



Demand Analysis of Virtual Reality Transportation Popularization of Science Application and Proposed Technical Solution Recommendations

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Abstract . In the context of the construction of a strong transportation country, it is necessary to improve the national transportation literacy and promote the development of transportation science popularization. In view of this, this paper first analyzes the current situation of virtual reality transportation science popularization research, then points out the characteristics and needs of transportation science popularization content, and finally puts forward the technical solutions of virtual reality transportation science popularization application. The rapid development of new technologies calls for accelerating the development of virtual reality transportation popular science applications, creating informed and interesting popular science works, and improving the literacy of all people in transportation popular science.

Keywords: virtual reality technology, popularization of transportation science, technical solutions, demand analysis

1 Introduction

As a major transportation country, China has improved the scientific literacy of young people, the public, and transportation practitioners and managers by strengthening the popularization of science in transportation, which is an inevitable requirement for building a strong transportation country. However, the relative backwardness of the means of popularization of science in the transportation industry has led to the traditional popularization of science using newspapers, books, radio and television as the main media, which has resulted in a lack of knowledgeable and interesting science content, insufficient timeliness and coverage of popularization of science, and a certain gap with the personalized popularization of transportation science needs of the public. It is necessary to change the original traditional way, the use of virtual reality technology, including mixed reality, augmented reality, extended reality and other technical means, to create new and interesting transportation science population works.

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2 Analysis of the current research status of virtual reality transportation popular science

2.1 Industry demand

As scientific and technological achievements become more and more fruitful, new ways of expression and dissemination become indispensable, and new technologies such as virtual reality technology provide new means of propaganda for the popularization of transportation science. With the continuous emergence of transportation science and technology achievements, modern transportation equipment such as super high-speed rail, magnetic levitation rail transportation, unmanned aerial vehicles, ultra-high-speed aircraft, automatic water transport ships, and photovoltaic roads, hydrogen roads, magnetic levitation roads, etc., directly supply kinetic energy to vehicles and realize the ability to transform the product of recycling high technology. The same rapid development results also include regulation technology of deep water channel in complex giant estuaries, saturated diving technology, under the railroad and highway construction technology under the extreme complex geological terrain and extreme harsh climate conditions, mega-bridge and tunnel construction technology, air, space, vehicle and ground information integration safety and control technology, etc. Virtual reality (VR) and other new technologies take the lead in applying in the field of transportation and are constantly iterating and optimizing, which helps to accelerate the popularization and promotion of the achievements of transportation science and technology, and provides technical support for science popularization and publicity [1].

Virtual reality technology plays a positive role in enhancing the effectiveness of transportation science popularization. In the operation and development of intelligent transportation industry, virtual reality technology plays an important role in the transportation industry as a high-tech technology. Virtual reality traffic simulation can be used to simulate, track and control traffic flow, such as traffic congestion, incident management, signal control and network design optimization, etc., in order to analyze the traffic conditions for traffic management, or to help traffic reconstruction in urban development. Aiming at the situation that transportation construction may damage wildlife habitats, virtual reality technology can be applied in wildlife protection, to create a domestic and international publicity benefits of transportation science popularization, to establish China's transportation industry to build a "green transportation" image. Scene roaming can be applied to the planning and design of three-dimensional scenes of tourist highways [2] and waterways as well as the movement mode based on virtual motion objects. Among them, the movement mode based on virtual motion objects can not only control the specific driving route freely, but also run according to the selected route, at the same time, it can realize the actual situation of the scene observed in different angles and distances; given that the 360-degree panoramic content can bring people an immersive sense of reality, it can be used in the online exhibition hall of the transportation industry. Through the construction and enrichment of virtual reality popular science resources, we can turn the abstract knowledge in the transportation industry into animation, pictures and videos, and

carry out interactive operations with the help of virtual reality technology. In this way, the knowledge of the transport industry can come down from the books and be active in front of the public, which is convenient for the public to grasp and learn, in order to promote the scientificization and informatization of transport resources and achieve the goal of popularizing the science of transport resources.

2.2 VR technology evolution and trends

Virtual Reality (VR) refers to the use of computer technology as the core of modern technology to generate realistic visual, auditory, tactile integration of a certain range of virtual environments, allowing the user to use the necessary equipment in a natural way to interact with the virtual environment objects, interact with each other, so as to get the feeling of being in the same real environment and experience. Virtual reality technology not only makes the development of various industries more scientific, but also gives the public life more wonderful, its value is mainly embodied in: planning decision-making, design evaluation, training experience, culture and entertainment, science education and other aspects.

Virtual reality is characterized by Immersion, Interaction, Imagination and Intelligence. Based on a number of core technologies such as dynamic environment modeling technology, stereoscopic display and sensor technology, real-time 3D graphics generation technology, and system integration technology, it mainly focuses on the accuracy of the virtual environment representation, the authenticity of the synthesis of the virtual environment perceptual information, the naturalness of the interaction between people and the virtual environment, the real-time display, and the resolution of graphic generation issues.

At present, VR technology has gradually matured internationally and is developing in the direction of visual, auditory and tactile multi-sensory immersive experience. At the same time, the corresponding hardware equipment is also developing towards miniaturization and mobility. In China, VR technology is also accelerating its development.

In the last two years, the rapid development of domestic communication networks and the emergence of 5G have injected a strong dose of VR technology for further development and leap. As 5G technology brings advantages such as high bandwidth and low latency, VR and AR are provided with key support, and cloud VR and VR real-time live broadcasting begin to rise. Virtual reality technology has entered the take-off stage, evidenced by that cloud rendering technology, artificial intelligence technology, as well as point-of-view technology are promoting the application and development of virtual reality technology, and perceptual interaction is increasingly focusing on naturalization, contextualization, and intelligence. The innovative application of “virtual reality +” accelerates the development to the field of production and life.

2.3 Current situation of VR transportation popular science research

The popularization and development of technology has led to the application of virtual reality technology in all aspects of transportation, playing an increasingly important role in transportation popular science. The footprints of the application of virtual reality technology can be seen in traffic safety, curriculum design, traffic program development, traffic publicity display, traffic research results publicity, etc. Leon-Paredes [3] et al. introduced a virtual reality (VR) platform designed for road safety education, which can be used to educate and train the public about the safety of drunk driving, high-speed driving, cyclists and users of the tram system. Aati [4] and others used a virtual reality platform to train state Department of Transportation (DOT) staff who inspect work zone compliance. The Pejing VR Traffic Safety Science Experience System provides a realistic VR traffic safety education environment for the experiencers, allowing them to be immersed in the streets, on the road, on the highway, to popularize traffic laws and regulations, and to feel the consequences of not abiding by the traffic rules. Yichuancheng traffic safety popularization course includes VR drunk driving simulation experience, VR bicycle safe riding simulation experience, VR pedestrian traffic safety simulation experience, VR bus riding safety simulation experience, VR traffic sign connecting (game version) and so on, which is applicable to all kinds of educational bases, all kinds of primary and middle schools and schools as well as enterprises, institutions and governmental units. Traffic safety skills can also be improved through various training in a realistic virtual traffic environment. Using an immersive virtual reality (VR) flight deck, Labedan P [5] et al. trained pilots in an experiment involving four pilots who had to perform the same traffic pattern scenarios (takeoff, downwind, and landing) in both a VR simulator and real flight conditions. In accordance with the goal of building “Golden Class” put forward by the Ministry of Education, Wang Jun [6] and others from the School of Architecture and Design, Southwest Jiaotong University, carried out teaching reforms based on their own disciplinary development direction and scientific research characteristics, combined with the virtual simulation experimental teaching program of transportation architecture design. The college carries out the teaching of virtual simulation in the course of transportation architecture design by combining two-dimensional plane and three-dimensional space through the technical means of building information modeling, virtual reality technology, computer programming, animation simulation and human-computer interaction. In order to improve the level of military sea projection simulation training and enhance the trainees' job capability, Wu Xiaodong [7] and others conducted military sea projection simulation training based on VR technology. Through the virtual animation display of the past, present and future development of rail transportation and the city, Huang Xiaomei [8] enhanced people's understanding and support of rail transportation construction. Zhao Yongguo et al [9] realized the 3D GIS-based highway traffic electronic sand table display with Xinjiang highway as an example, dynamically displaying the real topographic and geological features of the areas along the Xinjiang highway network, providing scientific basis and reference for highway planning decisions. Bayerische Motoren Werke AG launched the new BMW 7-series car with the help of holographic projection technology [10],

which realized a stunning effect. Mitsubishi Motors [11] used real car test drive experience simulator in Chengdu Auto Show to simulate test drive, so that drivers can experience the driving experience of cars on roads, snow and ice, deserts, mountains and other sections without leaving the exhibition hall. Toyota Motor Corporation in Japan, also keen to use virtual reality technology for the display and release of new products, designed an augmented reality product promotion catalog [12] to assist vehicle sales negotiation, so that the negotiation of the non-displayed vehicles is more convenient. Toyota held a mixed reality new car launch event for its new car Corolla Fielder in Tokyo, Japan [13]. 360-degree cameras were used to shoot the event, and users could rotate the picture arbitrarily through their mobile phones to realize real-time hybrid display of the launch site and post-production effects.

At present, the application of virtual reality technology in transportation popular science is in a scattered state, and tends to customize development, and the cost is high, which limits the large-scale promotion and development of virtual reality technology. In view of these existing problems, it is necessary to propose a systematic and replicable virtual reality transportation popular science technology scheme, which is conducive to the promotion of virtual reality technology in transportation popular science.

3 Characteristics and Demand Analysis of Transportation Popular Science Content

The characteristics of the transportation industry are different from those of other industries. As the “first official” of national economic and social development, transportation has the functional attributes of being pioneering, basic, strategic and service-oriented. Generally speaking, it has many points, long lines, wide areas, many kinds of transportation services, a huge population, a great responsibility for safety, and a high proportion of energy consumption. Transportation science and technology content is different from that of meteorology, environmental protection and other industries, with the following two characteristics:

(1) Transport science and technology knowledge is distributed in the entire process of transport services

The scientific and technological knowledge of the transportation industry is distributed in various fields and the entire process of transportation services, and there are scientific and technological knowledge and innovation of transportation science and technology in infrastructure, transportation equipment, major events and transportation services.

(2) The object of transportation service is also the object of science popularization

All kinds of people participate in all stages of transportation, the scientific quality of the participants directly affects every link of transportation services, and the object of transportation services is also the object of science popularization. Therefore, it is necessary to increase the science popularization of the service object, and the object of transportation service is also the object of science popularization.

The science popularization work of transportation exists in the entire transportation service process. The transportation industry not only needs to popularize the scientific and technological knowledge of infrastructure and transportation equipment, but also needs to popularize the scientific knowledge of transportation services such as safety, civilization and efficiency. Only by improving the quality level of the participants in transportation science can we promote the rapid development of the transportation industry.

The key population targets for popularization of science are four groups of people: young people, farmers, urban workers, leading cadres and civil servants. The ideal state of transportation science popularization runs through the whole process of transportation, not only in a certain aspect is involved, to expand the scope of transportation science popularization. In the means of publicity, continuous innovation and expansion of new media channels is indispensable, so as to realize a rich variety of ways to show and reflect in the lives of the people.

4 Conclusion and outlook

This paper carries out research with a view to the application of virtual reality traffic science popularization, and analyzes the current situation of virtual reality traffic science popularization research. Based on the traffic popularization content characteristics and needs, this paper analyzes and forms a virtual reality traffic popularization technology proposal, which gives guidance on the content characteristics, technology selection, technology solutions, and equipment needs for the application of virtual reality technology in traffic popularization. Given the solutions applicable to transportation industry science popularization applications such as virtual driving, virtual flight, hybrid reality cycling, virtual walking, virtual navigation, AR interaction, panoramic publishing, holographic perception, and online exhibition halls, the applicability of virtual reality technology in transportation science popularization has been verified to some extent.

The market of virtual reality technology in the transportation science popularization industry is promising, and it is indispensable at this stage to be problem-driven, in-depth business, technology enhancement, in-depth integration and innovative development. The next research focus will be placed on green transportation, low-carbon travel, transportation safety production and other fields, specifically around the VR popular science application and case practice.

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References

1. Wu Zhaohui; Wu Xiaobo; Wang Liang. Outlook on the development trend of intelligent transportation in the context of transportation power[J]. Transport Research,2019,(04):26-36.
2. Wu Chaohui; Fu Zhiqiang; Wang Liang; Dou Fei. Research on BIM perception and engineering evaluation method for highway in virtual reality[J]. Journal of System Simulation, 2020,(07):1402-1412.
3. Virtual reality simulation and perception of traffic congestion scenes Shi K., Wang L., Wang L., Wu Z.(2019) Proceedings - 2019 International Conference on Virtual Reality and Visualization, ICVRV 2019, , art. no. 9213042 , pp. 7-10.
4. Immersive work zone inspection training using virtual reality Aati K., Chang D., Edara P., Sun C.(2020) Transportation Research Record, 2674 (12) , pp. 224-232.Virtual reality for pilot training: Study of cardiac activity.
5. Labedan P., Darodes-De-Tailly N., Dehais F., Peysakhovich V. (2021) VISIGRAPP 2021 - Proceedings of the 16th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications, 2 , pp. 81-88.
6. Wang Jun. Exploration of the Teaching Reform of Transportation Architecture Design Combined with Virtual Reality Technology[A]. National Higher School Architecture Professional Education Guidance Sub-committee of Architectural Digital Technology Teaching Working Committee. Sharing - Synergy - Proceedings of 2019 National Architecture Faculty Teaching and Research Symposium on Architectural Digital Technology [C]. National Higher School Architecture Professional Education Guidance Sub-committee of Architectural Digital Technology Teaching Working Committee.:2019:4.
7. Wu Xiaodong; Yao Yuan. Research on simulation training of sea delivery of troops based on VR technology[J]. Journal of Military Transportation University,2022,(07):52-56.
8. Huang Xiaomei. The application of virtual reality technology in the bidding of rail transportation project[J]. Railway Survey, 2011, 37(6):35-36.
9. Zhao Yongguo, Zhang Dunhu, Wang Yong, et al. Development of Highway Traffic Electronic Sand Table Based on 3D GIS[C]// National Highway Science and Technology Innovation High-level Forum. 2006.
10. Bayerische Motoren Werke AG. Holographic naked eye 3D BMW 7 Series car launch [EB/OL]. ,2016-5-10. http://v.youku.com/v_show/id_XNzQ0NDQwNzg4.html.
11. Digital Display Online. 2015 Chengdu auto show surprised VR virtual reality simulation test drive [EB/OL]. ,2016-5-10. http://www.szzs360.com/news/2015/9/2015_1_zs4237.htm .
12. FengMei(Beijing) Technology Development Co. Toyota Car Viewer [EB/OL]. ,2016-5-10.<http://www.beijing-mts.com.cn/Products/Details/28> .
13. Toyota Motor Corporation. Corolla Fielder New Car Launch [EB/OL].,2016-5-10. http://v.youku.com/v_show/id_XMTI2NDk4NDk4OA==.html.

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