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Article

Implementation of Smart Tourism using a 360° Virtual Tour at Belalang Adventure Batam

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***Abstract*— The growth of smart tourism, particularly through 360° virtual tour (VT360°) technology, presents an effective promotional strategy in the period following the COVID-19 pandemic. This approach is especially suitable for outdoor tourist destinations that seek to engage with a global audience. This research was specifically conducted to design and put into practice VT360° technology at Belalang Adventure in Batam. The main goals were to increase the availability of information for potential visitors and improve the location's appeal to foreign tourists, who often research destinations online before traveling. This study employed a Research and Development (R&D) method, which included systematic stages of initial observation, capturing high-quality images with Google Street View, editing the photos with Adobe Lightroom, and building the final virtual tour on the Theasys platform. The outcome is a fully interactive virtual tour that highlights key points of interest, including the main entrance, the ticket counter, and various game areas, all of which can be conveniently accessed online from any device. This digital tool has proven to be an effective and low-cost method for tourism promotion. It also shows the considerable potential for small and medium-sized tourism businesses to use immersive technology to reach a wider market. Based on these findings, this study recommends forming collaborations with tour operators, local tour guides, and hotels to broaden the distribution of the virtual tour, making it a central part of a more extensive and combined promotional strategy.**

***Keywords*—360 virtual tour; belalang adventure batam; smart tourism; tourism digitalization.**

1. Introduction

Batam City is known as a destination for both local and foreign tourists. Many tourists visit Batam because of its strategic position, directly bordering Singapore and Malaysia (Fahlevi et al., 2024). Consequently, these two countries are the source of the highest number of tourists visiting Batam (BPS Batam, 2024). Batam has many interesting tourist destinations, such as beaches with white sand, exotic islands, modern shopping centers, and outdoor tourism (Hariyanto & Dewi, 2023; Simbolon et al., 2023). One company that provides outdoor tourism is Belalang Adventure. It is a popular destination among the people of Batam because it has many facilities, a strategic location, and a variety of outdoor adventure and educational games.

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Outdoor tourism offers many advantages for visitors. Koroll (2022) explains that outdoor tourism is useful for developing social/interpersonal skills, leadership skills, emotional management, self-confidence, identity creation, and technical skills for individuals who participate. The increase in the number of foreign tourists coming to Batam presents potential for the outdoor tourism industry. The outdoor tourism business has grown since the number of COVID-19 cases decreased. Although foreign tourist visits to Batam have increased, many destinations like Belalang Adventure do not have immersive and informative digital promotion media. This limits their promotional reach, especially for foreign tourists who want to get a picture of the location before visiting.

However, despite the increasing number of foreign visitors to Batam, many local destinations like Belalang Adventure have not yet adopted immersive and informative digital media for promotion. This gap limits their ability to reach a wider international audience, particularly tourists who prefer to see a detailed preview of a location before committing a visit. To address this challenge, one highly effective marketing strategy is the creation of a 360° virtual tour (VT360°). This technology is a cost-effective promotional tool that allows potential visitors to virtually explore a location from anywhere in the world (Rodrigues & Cheiran, 2020). According to Fatma et al. (2019), VT360° helps tourism managers provide information to potential visitors. Meanwhile, according to Akhsani et al. (2023), VT360° makes campus promotions beautiful and interactive. The primary objective of this research project was to develop and implement a VT360° for Belalang Adventure. The goal was to provide an easy-to-access, detailed overview of the facilities and layout of the park, thereby attracting more interest from foreign tourists and encouraging them to visit.

1.1. Outdoor Tourism

Outdoor tourism is a recreational activity conducted outdoors, with activities designed to explore and develop an individual's potential (Safitri & Mulyono, 2022). According to E. A. Safitri et al. (2024), outdoor tourism is a fun activity that includes games, challenges, and adventures carried out in nature. It is often chosen by tourists for refreshment during holidays, self-discovery, and building relationships with others through teamwork, communication, and leadership skill development (Sabela & Komariah, 2020). Isaghoji & Par, (2024) define outdoor tourism as follows: "The term “outdoor tourism” includes all places that make people feel they can experience a special sensation “away from the hustle and bustle of the world.” For some people born and raised in the city, that place might be a city park, a local nature reserve, or the countryside near home.

1.2. Virtual Reality

Virtual reality is a technology that allows users to interact directly with a computer-generated environment, making the user feel as if they are actually in that place (Ayuni & Juhana, 2025; Prambayun et al., 2022). The term "virtual reality" originated in the 1980s from Jaron Lanier, who founded the company VPL Research to study the world's first virtual reality (Zimmerman et al., 1986). The term was later popularized by Japanese author Hattori (1991) in his book "What's Virtual Reality?". Virtual reality is an immersive technology that allows users to access a virtual environment or metaverse for an interactive, multi-sensory, and real-time experience (Leveau & Camus, 2023). According to Lavalle (2023), virtual reality targets an organism's behavior using artificial sensory stimuli, while the organism is unaware of the interference.

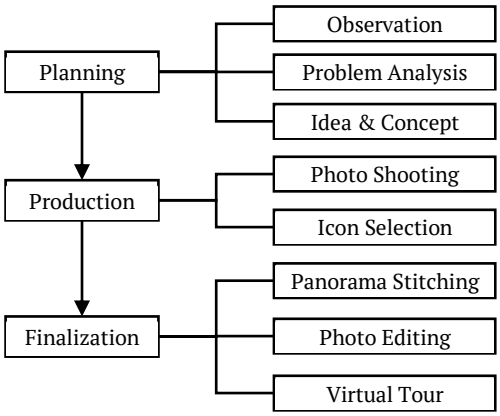


Fig. 1. Research flow (Budi & Wenas, 2018)

1.3. Virtual Tour 360°

From 2018 to 2021, the COVID-19 pandemic forced people worldwide to stay at home or be isolated from the outside world. In response, governments in various countries used VT360° technology as a solution to relieve their citizens' stress (Yang et al., 2021). A VT360° is a virtual representation of a real attraction, where tourists experience a 3D technology created as a preview before visiting a certain place or as a way to extend the experience for past visitors (Kim & Hall, 2019). VT360° has emerged as an alternative to physical tourism to provide a beautiful picture of real destinations and attractions (Pestek & Sarvan, 2021).

2. Method

This study uses a Research and Development (R&D) approach, as illustrated in Fig. 1. According to Sugiyono (2021), “R&D is a research method used to produce a certain product and test the effectiveness of that product.” R&D is a process of developing a new product or improving an existing one and then validating the product so that it can meet the needs of various parties (Dafitri et al., 2023). The R&D was developed by designing a VT360° which was carried out by making direct observations at the location and capturing images at Belalang Adventure.

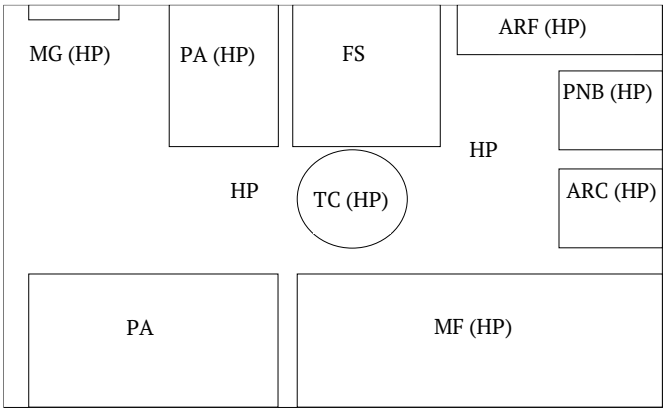
Observations were made twice: on May 18, 2024, to observe and experience the outdoor activities, and on May 25, 2024, to execute the VT360° image capture. The equipment used included a smartphone and a laptop, combining web networks, software, and hardware. The author also used generative AI to adjust sentences in the research report. The initial step was to capture images using the "Google Street View" software because of its wider reach compared to other software. The next step was designing a logo to be placed on the hotspots (clickable points in the VT360°). For image editing, "Adobe Lightroom" software

was used because it is easy to use and flexible on a smartphone. The final step involved using the "Theasys" web platform to create the VT360° due to its diverse feature options.

3. Results

3.1. Field Observation

The researchers visited the Belalang Adventure location directly at Golden City, Bengkong Laut, Bengkong District, Batam City. This observation was conducted with Mr. Oman, the owner of Belalang Adventure, who provided a detailed explanation of the various facilities, games, and tourist experiences offered. During the observation, the research team conducted a thorough review of the entrance access, ticket counter area, individual and group game areas, and other strategic points that are often centers of visitor activity. The observation results showed that Belalang Adventure has great potential for further development through the use of digital technology. One of the main needs identified was the presence of interactive promotional media such as a VT360°, which would allow potential tourists to explore the location visually and immersively without being physically present. This is very important, especially for foreign tourists who want to confirm the conditions and facilities before visiting. In addition, the VT360° also serves as a tool to increase visitor confidence, expand marketing reach, and provide a real and accurate picture of the atmosphere and activities offered by Belalang Adventure. Through observation, the researchers were able to create a map to determine hotspot positions and areas to be photographed, as illustrated in Fig. 2.



Note: HP (hotspot), MG (main gate), PA (parking area), FS (free space), TC (ticket counter), MF (main field), ARF (air riffle games), PNB (paintball game), ARC (archer game)

Fig. 2. Mapping results of Belalang Adventure

3.2. Image Photography

The researchers used the "Google Street View" software, as illustrated in Fig. 3. Based on the researchers' observations, this software was the best available as of June 2024. The researchers took five images: (1) The entrance view of Belalang Adventure, (2) The ticket counter view, (3) The shooting games area, (4) The main lobby field, and (5) The cooperative games area. However, the fourth and fifth image captures failed, resulting in blurry photos. Therefore, it is recommended to use different software for future research. The entrance view was chosen to show the external conditions and the gate to Belalang Adventure. The ticket counter view was selected because it covers almost all the games. The shooting games area was chosen to see more details of the most popular games, namely archery and paintball shooting. The main lobby field is where the guide usually explains the games if a package is booked. The cooperative games area was intended to capture parts of the games that had not yet been photographed.

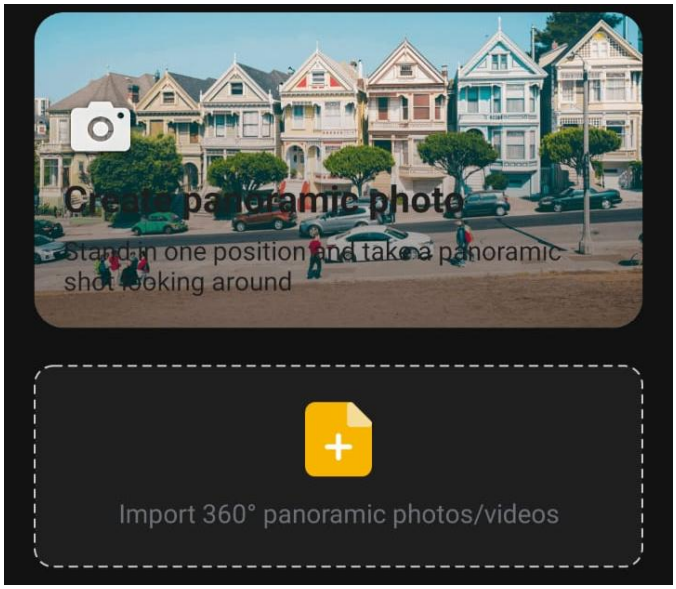


Fig. 3. Google street view software

3.3. Icon Search

After discussions with the management of Belalang Adventure, it was agreed that the hotspot icons in the VT360° would use the official Belalang Adventure logo as the main element. This decision was made to strengthen the destination's visual identity and provide a professional and consistent impression on potential visitors. The logo was used on interactive points in the virtual tour to mark important areas such as the entrance, ticket counter, and game zones, as illustrated in Fig. 4. By displaying the original logo in the hotspots, it is hoped that the user experience will become more personal and directly reflect the brand image of Belalang Adventure. In addition to increasing visual appeal, this approach also makes it easier for users to recognize important elements in the VT360° due to the familiar and easily recognizable design consistency.

3.4. Panorama Stitching

Panorama stitching is an important process in creating a VT360°, which involves combining several panoramic photos into a single complete view that presents a 360° visual. This

process aims to create an illusion of a comprehensive and realistic space, so that users can feel as if they are directly at the tourist location. After panoramic photos were taken from various points using Google Street View software, the next step was to precisely merge these photos to avoid distortion or inconsistencies between frames. This stitching process requires high precision, especially in adjusting the horizon points, lighting, and overlapping objects. Therefore, the software used must support automatic stitching capabilities while also providing manual editing options for further correction if needed. The researchers ensured that each resulting panorama had a smooth transition between viewpoints, so that when explored in VT360° mode, the user experience is not disturbed by visual errors. This process also included trimming unnecessary parts of the image, equalizing colors between segments, and checking the final image resolution quality to ensure it remains sharp and responsive when displayed on various devices, including smartphones and VR headsets. With good panorama stitching, the entire VT360° can appear professional, immersive, and attractive to visitors.

Fig. 4. Hotspot with the official Belalang Adventure logo

3.5. Photo Editing

After the panorama stitching process was complete, the next stage was image editing to ensure maximum visual quality in the VT360°. Editing was done using Adobe Lightroom software because of its ability to handle color, lighting, and sharpness settings efficiently and its user-friendly nature, especially on mobile devices. This editing process included exposure correction, contrast enhancement, white balance adjustment, and removal of unwanted noise or visual disturbances. In addition, light cropping was done to tidy up the photo composition to focus more on the main objects in each frame. One of the main goals of this stage was to equalize the color tone between panoramic photos so that the visual transition when the user moves from one hotspot to another remains consistent and does not disrupt the immersive experience. During the editing process, the Belalang Adventure logo watermark was also added at several points as a marker and branding effort. The researchers chose natural and not excessive editing settings to maintain the original atmosphere of the tourist location. With optimal editing results, the VT360° display becomes more professional, visually attractive, and can give a positive first impression to potential visitors, especially those accessing it from outside the region or abroad.

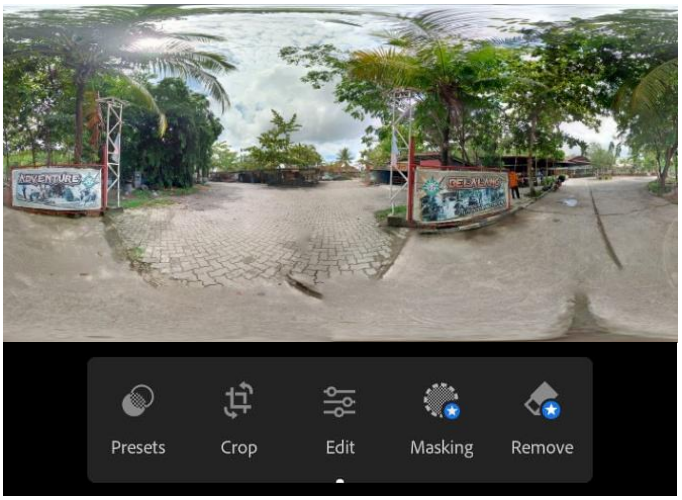


Fig. 5. Editing using Adobe Lightroom

3.6. Creation of the VT360°

The VT360° creation stage was carried out using the Theasys platform, a web network that provides complete features for designing virtual tours based on panoramic photos. Theasys was chosen for its ability to present a responsive interactive interface, support gyroscope technology for mobile devices, and allow the integration of various multimedia elements such as text, hotspot icons, and navigation between panoramic points. The creation process was done by uploading the edited photos to the Theasys platform, then adding hotspots at strategic points such as the entrance area, ticket counter, and game zones. Each hotspot was equipped with the Belalang Adventure logo to strengthen the visual identity and provide an exclusive impression; when "clicked," it would show a change in the image section or an explanation of the facility (Table 1). One of the excellent features of Theasys is its drag-and-drop ease and its ability to display the VT360° in various formats such as a link, HTML, and iframe, making it easy to integrate into websites, social media, or send directly to potential visitors.

However, there is one significant drawback of Theasys, which is the fee of USD 10 (as of July 1, 2025) that must be paid to publish the VT360° project in its full version without a watermark. Nevertheless, this fee only applies to the initial download and can be reduced to USD 5 (half) by paying a subscription fee of USD 23.99 (as of July 1, 2025) (Theasys, 2025). After the virtual tour is published by the manager, anyone can access it for free without needing to pay or register. This drawback does not hinder the end-user experience and still allows the use of the VT360° as an effective promotional tool for Belalang Adventure.

4. Discussion

4.1. Final Result

After going through all the stages from observation, image capture, panorama stitching, visual editing, to the creation of the VT360° using the Theasys platform, the final result is an interactive virtual tour of the Belalang Adventure tourist destination. The production process took approximately one full day, including technical preparation, visual content processing, and finalization of interactive features in the virtual tour. The created VT360° displays several main points of the location: the entrance gate view, ticket counter, shooting game area (archery and paintball), and cooperative game zone. Each point is equipped with a hotspot featuring the Belalang Adventure logo to mark and explain the location visually and to strengthen the branding of the tourist spot. The final result of this project has been released in digital format and can be accessed by the public via the following link: (https://bit.ly/VRBelalang). This VT360° can be easily opened on computers and smartphones without additional applications and supports the gyroscope feature for an immersive experience. With this VT360°, potential visitors, especially foreign tourists, can get a comprehensive picture of the facilities and atmosphere at the location before making a physical visit. This final result is expected to be an effective and professional digital promotion medium and to support Belalang Adventure's marketing strategy in attracting visitors from various backgrounds.

4.2. Hotspot Testing

Based on the test results of the hotspot points in the Belalang Adventure VT360°, all interactive features were declared to be functioning correctly. Each hotspot was placed at a strategic point in the three main parts of the tourist location. In the first part, the parking area and main lobby function to provide information about parking facilities and link to the next panoramic photo. In the second part, the ticket counter provides an explanation of the ticket purchase area, while the main field serves as a connecting point to the official website. The third part includes the game zone, with hotspots on the shooting games area, back to the main gate, archery, paintball shooting, and air rifle shooting, each providing complete information about the game location and connections between panoramas. The success of each hotspot ensures smooth navigation and informative user experience in exploring the VT360° interactively.

Table 1. Test results of hotspot points

Hotspot	Section	Function	Result
Parking Area	1	Explanation of parking facilities *	Active
Main Lobby	1	Connects to photo section 2	Active
Ticket Counter	2	Explanation of ticket counter facilities *	Active
Main Field	2	Connects to the official Belalang Adventure website *	Active
Shooting Games Area	2	Connects to photo section 3	Active
Back to the Main Gate	2	Connects to photo section 1	Active
Archery	3	Explanation of the archery game *	Active
Paintball Shooting	3	Explanation of the paintball shooting game *	Active
Air Riffle Shooting	3	Explanation of the air rifle shooting game *	Active

* Note: Link to a more complete explanation.

Table 2. VT360° beta test results

Question	Score					Mean
	1	2	3	4	5	
1. Is the design engaging?	0	2	6	13	9	3,96
2. Is the information easy to understand?	0	0	8	12	10	4,06
3. Is the navigation easy to use?	0	0	4	15	11	4,23
4. Does it provide a pleasant experience?	0	0	4	13	13	4,30
5. Does it provide useful information?	0	1	6	10	13	4,16
6. Are the hotspot points interactive?	1	1	10	12	6	3,70
7. Are you satisfied with using this VT360°?	0	0	3	14	13	4,33
8. I did not find any errors in the VT360°.	0	1	5	14	10	4,10

4.3. VT360° Testing

To determine if the VT360° was ready for use, the researchers conducted a beta test with visitors who had been to Belalang Adventure, using questions adapted from previous research (Latifah & Antika, 2025). Using a Likert scale of 1-5 (Strongly Disagree to Strongly Agree) with a minimum sample calculation recommended by Nielsen (1993), the minimum sample obtained after calculation was 30 respondents to get valid results. The test results showed that the majority of respondents gave positive ratings to various aspects of the VT360°, as shown in Table 2. The statement with the highest average score was "Are you satisfied with using this VT360°?" with a mean score of 4.33, followed by "Does it give a pleasant impression?" (mean 4.30) and "I did not find any errors in the VT360°" (mean 4.10). This indicates that the VT360° media provides a pleasant, satisfying, and technically sound experience for its users. Meanwhile, the statement "Are the hotspot points interactive?" had the lowest average score of 3.70, and the question "Is the design attractive?" had a score of 3.96, although still in the good category. This finding suggests that the interactivity of the hotspots and the appearance of the VT360° can still be improved to maximize the user experience. Overall, the beta test results show that all indicators are in the

mean range of 3.70-4.33, which indicates that the VT360° has successfully met the functional, informative, and aesthetic aspects in the context of digital tourism promotion.

5. Conclusion

Overall, this research concludes that the implementation of a VT360° at Belalang Adventure can be an effective solution to make it easier for potential visitors to get information about the facilities and location. It is hoped that the VT360° will attract foreign tourists to visit. This was achieved using software-based technologies such as Google Street View for image capture, Adobe Lightroom for image editing, and Theasys for creating the interactive VT360°. After testing, it was concluded that all created points were successful, so the VT360° designed by the researchers is ready for use for promotional media needs. With the existence of the VT360° at Belalang Adventure, it is recommended that Belalang Adventure collaborate with other parties such as tour operators, tour guides, and hotel companies. This cooperation could involve sharing the VT360° with related parties to make it easier for tourists to see the facilities and location of Belalang Adventure. For future research, it is recommended to photograph a minimum of 6-9 image sections to improve the appearance and interactivity of the hotspots. In addition, it is important to use other software (besides that used in this study) to compare the effectiveness of the results, especially during image capture where errors occurred, resulting in only three image sections (Table 1).

Data Availability

All data produced or examined during this study are present in this paper.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Authors' Contributions

All authors participated in this research. MZDP designed the idea and concept. The WAP and JKM compiled the initial manuscript. V, S, and JFA made improvements. RF and FAS provided supervision. Finalization was done by the MZDP, RF, and FAS. All authors have reviewed and approved the final manuscript.

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