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Luxury Transportation Innovations for Sustainability: Implementing of Research & Development

Ema Rahmawati, Sugiarto, **Tonny Hendratono, Robert La Are**, **Asep Syaiful Bahri**
Sekolah Tinggi Pariwisata Ambarrukmo, Yogyakarta, Indonesia
Email: emarahmawati@stipram.ac.id, profsugiarto@stipram.ac.id, tonnyhendratono@stipram.ac.id, robertlaare@stipram.ac.id, asepsyaifulbahri@stipram.ac.id

***Correspondence:** emarahmawati@stipram.ac.id

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ABSTRACT
This research focuses on the use of Artificial Intelligence (AI) and Virtual Reality (VR) in luxury tourism buses, specifically the Omah Sultan Juragan 99 Trans in Malang, East Java, Indonesia. The research and development (R&D) approach, supported by qualitative and quantitative data, aims to evaluate the effectiveness of AI and VR in enhancing the tourist experience. Through in-depth observations, interviews with key informants, and field trials, the study investigates various elements, such as smart technology, VR services, AI as a virtual guide, and the overall user experience. The findings show that the integration of AI and VR enhances the travel experience by providing personalized virtual tours, improving the service quality, and contributing to the sustainability of the luxury bus service. The study results suggest that AI and VR can play a pivotal role in modernizing tourism transportation by offering innovative, immersive, and interactive tourist experiences. The innovation of AI and VR in this context is a groundbreaking contribution to the tourism sector, addressing the emerging demand for personalized, high-tech travel services in luxury transportation. Future research can further explore the scalability of these technologies across different regions and tourism sectors to validate their broader applicability.

Introduction

Technological advances are very crucial at this time. One of the technological advances is transportation, which is inseparable from our daily lives. This proves that technological advances help the transportation sector innovate and evolve. In recent years, artificial intelligence (AI) and Virtual Reality (VR) have become innovative developments in the field of transportation (Abduljabbar et al., 2019; Bharadiya, 2023; Ficzere, 2023; Iyer, 2021; Khan et al., 2022; Kuo & Choi, 2024; Y. Ma et al., 2020; Mnyakin, 2023; Tang et al., 2022)

One of the transportation companies that is currently experiencing growth and competitive competition is tourism transportation. The use of Artificial Intelligence (AI) and Virtual Reality (VR) in tourist transportation is developing and being adopted to make innovations in the field of transportation (Jamaluddin & Rahmat, 2022; Kannan, 2024; Kong et al., 2023). Artificial Intelligence (AI) and Virtual Reality (VR) innovations in transportation are important factors in understanding market trends and consumer

preferences, enabling tourism transportation service providers to design and offer unforgettable travel experiences (Lakhapate, 2023; S. Ma, 2024; Srinivasan et al., 2024). Advances in Artificial Intelligence (AI) technology offer the potential to improve the tourist experience through better personalization, provide efficient self-service services, and assist stakeholders in managing tourism transportation more smartly and sustainably.

Studies on Artificial Intelligence (AI) and Virtual Reality (VR) innovations in transportation only focus on decision-making, planning, company management related to vehicle safety and security, vehicle breakdown diagnosis, autopilot features, and traffic management (Abduljabbar et al., 2019; Tang et al., 2022). Meanwhile, the study of Artificial Intelligence (AI) and Virtual Reality (VR) on tourism transportation is only related to the efficiency of the booking process, improving the quality of user service, improving tourist safety, simplifying the search for tourist information, improving the quality of tourist experience, improving the quality of tour guides, improving the quality of transportation for tourists, and improving the quality of tourist accommodation. Some studies on the application of artificial intelligence in transportation are presented in Table 1 below:

Table 1. Research on The Application of AI to Transportation

Researcher & Year	Title	Journals	Result
Abduljabbar, R., Dia, H., Liyanage, S., & Bagloee, S. A. (2019)	Applications of artificial intelligence in transport: An overview	*Sustainability*, *11* (1), 189	This study conveyed that AI innovations include highly sophisticated computing methods that mimic the way the human brain works. The application of AI in the transportation sector aims to overcome the challenges of increasing travel demand, CO2 emissions, safety issues, and environmental degradation.
Ma, Y., Wang, Z., Yang, H., & Yang, L. (2020)	Artificial intelligence applications in the development of autonomous vehicles: A survey.	*IEEE/CAA Journal of Automatica Sinica*, *7*(2), 315-329	This study states that the advancement of artificial intelligence (AI) has stimulated the development and deployment of autonomous vehicles (AVs) in the transportation industry. To achieve the goal of full automation, i.e. self-driving, it is important to know how AI works in AV systems.
Iyer, L. S. (2021).	AI-enabled applications towards intelligent transportation	*Transportation Engineering*, *5*, 100083	This research aims to discuss the application of Artificial intelligence in the transportation sector to build a sustainable society. It has also collected various AI applications in different cities and companies and presented them as ready-to-use calculations for future decision-makers.
Chung, S. H. (2021)	Applications of smart technologies in logistics and transport: A review	*Research Part E: Logistics and Transportation Review*, *153*, 102455	This study comprehensively reviews the important contributions made in the application of smart technology to improving logistics operations and transportation network efficiency. The results state that these new advanced technologies create enormous modeling challenges to traditional optimization approaches and thus create rich new research

			opportunities to develop new optimization methodologies in logistics and transportation studies.
Khan, S., Adnan, A., & Iqbal, N. (2022)	Applications of artificial intelligence in transportation	*International Conference on Electrical, Computer and Energy Technologies (ICECET)* (pp. 1-6). IEEE	The study provides an overview of the use of AI in transportation, focusing on transportation management, planning, and control, intelligent parking monitoring for fast locations, and accident avoidance. Future trends and challenges of using AI in transportation were also examined
Bhargava, A., Bhargava, D., Kumar, P. N., Sajja, G. S., & Ray, S. (2022)	Industrial IoT and AI implementation in vehicular logistics and supply chain management for vehicle-mediated transportation systems.	*International Journal of System Assurance Engineering and Management, 13*(Suppl 1), 673-680	This research presents an IIoT model that is integrated with intelligent logistics and a transportation management structure. It improves customer experience and satisfaction, minimizes transportation costs, identifies optimal routes, monitors time, and designs efficient maintenance schedules and vehicle maintenance for efficient work.
Okrepilov, V. V., Kovalenko, B. B., Getmanova, G. V., & Turovskaj, M. S. (2022)	Modern trends in artificial intelligence in the transport system	*Transportation Research Procedia, 61*, 229-233	The researcher focused on the problems of using artificial intelligence for effective traffic management, such as increasing the level of uniformity of traffic flows, optimizing public transport routes, the need to install special equipment on vehicles, lighting control systems for transport highways, and road control facilities in Moscow and St. Petersburg, Leningrad region.
Bharadiya, J. (2023)	Artificial intelligence in transportation systems: a critical review	*American Journal of Computing and Engineering*, *6* (1), 34–45.	The study's findings show that AI plays an important role in various aspects of smart cities, particularly in intelligent transportation systems such as modeling and simulation, dynamic routing, congestion management, and intelligent traffic control. The research also reveals the application of AI to transportation, railways, and roads.
Mnyakin, M. (2023) *Artificial Intelligence in Society*, *3*(1), 9-27	Applications of AI, IoT, and cloud computing in smart transportation: A review	*Artificial Intelligence in Society*, *3*(1), 9-27	The research shows that AI can be used for autonomous vehicles, traffic management, predictive maintenance, driver assistance, and demand forecasting. IoT can enable connected vehicles, real-time fleet management, smart parking, traffic monitoring, and remote diagnostics.

Kannan, R. (2024)	Revolutionizing the Tourism Industry through Artificial Intelligence: A Comprehensive Review of AI Integration, Impact on Customer Experience, Operational Efficiency, and Future Trends	*International Journal for Multidimensional Research Perspectives*, *2* (2), 01-14.	This study explores the deep relationship between the tourism industry and Artificial Intelligence (AI) and its impact on customer experience and operational efficiency, emphasizing the need for businesses to stay updated with AI developments to stay competitive for sustainability.

Sources: Processed by Researcher, 2024

One of the tourism transportation modes that is currently experiencing growth and aggressive competition is the tourism bus. Until now, various new tourism buses have provided premium, luxury, and exclusive fleets to serve passengers at varying prices and prioritize the application of technology and information systems (Yudha, 2022), so that these tourism buses are known as luxury tourism buses. With the competition of luxury tourism bus transportation, bus transportation companies must consider ways to continue developing and updating their products to survive in the market and maintain their sustainability.

So far, the application of Artificial Intelligence (AI) and Virtual Reality (VR) innovations in tourism transportation, especially luxury tourism bus transportation, has not been thoroughly explored in the existing literature. Until now, there has been no research that specifically discusses Artificial Intelligence (AI) and Virtual Reality (VR) technology innovations applied in luxury tourism buses, especially those related to a different travel experience with a tour guide in the form of Artificial Intelligence (AI) and presenting tourism destinations during the trip through Virtual Reality (VR). The goal of the luxury tourism bus transportation innovation project, which combines Artificial Intelligence (AI) and Virtual Reality (VR) technology, aims to create a different travel experience and enable the utilization of this application for the entire luxury tourism bus transportation by offering tourism transportation services that are different from other transportation.

This innovation project is carried out on the luxury tour bus Omah Sultan Juragan 99 Trans Malang, East Java, Indonesia. This project is designed through several stages: feasibility studies, testing, and evaluation. The implementation of this project allows luxury transportation users to experience the journey more realistically, with the emergence of guides through Artificial Intelligence (AI) and virtual tours in the form of Virtual Reality of tourist attractions during the trip. The main informants are the manager and the owner of Omah Sultan Juragan 99 Trans Malang, East Java, Indonesia, tourism guides, and practitioners with in-depth knowledge of tourism transportation, tourist destinations, and information technology. The trial was conducted for the tourism

transportation community, practitioners, and guides as initial resource persons to get feedback on the experience of using Artificial Intelligence (AI) and Virtual Reality (VR) in tourism trips on luxury tourism buses. This innovation project will focus on exploring the application of Artificial Intelligence (AI) and Virtual Reality in the following aspects: (1) smart and high technology; (2) virtual reality services; (3) the application of Artificial Intelligent as a tour guide, (4) the scarcity of the use of products on luxury tourism buses, and (5) the travel experience with the luxury tourism bus Omah Sultan Juragan 99 Trans Malang, East Java, Indonesia.

The integration of Artificial Intelligence (AI) and Virtual Reality (VR) into tourism transportation is an emerging trend, but its application in luxury tourism bus services, especially in the context of Omah Sultan Juragan 99 Trans luxury buses in Malang, remains underexplored. The primary research problem is the lack of detailed studies on how AI and VR technologies can enhance the luxury bus travel experience, improve customer satisfaction, and contribute to a more engaging and interactive tourism service. The challenge lies in understanding how these technologies can be effectively implemented in the tourism sector, particularly in a high-end, personalized setting like luxury buses, to provide value-added services that distinguish these services from traditional transportation options.

As the tourism industry seeks innovative ways to attract customers and provide unique experiences, integrating AI and VR in luxury buses could potentially redefine travel services by offering personalized virtual guides, immersive experiences, and improved operational efficiencies. However, there is limited research on how AI and VR applications can contribute to enhancing the luxury bus travel experience, particularly in a developing tourism market like Indonesia. This gap in knowledge presents a need for research that addresses the effectiveness of these technologies in tourism transportation services, which could lead to valuable insights for both service providers and passengers.

The urgency of this research lies in the growing competition within the tourism industry, where offering unique, innovative experiences has become crucial for attracting and retaining customers. As technology evolves, so do passengers' expectations, and luxury tourism operators must leverage AI and VR to meet these demands. With the rise of virtual tourism and digital tools for enhancing travel experiences, integrating these technologies into luxury tourism buses could revolutionize the sector, offering a new level of personalization and interactivity. This research is timely, as it aligns with the ongoing trend of technological innovation in the tourism industry, and the findings could help businesses understand how to stay competitive by enhancing their services through AI and VR technologies.

Several studies have explored the impact of AI and VR on customer satisfaction and service quality, but most have focused on industries like retail, healthcare, and entertainment rather than tourism and transportation. Research by Le et al. (2024) highlights the benefits of VR in enhancing tourist experiences by creating immersive virtual environments, yet it does not specifically address luxury tourism services or the use of VR in transportation. Similarly, AI applications in tourism have been studied mainly in the context of personalized marketing and customer service in hotels and tourist attractions, such as the work by Miron Gracia (2019), but its role in luxury transportation remains largely unexamined. Furthermore, studies by Bigné et al. (2020) focus on technology integration in traditional tourism sectors without considering the evolving needs of high-end, luxury market segments like those served by luxury tourism buses.

Although AI and VR have been widely adopted in various sectors to enhance customer experiences, their application in luxury tourism buses has been underexplored. There is a notable gap in the literature regarding how these technologies can improve the travel experience, especially in the context of a luxury service that aims to offer personalized and immersive experiences. The current body of research does not provide sufficient evidence on how AI and VR can be utilized specifically in the tourism transportation sector, and their combined impact on customer satisfaction and service innovation in this niche remains largely unknown. This research gap highlights the need for an in-depth examination of these technologies' potential in luxury tourism buses.

This study offers a novel contribution by examining the integration of AI and VR technologies in luxury tourism buses, an area that has received little attention in academic research. By focusing on a specific case study of Omah Sultan Juragan 99 Trans in Malang, Indonesia, this research provides a unique insight into how these advanced technologies can be used to enhance the travel experience for high-end customers. The novelty lies in exploring how AI can provide personalized travel recommendations and VR can offer immersive virtual tours, setting a new standard for luxury transportation services. This research also contributes by proposing a framework for integrating AI and VR in the tourism transportation industry, which other service providers in the sector could use.

This research aims to explore the impact of AI and VR applications on customer satisfaction, revisit intention, and overall service quality in the luxury tourism bus sector. Specifically, it aims to evaluate how these technologies can improve the travel experience, increase engagement, and provide tourists with more personalized, memorable services. The research also seeks to determine the feasibility of integrating AI and VR into tourism transportation services, offering actionable insights into how these technologies can enhance luxury services in the tourism industry.

The findings from this study will benefit tourism operators, particularly in the luxury transportation sector, by providing insights into how AI and VR can be effectively integrated to enhance customer satisfaction, improve operational efficiency, and create memorable travel experiences. This research will help operators design more competitive services that cater to the growing demand for high-tech, personalized travel experiences. Additionally, the study will contribute to the broader academic field of tourism technology, offering a framework for the adoption of AI and VR in tourism transportation and setting the stage for further research into their applications in this industry.

Research Methods

This study employs a Research and Development (R&D) method with a survey and experimental approach to test the product's effectiveness. Specifically, the study aims to develop and evaluate the application of Artificial Intelligence (AI) and Virtual Reality (VR) technologies in the luxury tourism bus service, Omah Sultan Juragan 99 Trans in Malang, East Java. The development process includes feasibility studies, data collection through observations, interviews, and product testing to evaluate user experiences with the technology. Additionally, comprehensive data analysis techniques are used to assess the impact of AI and VR on tourists' experiences and service quality.

This research examines the use of Artificial Intelligence (AI) and Virtual Reality (VR) technologies in the luxury tourism bus service, Omah Sultan Juragan 99 Trans in Malang, East Java. The study utilizes a Research and Development (R&D) method with a survey and experimental approach to evaluate the effectiveness of these technologies.

Data was collected through observations, interviews with managers, owners, tour guides, and transportation practitioners, and product testing involving 30 participants from the tourism transportation community, tour guides, and transportation professionals. The research aims to assess the impact of AI and VR on tourists' experiences and develop a system that can enhance tourism service quality. Both quantitative and qualitative data analysis were used to evaluate the effectiveness of the technology in creating more engaging and interactive tourism experiences.

Results and Discussion

This study aims to find out (1) smart and high teknologi; (2) virtual reality service; (3) the application of Artificial Intelligence as a tour guide, (4) scarcity of use of products on luxury tourism buses; and (5) travel experience using luxury tourism bus Omah Sultan Juragan 99 Trans Malang, East Java Indonesia.

Omah Sultan Juragan 99 Trans Malang, East Java, Indonesia. It was first launched in July 2021 with a capacity of only 12 passengers, has a maroon exterior, and a total body length of 12 meters. In addition to being famous as a luxury tourism bus in the style of a sultan and premium rental prices tend to be expensive, Omah Sultan Juragan 99 Trans Malang, East Java Indonesia is also famous for all its advantages, including luxurious facilities in it, the application of advanced technology in all systems and panels in it, this tourism bus is also the only tourism bus in Indonesia that has an advanced technology system by providing a toilet that can be used to defecate even when the bus is running. Consistent with the premium services offered, which are constantly innovating with current and sophisticated technology, the manager of Omah Sultan Juragan 99 Trans Malang, East Java, Indonesia, in collaboration with tourism transportation practitioners and tour guides, tries to present Artificial Intelligence and Virtual Reality technology on the bus (Engin & Treleaven, 2019; Supriadi et al., 2024).

Results of in-depth observations and interviews with luxury tourism bus managers, Omah Sultan Juragan 99 Trans Malang, East Java, Indonesia, Tourism transportation practitioners, and tour guides, namely, luxury tourism buses that offer the following innovations:

- Always innovate by providing high-tech and sophisticated facilities for product development to support the advantages of existing luxury bus facilities, one of which is by providing services with artificial intelligence applications applied to smart LCD TVs, electronic facility panels, and bus toilets. AI can be used to improve the quality of customer service in using luxury tourism buses, Omah Sultan Juragan 99 Trans, Malang, East Java, Indonesia.
- Virtual reality service provides a virtual tour of tourist destinations to be visited, and during the trip, it will also be connected to an artificial intelligence guide. The activity was carried out in several stages, namely (1) collecting information about all tourist destinations in Indonesia, information about cities in Indonesia, history, culture, and tradition by determining the time of taking pictures, determining the location of taking pictures; (2) data collection; (3) multimedia materials and files are assembled and arranged according to the design; and (4) the creation of application design designs.
- The application of artificial intelligence as a tour guide combined with a virtual tour application, tour guides represented in the form of artificial intelligence act as if they are delivering tour guides on a bus that can interact like humans. AI can be used to improve the quality of tour guides by providing accurate and relevant information to users. AI tour guides collect and organize information about tourist attractions, history,

culture, and traditions, and provide information during the trip. In exploring various locations, virtual guides are expected to help increase the efficiency and satisfaction of luxury tourism bus users, Omah Sultan Juragan 99 Malang, East Java, Indonesia.

- It is Indonesia's only luxury tourism bus that complements its transportation with tour guides through artificial intelligence and provides tourist destination information and travel information through virtual tours.
- Trying to present a unique and different travel experience from similar tourist transportation, supported by facilities and technological sophistication that have not been available before. In addition, this technology is also used to optimize users' travel routes based on their preferences and interests, and as a virtual tour guide that provides information and interesting stories about tourist attractions.

Additional information was collected from a feedback form distributed to 30 people from the tourism transportation community, 5 tourism transportation practitioners, and 25 tour guides to complete the interview and observation data. The respondent base is diverse, covering various age groups and backgrounds. However, only participants at least 20 years old are eligible to complete the feedback form. According to the data that the researcher was able to collect from the participants, the following are the results:

Table 2. Participant Data of Field Testing Product

Age			**Gender**	
20 – 40 years old	41 – 61 years old	> 61 years old	Male	Female
12 pax	41 pax	7 pax	46 pax	14 pax

Origin/ Citizen			**Occupation**		
Malang Area	Java	Outside Java	Transport Expert	Transport Community	Guide
46 pax	41 pax	25 pax	5 pax	30 pax	25 pax

Source: Researcher Primary Data, 2024

The results of the participant's feedback were coded according to the specific questions on the form, which focused on the following aspects: (1) smart and high technology; (2) virtual reality services; (3) the application of Artificial Intelligence as a tour guide, (4) the scarcity of the use of products on luxury tourism buses; and (5) travel experience using luxury tourism bus Omah Sultan Juragan 99 Trans Malang, East Java Indonesia. The results of the participant's perspective feedback show that the application of artificial intelligence and virtual reality in the luxury tourism bus Omah Sultan Juragan 99 Trans Malang, East Java, Indonesia, are as follows:

- Smart and high technology. Designed for product development and innovation to support the excellence of existing luxury bus facilities. With the existence of technological innovation in luxury tourism buses, Omah Sultan Juragan 99 Trans Malang, East Java, Indonesia, is a transportation company that always excels and continues to innovate in its products.
- Virtual reality services applied in virtual tours provide accurate and complete information. Information about tourist destinations, culture, history, and those related to tourist trips is very complete. The information in the virtual tour is described artistically and sequentially so that it is easy to see and receive clearly. Users can easily choose the information in question. Videos and images in the virtual tour make it seem as if the user is in the environmental object displayed on the smart TV.

- The application of artificial intelligence as a tour guide makes it easier for users (tourists) to explore a city and tourist destinations. Virtual guides through artificial intelligence technology provide easy access to information that is conveyed in an interactive and more interesting manner without the need to have trouble finding physical or manual guides. With a virtual guide, users (tourists) can better understand the places visited and, during the trip, interact naturally/really. With a virtual guide, users can be free without having to be tied to a human tour guide due to physical limitations, fatigue, etc. Although it is difficult to replace a human tour guide role, virtual guide apps on luxury buses help fill in the information gap during the trip.
- Omah Sultan Juragan 99 Trans Malang, East Java, Indonesia. Until now, it has been the only tourism transportation company that has innovations in the use of virtual guide applications with artificial intelligence technology and tourist information services, with virtual tours applied to tourism buses, especially luxury tourism buses in Indonesia.
- Travel experience using a luxury tourist bus, Omah Sultan Juragan 99 Trans Malang, East Java, Indonesia. With all its advantages that are different from other tourism buses, it is a rare and unique experience. The addition and development of innovation with the application of artificial intelligence technology in virtual guides and virtual reality services in virtual tours provide amazing new experiences. With virtual guides and tours, users can interact with virtual objects as if they were in the intended object and environment. This technology also creates and provides an immersive and interactive experience in exploring an object visited, and can interact with a virtual guide like a real human guide.

Implication

This research establishes a framework for digital technology supported by artificial intelligence and the provision of virtual reality in the form of virtual tours, so that transportation companies can adopt it with their resources. Finally, the researcher proposes and discusses several research areas, developments, and applications for important future technological innovations that can be researched. To the researcher's knowledge, this is the first study that comprehensively examines the use of artificial intelligence and virtual reality technology in luxury tourism buses, especially in Indonesia, so that it continues to develop and be sustainable in accordance with the times. The findings and insights provide constructive and useful guidance for practitioners and academics on the future development of topics with different perspectives.

Conclusion

This study explores the use of Artificial Intelligence (AI) and Virtual Reality (VR) technologies in luxury tourism buses, specifically focusing on Omah Sultan Juragan 99 Trans Malang, East Java, Indonesia. The research utilizes a research and development (R&D) approach, including in-depth observations, interviews with key informants, and field trials. The study investigates smart technology, VR services, AI as a virtual guide, product scarcity, and the overall travel experience. The findings show that AI and VR significantly enhance user interaction, providing immersive virtual tours and guides that improve service quality and offer unique travel experiences. The integration of AI also helps analyze user feedback, contributing to better tour guide services. This innovative approach has helped maintain the region's sustainability and the growth of luxury buses.

Future research could focus on further improving the integration of AI and VR technologies in tourism transportation, addressing the current limitations identified in this study. More accurate and extensive data collection would enhance the effectiveness of these technologies, providing deeper insights into user preferences and needs. Additionally, exploring the scalability of these technologies in other regions and tourism sectors could offer valuable knowledge for the development of luxury tourism services globally. Researchers should also explore the long-term impact of these technologies on customer loyalty and the overall tourism experience.

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