characters, commonhazelm, and so on. There are many assets at each level on the 7 islands in MR Banyak Island. For example, Figure 8 highlights the assets used in the Asok Island level of MR Banyak Island.


Fig. 8: Asok Island Level Content

It can be seen that the materials at the Asok Island level are so many, starting from Foliages, HLOD, Lighting, PCG to Landscape which has many materials. The list of island names featured in the MR Banyak Island application is presented in Figure 9.
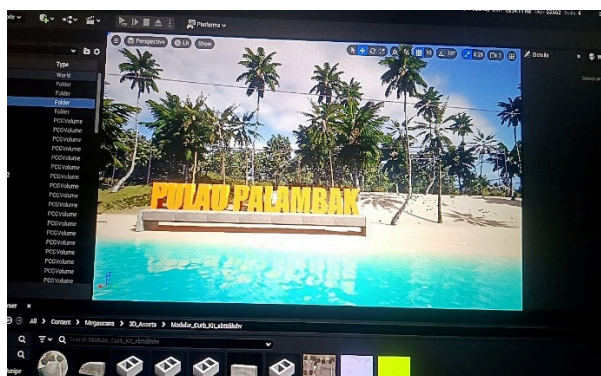

Fig. 9: Island Name Display on MR Banyak Island

Figure 10 illustrates the interior view a user experiences while exploring the virtual environment of MR Banyak Island.
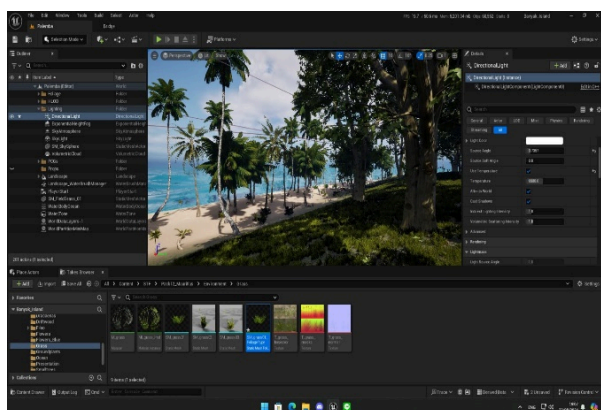
Fig. 10: Material Exploration at MR Banyak Island

Sensory feedback contains 3 menus, namely reset orientation, restart and real life. Reset orientation functions to restore the initial position of the UI display in the virtual world of the Meta VR Oculus Quest 2 device. Sometimes when busy playing or exploring Banyak Island virtually (Huang and Ismail, 2024), users make movements that make the orientation of the viewing angle in MR Banyak Island widen, resulting in the UI screen display in Meta VR Oculus Quest 2 being doubled or cut off, so a feature was created to restore the state of the viewing angle using reset orientation. Restart functions to restart or return MR Banyak Island back to the initial UI display position of MR Banyak Island. This is done to anticipate if the reset orientation feature cannot accommodate bugs that occur in MR Banyak Island (Rianmora *et al.*, 2023). Real life brings users back to the initial screen from anywhere in the simulation. These options are visually represented in Figure 11, which shows the sensory feedback menu in MR Banyak Island.
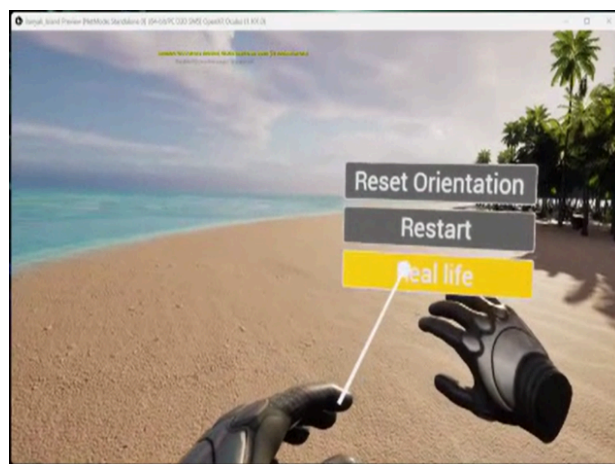
Fig. 11: Sensory Feedback Menu

In addition to the UI features, Figure 12 presents a live view of one of the research team members using the Meta VR Oculus Quest 2 while testing the MR Banyak Island application.

Fig. 12: Sensory Feedback Testing Using Meta VR Oculus Quest 2

It can be seen that the Meta VR Oculus Quest 2 device used by the Research Team is conducting a sensory feedback test. Not only the research team who

are using the Meta VR Oculus Quest 2 device can see the MR view of Banyak Island, other people around the research team can also see what the research team sees through Meta Horizon which has been installed first on the smartphone (Dwivedi *et al.*, 2022).

Initial alpha testing produced expected outcomes, leading to subsequent beta testing involving media experts, subject matter experts, and users. Results from the beta tests indicated that media experts rated the application's suitability for use at 81%. In addition, subject matter experts assessed that the MR Banyak Island application was highly relevant to the mixed reality course content, with a rating of 87.5%. Presented

below is Table 2, which displays the results of beta testing conducted on users:

Based on beta testing with users, an average percentage of 86.9% indicated that the MR Banyak Island application implemented in the mixed reality course using Meta VR Oculus Quest 2 is highly suitable for use, leading us to plan further development of the application to enhance the learning experience. To complement these findings, Table 3 presents a comparison between Metaverse Tourism and Accessible Tourism, showing how the MR Banyak Island application aligns with both concepts by combining immersive technology with inclusive design principles.

Table 2: Presented below are the results of user response data processing

Statement	Percentage
My comfort level while using MR Banyak Island Application via the Meta VR Oculus Quest 2 was exceptionally high, with a rating of 8/10	86%
The display quality of MR Banyak Island Application via the Meta VR Oculus Quest 2 is outstanding, with a rating of 9/10	87.5%
The device's responsiveness during use was satisfactory, with a rating of 8.5/10	83%
I experienced minimal eye strain while using MR Banyak Island Application via the Meta VR Oculus Quest 2, with a rating of 7.5/10	86%
The available application ecosystem for the Meta VR Oculus Quest 2 is robust, with a rating of 8.5/10	87.5%
Overall, my experience with MR Banyak Island Application via the Meta VR Oculus Quest 2 was extremely positive, with a rating of 8.8/10.	87.5%
I highly value the features and capabilities provided by MR Banyak Island Application via the Meta VR Oculus Quest 2	88%
The 3D assets in this VR application have a remarkably realistic visual appearance, enhancing the overall user experience	88%
The interior layout of each 3D object is neatly arranged, creating a more immersive experience within the MR Banyak Island application	86%
The size of the 3D objects is overall consistent, allowing me to focus on other details within the MR Banyak Island application	87.5%
The virtual environment in this MR Banyak Island application provides an immersive experience, increasing my interest and motivation to learn science	87.5%
The interaction and navigation within this MR Banyak Island application are easy and intuitive, making me feel more comfortable and confident when conducting experiments	86%
The audio quality in Application A is clear, allowing me to enjoy an immersive audio experience	90%
The size of the 3D objects is overall consistent, creating a more realistic impression within the MR Banyak Island application	85%
The features in MR Banyak Island Application appear extremely realistic, allowing me to experience a more immersive experience	88%
Average	86.9%

Table 3: Differences Between Metaverse Tourism and Accessible Tourism

Key Concept	Definition	Operationalization
Metaverse Tourism	The use of immersive technologies (such as VR and AR) to create virtual travel experiences that allow users to explore and interact with digital representations of real-world or fictional destinations.	1. Technological Infrastructure: Implementing advanced VR and AR technologies. 2. Content Creation: Developing engaging digital representations of tourist destinations. 3. User Experience: Ensuring seamless and immersive experiences. 4. Accessibility: Making virtual tourism accessible to a broad audience. 5. Sustainability: Promoting sustainable tourism practices.
Accessible Tourism	Ensuring that tourism destinations, products, and services are accessible to all people, regardless of physical, sensory, or cognitive abilities, promoting inclusive environments.	1. Universal Design: Applying principles to tourism infrastructure. 2. Physical Accessibility: Enhancing physical accessibility of sites and transportation. 3. Information Accessibility: Providing information in multiple formats. 4. Service Accessibility: Training staff to offer inclusive services. 5. Policy and Regulation: Enforcing supportive policies.

Conclusion

The research on Metaverse Tourism Development: Accessible Tourism on Banyak Island Aceh using Immersive Technology based on Mixed Reality concludes the following: Promotion of Banyak Island Aceh: Banyak Island Aceh, with its exotic beaches offering stunning sunsets and sunrises, is a natural

heritage that must be promoted. It is one of Indonesia's charming tourist destinations. Access Challenges: Access to Banyak Island Aceh poses a significant challenge that requires more attention from the local government. Currently, the ferry schedule is limited to twice a week, which often does not align with the travel plans of residents or tourists (Fazio *et al.*, 2023). Virtual Tourism Solution: The MR Banyak Island platform addresses the access problem by allowing tourists who are hesitant to visit due to transportation issues to explore the island virtually in 3D. This virtual visit can assure them of the island's worthiness as a tourist destination despite the limited transportation access. Technological Implementation: The MR Banyak Island Aceh application was developed using Unreal Engine, a software created by Epic Games Company. This advanced technology enhances the immersive experience of virtual tourism. Accessible Tourism: MR Banyak Island is a viable solution for users with limited mobility, including individuals with disabilities, the elderly, those with temporary health issues or chronic diseases, and caregivers of children using wheelchairs. This application enables these users to visit Banyak Island Aceh virtually, making the concept of Accessible Tourism more tangible and eliminating mobility barriers for travelers. This research demonstrates that implementing accessibility tourism on Banyak Island Aceh through Mixed Reality technology allows anyone to virtually visit the island in 3D, including people with limited mobility. This approach ensures that travel routes and safety concerns during the journey are no longer obstacles, thereby promoting inclusive and accessible tourism.

Acknowledgment

Conflict of Interest

The authors declare that there are no conflicts of interest.

Funding Information

Author's Contributions

Dodi Siregar: Collected data and contributed to technical design of the MR application.

Septiana Dewi Andriana: Conceptualized the research, supervised the project, and led manuscript writing.

Tengku Mohd Diansyah: Developed the PCG algorithm and user interface elements.

Dody Hidayat: Supported 3D modeling and conducted testing and analysis.

Ethics

This study did not involve human or animal experimentation requiring ethical approval. All survey respondents and interviewees provided informed consent before participation. The research complies with ethical guidelines set by the University of Harapan Medan.

References

Achillas, C., Aidonis, D., Tsampoulatidis, I., Folinas, D., Kostavelis, I., Tsolakis, N., Triantafyllou, D., Vlachokostas, C., Kelemis, A., & Dimou, V. (2024). Empowering Tourism Accessibility: A Digital Revolution in Pieria, Greece. *Applied Sciences*, *14*(23), 11136. https://doi.org/10.3390/app142311136

Andriana, S. D., & Damayanti, F. (2023). Desain Metaverse: The Future of Tourism Pariban Berbasis Augmented Reality Menggunakan Metode Markerless User Defined Target. *Jurnal Unitek*, *16*(2), 172-182. https://doi.org/10.52072/unitek.v16i2.668

Buhalis, D., & Karatay, N. (2022). *Mixed Reality (MR) for Generation Z in Cultural Heritage Tourism Towards Metaverse*. 16-27. https://doi.org/10.1007/978-3-030-94751-4_2

Buhalis, D., Leung, D., & Lin, M. (2023). Metaverse as a Disruptive Technology Revolutionising Tourism Management and Marketing. *Tourism Management*, *97*, 104724. https://doi.org/10.1016/j.tourman.2023.104724

Chen, A. N. K. (2024). Information Systems Research of Immersive Technologies - Virtual Reality, Augmented Reality, and Mixed Reality. *Journal of Information Technology Case and Application Research*, *26*(3), 256-263. https://doi.org/10.1080/15228053.2024.2401993

Darcy, S., McKercher, B., & Schweinsberg, S. (2020). From tourism and disability to accessible tourism: a perspective article. *Tourism Review*, *75*(1), 140-144. https://doi.org/10.1108/tr-07-2019-0323

Diansyah, T. M., Aulia, R., & Siregar, D. (2019). Desain Grafis Peningkatan Kemampuan Multimedia Pada Remaja Desa Seantis. *Tunas*, *1*(1), 35. https://doi.org/10.30645/jtunas.v1i1.10

Diva, A. S. (2023). Visitor Perceptions of the Attractions of Tourist Attractions in Pulau Banyak District, Aceh Singkil Regency. *Diva Scientific Journal of Social and Political Science, 3*(1), 1-11.

Dwivedi, Y. K., Hughes, L., Baabdullah, A. M., Ribeiro-Navarrete, S., Giannakis, M., Al-Debei, M. M., Dennehy, D., Metri, B., Buhalis, D., Cheung, C. M. K., Conboy, K., Doyle, R., Dubey, R., Dutot, V., Felix, R., Goyal, D. P., Gustafsson, A., Hinsch, C., Jebabli, I., … Wamba, S. F. (2022). Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *International Journal of Information Management, 66*, 102542. https://doi.org/10.1016/j.ijinfomgt.2022.102542

Fazio, G., Fricano, S., Iannolino, S., & Pirrone, C. (2023). Metaverse and Tourism Development: Issues and Opportunities in Stakeholders' Perception. *Information Technology & Tourism, 25*(4), 507-528. https://doi.org/10.1007/s40558-023-00268-7

Gaberli, Ü. (2019). Tourism in Digital Age: An explanation for the impacts of virtual, augmented and mixed reality technologies on tourist experiences. *Journal of Tourism Intelligence and Smartness, 2*(2), 61-69.

Han, D.-I., tom Dieck, M. C., & Jung, T. (2018). User experience model for augmented reality applications in urban heritage tourism. *Journal of Heritage Tourism, 13*(1), 46-61. https://doi.org/10.1080/1743873x.2016.1251931

Huang, S., & Ismail, A. I. B. (2024). Generative Adversarial Network to Evaluate the Ceramic Art Design through Virtual Reality with Augmented Reality. *International Journal of Scientific and Advanced Education, 12*(6), 508-520.

Kleftodimos, A., Evagelou, A., Gkoutzios, S., Matsiola, M., Vrigkas, M., Yannacopoulou, A., Triantafillidou, A., & Lappas, G. (2023). Creating Location-Based Augmented Reality Games and Immersive Experiences for Touristic Destination Marketing and Education. *Computers, 12*(11), 227. https://doi.org/10.3390/computers12110227

Kotronoulas, G., Miguel, S., Dowling, M., Fernández-Ortega, P., Colomer-Lahiguera, S., Bağçivan, G., Pape, E., Drury, A., Semple, C., Dieperink, K. B., & Papadopoulou, C. (2023). An Overview of the Fundamentals of Data Management, Analysis, and Interpretation in Quantitative Research. *Seminars in Oncology Nursing, 39*(2), 151398. https://doi.org/10.1016/j.soncn.2023.151398

Narin, N. G. (2021). A Content Analysis of the Metaverse Articles. *Journal of Metaverse, 1*(1), 17-24.

Nst, S. P., Siregar, D., & Siregar, Y. S. (2020). Designing 3D Modeling and Animation of Home Interiors Using 3DS Max Software. *National Seminar on Information & Communication Technology, 1*(1), 334-340.

Ozdemir, M. A. (2021). *Virtual Reality (VR) and Augmented Reality (AR) Technologies for Accessibility and Marketing in the Tourism Industry.* 277-301. https://doi.org/10.4018/978-1-7998-6428-8.ch013

Rahmadi, M. M., Liviawaty, E., Faizal, I., Purba, N. P., Ramadhan, R. A., Amrullah, R., & Dianti, I. E. (2022). The vulnerability of Small Islands from Coastlines Change in Indonesia. *IOP Conference Series: Earth and Environmental Science, 1095*(1), 012026. https://doi.org/10.1088/1755-1315/1095/1/012026

Rianmora, S., Punsawat, P., Yutisayanuwat, C., & Tongtan, Y. (2023). Design for an Intelligent Waste Classifying System: A Case Study of Plastic Bottles. *IEEE Access, 11*, 47619-47645. https://doi.org/10.1109/access.2023.3274862

Rosalina, P. D., Dupre, K., Wang, Y., Putra, I. N. D., & Jin, X. (2023). Rural Tourism Resource Management Strategies: A Case Study of Two Tourism Villages in Bali. *Tourism Management Perspectives, 49*, 101194. https://doi.org/10.1016/j.tmp.2023.101194

Subarkah, A. R., Rachman, J. B., & Akim. (2020). Destination Branding Indonesia Sebagai Destinasi Wisata Halal. *Jurnal Kepariwisataan: Destinasi, Hospitalitas Dan Perjalanan, 4*(2), 84-97. https://doi.org/10.34013/jk.v4i2.53

Tendero-Peiró, C., Asensio-Montesinos, F., Anfuso, G., & Corbí, H. (2024). The Coastal Scenery of São Miguel Island, Azores Archipelago: Implications for Coastal Management. *Journal of Marine Science and Engineering, 12*(5), 707. https://doi.org/10.3390/jmse12050707

Terebukh, A., Senkiv, M., & Moroz, O. (2021). Accessible Tourism for All and Its Contribution to Sustainable Development: Experience of the European Union. *Sustainable Development - State and Prospects*, 115-127.

Wang, X., Lafreniere, B., & Zhao, J. (2024). Exploring Visualizations for Precisely Guiding Bare Hand Gestures in Virtual Reality. *Proceedings of the CHI Conference on Human Factors in Computing Systems.* CHI '24: CHI Conference on Human Factors in Computing Systems, Honolulu HI USA. https://doi.org/10.1145/3613904.3642935