Discussion on the interior design of straddle monorail from the perspective of user experience

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Abstract. With the rapid development of the economy, people's demands for travel have gradually shifted from focusing on speed and timeliness to focusing on the quality and experience of travel, which has put forward new requirements for the interior of the vehicles they ride on. Although straddle type monorail vehicles are highly regarded in terms of appearance and function, their interior design still follows the traditional subway style, which cannot meet the high-quality needs of tourists for a comfortable and enjoyable experience. This article aims to sort out user experience related theories, starting from the user's senses, combined with the structural composition, development history, and current situation of the interior of straddle monorail vehicles, and propose targeted interior design suggestions to improve the travel experience of tourists.

Keywords: Straddle monorail train; Interior; User experience.

1 Introduction

With the development of the economy and the improvement of living standards, people's demand and expectations for travel are also constantly increasing. Unlike traditional tourism, tourists nowadays pursue a desire to obtain richer, unique, and comfortable experiences during their travels. In this context, straddle monorail trains are gradually being applied in tourist attractions, tourist routes, and suburban routes due to their unique advantages such as low speed stability, strong climbing ability, and low cost. With its unique aerial driving perspective, it brings unprecedented landscape experiences to tourists. Although straddle monorail trains have a long history, their interior design still follows the traditional subway interior style, which does not meet the physiological needs and psychological expectations that passengers want to obtain during their travels. For tourists, traveling is not only about moving from one place to another in a check-in style, but also about pursuing a sense of experience during the journey. The traditional subway style interior design clearly cannot meet the needs of tourists. This article reviews the development history and current situation of the interior design

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of straddle monorail trains, combined with relevant user experience theories, and proposes design criteria for the interior design of straddle monorail trains from the perspective of user perception, and looks forward to future development.

2 Overview of Interior Development of Straddle Monorail Trains

2.1 Development History

2.1.1 Meeting Basic Requirements

Monorail technology rose from the late 18th century to the middle and late 19th century. During this period, developers did not give much consideration to the internal space of their rides. Figure 1 shows Louis in 1909 invention the monorail train, this stage of the train mainly to carry cargo, you can see that behind the body is a simple straight board, passengers sit on the freight box or stand behind the front, the train of this period did not take into account the passenger riding factors.

Fig. 1. The monorail invented by Louis Brennan

2.1.2 Function Attribute Upgrade Phase

Since the 1960s, the development center of straddle monorail vehicles has gradually shifted to Japan, and multiple straddle monorail projects such as Tokyo Haneda Airport Monorail, Osaka World Expo Monorail, and Shonan Monorail have been built and operated, making Japan the country with the longest total distance of straddle monorail operation in the world. The train is equipped with seats and benches inside, as well as luggage racks for tourists to place large luggage. The focus is on practicality and functionality, which meet the basic needs of passengers, but the riding experience of passengers has not been given sufficient attention. The colors commonly used inside the carriage have relatively low brightness, giving a dull atmosphere.

2.1.3 Emotional Needs Exploration Stage

Starting from the 21st century, the development center of straddle type monorail vehicles has shifted to China and is in a high-speed development stage. The design focus has also shifted from the exterior of the train to the interior, with a greater focus on whether its interior can better meet the internal expectations of users for the travel experience.In the fast-paced city life, people not only expect the straddle monorail to provide efficient and convenient transportation services during the journey, but also

want it to bring a sense of peace and tranquility during the journey. Passengers crave a sense of home in the cabin, whether it's through the warm seating design, soft lighting, or thoughtful amenities.

Currently, straddle trains enhance the passenger experience by using more suitable, environmentally friendly materials and intelligent equipment. As shown in Figure 2, the straddle monorail train developed by CRRC Sifang Co., Ltd., the interior space is simple and bright, with clear zoning. The passenger compartment adopts a new type of TPU floor cloth, which has the advantages of wear resistance, self-cleaning, and environmental protection. The vehicle adopts the new nano ceramic film window, the volume is increased by 30%, and the ultraviolet radiation is more than 99% and the infrared radiation is more than 95%, ensuring the riding comfort when the elevated open-air operation.

Fig. 2. The new straddle monorail developed by CRRC Sifang Company

2.2 Interior Composition

The interior of a straddle type monorail train includes floors, side wall panels, side wall covers, end wall panels, roof panels, windows, and the intake and exhaust ports of the shell system. It also includes passenger seats, pillars, armrests, suspension rings, lighting, passenger information displays, broadcasting speakers, passenger emergency alarms, door emergency unlocking devices, and door status indicator lights, monitoring cameras, fire extinguishers, etc.

3 Overview of User Experience Theory

User experience is a purely subjective feeling established by users during the process of using a product. In today's society, user experience has penetrated into various fields, covering multiple levels from functional satisfaction to emotional resonance. The ISO 9241-210 standard defines user experience as "people's cognitive impressions and responses to the products, systems, or services they use or expect to use."[1]. Simply put, it means "whether this thing is easy to use or inconvenient to use.". User experience focuses on the effects generated during practical applications. In recent years, its theory has been widely applied in various fields such as product development and interior space design. Although widely applied to various products, the frameworks and theories used for each type of product are different, and the processes vary according to different product or service systems. In the field of product design, user experience is generally divided into sensory level user experience, behavioral level user experience, and emotional level user experience [4]. The most commonly applied user experience

theory in terms of interior design is sensory experience. In the research on car interior design based on user perception, Chen Yangwei and Yu Shulan analyzed the ways and levels of user perception, the process of user perception, and the elements of car interior design from the perspective of user perception, and proposed a series of design guidelines for car interiors.[2] In Li Qian's research on shared car interior optimization design based on synesthesia design, the theory of synesthesia design under user experience aims to break down sensory boundaries, make the car interior more vivid, break down barriers to user experience, break through sensory boundaries, and experience a more comfortable and intelligent car interior design through the mutual transformation and communication of the five senses. This article will analyze the interior of a straddle monorail train from the perspective of sensory user experience and provide suggestions.[3]

4 Interior Design Principles Corresponding to Sensory Level User Experience

4.1 Visual Experience

Vision affects people's psychological experiences. Visual information plays an important role, as people observe the shape and ruler of objects Size, luster, and brightness create a comfortable impression. This visual impression is not an objective quality, but a spirit. The feeling of going up [8]. Visual comfort is gradually being recognized as one of the most important standards in product design.

4.1.1 Reasonable Color Matching

The visual experience mainly based on color is usually the first element of subjective judgment for passengers. When passengers enter the carriage, the color of the carriage will affect their senses and thus affect their riding experience. The reasonable combination of colors can provide emotional satisfaction for passen-gers. For example, as early as 2010[5], Hyeon Jeong Suk conducted an experiment on color emotions and found a positive correlation between the wavelength of color tones and human pleasure. The longer the wavelength, the higher the human pleasure. When choosing the color inside the carriage, full consideration should be given to the external landscape, and gray should be avoided as much as possible. On the premise that it does not affect passengers' appreciation of the scenery outside the window, colors with longer color wavelengths should be chosen to reduce the visual impact on passengers and improve their pleasure.

4.1.2 Reasonable Layout of Lighting

The reasonable layout of lighting is one of the important factors that determine the passenger experience when riding. Lighting design can create a comfortable seating space through visual means, enhance the overall atmosphere inside the car, and create an artistic conception to enhance the overall quality of its interior. As a designer, it is

necessary to fully consider the driving environment of the straddle monorail train and the proportion of the area occupied by its body windows. According to the survey, it was found that people's visual perception of the spatial environment is determined by factors such as illumination and color temperature. The change in color temperature will result in changes in the temperature of the light source, which has a significant impact on the passenger's riding psychology. The psychological changes of individuals under different color temperature indices. [6] As shown in figure 3,when the color temperature is between 2000-7000K, it is a comfortable and safe zone for passengers. Adjusting the color temperature in this range can also cause different psychological and emotional changes for passengers.For example, in hot weather, the color temperature can be adjusted between 5300-7000K. That can make passengers feel cool.

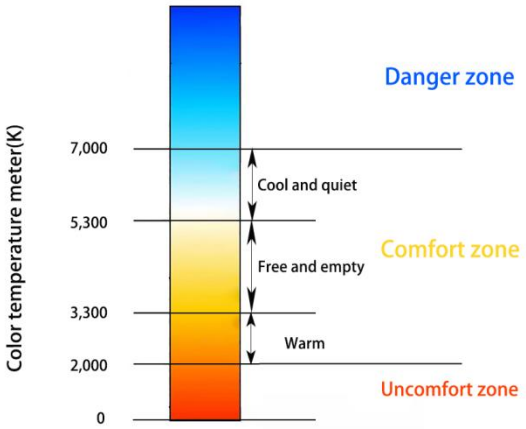

Fig. 3. Color temperature table

4.1.3 Clear Identification System

Identification is also an important component of the interior, but it is often overlooked. A complete and clear identification system can help passengers reduce many unnecessary troubles and quickly identify various facilities and services inside the carriage. Passengers can quickly locate through the identification system, thus using the various functions provided by the train more efficiently. The uniformity and standardization of the identification system can also enhance the overall aesthetics of the train interior, making the interior environment of the carriage more orderly. This not only provides passengers with a good visual experience, but also further enhances their sense of identification and trust in the train.

4.2 Tactile Experience

Tactile is a composite sensation that involves human hands and skin touching the surface of materials to perceive their properties. It is the primary method for people to understand and perceive materials. In the interior design of monorail vehicles, the tactile experience mainly considers the reasonable selection of interior materials. Different

materials will give people different sensory characteristics, and the same materials and different processing techniques will also give passengers a different experience. The tactile experience of passengers can be divided into direct tactile sensation and associative tactile sensation [6].Direct tactile sensation refers to the tactile experience formed by passengers directly contacting interior materials, including the elasticity of the materials, the surface texture of the materials, and the tactile sensation of the materials. Associative tactile sensation is the process in which information captured through visual perception evokes similar memories or associations in the brain, extracts and processes the information, and obtains a deeper level of experience. People feel cold when they see steel, warm and delicate when they see wooden materials, and soft when they see textiles. Therefore, if steel is used at the handrails, some textiles can be added above. In terms of details such as pillars and suspension rings of the train, wooden materials can be used to enhance the warmth of its interior.

4.3 Auditory Experience

The auditory experience is also an important sensory experience in the passenger riding experience. By optimizing the selection of sound insulation materials and optimizing seat layout, the interference of external noise can be reduced, allowing passengers to enjoy a more peaceful taking experience during driving. In addition, soft background music or natural sound elements can be appropriately integrated, which can not only soothe passengers' mood but also create a relaxed and pleasant riding atmosphere to enhance their riding experience. When playing background sound, attention should be paid to the loudness of the played sound. The values of sound loudness exist in the comfort zone and tolerance zone, as shown in Figure 4, which is the comfort zone and tolerance zone for human ear perception of sound loudness [7]. The sound loudness inside the train should be controlled within the comfort zone.

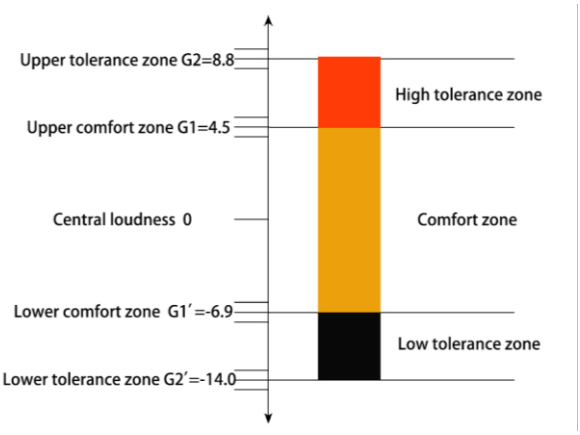

Fig. 4. Comfort zone and tolerance zone of human ear perception of sound loudness

5 Summary

This article provides an in-depth summary and overview of the development of straddle monorail interiors. From the perspective of sensory user experience, targeted optimization suggestions are put forward for the existing monorail interior. As a unique means of transportation, the interior design of the straddle monorail has great potential and room for development. Interior design should not only be limited to technical and aesthetic considerations, but should also focus on the physical needs and psychological expectations of visitors. As a designer of monorail vehicles, to avoid falling into the trap of blindly pursuing technological innovation and ignoring the actual needs of passengers, the ultimate goal of interior design is to provide passengers with a high-quality riding experience, not just to display technology. Therefore, while integrating new technologies, it is necessary to ensure that these technologies can truly bring convenience and comfort to passengers, and avoid the opposite and bring passengers a bad riding experience.

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