





Construction of a Virtual Reality Service Platform for Product Brand Design

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Abstract. The visual recognition system utilizes a complete and systematic visual communication system to shape a unique corporate image and create a corporate brand. With the rapid development of the global cultural and creative industry, innovative brand visual recognition systems are particularly important for the emerging cultural and creative parks. VR (Virtual Reality) technology, as the ultimate application form of multimedia technology, with its unique immersive experience advantages, has evolved from a single visual form to digitalization and dynamism. It is an effective means of digital design for brand visual recognition systems, creating personalized memory points, and promoting wider and effective dissemination of park brands. This article studies the role and methods of virtual reality art in the process of brand image shaping, and proposes the concept of using virtual reality art to carry out brand image dissemination. We identified the opinion leaders in the virtual brand community, and then used the post content of the opinion leaders as the source of demand acquisition. Finally, we constructed a virtual reality service platform for product brand design, and verified and analyzed the platform's user experience and usage efficiency.

Keywords: Product Brand Design; Virtual Reality; Service Platform

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1 INTRODUCTION

Brand image is the individual characteristics of a brand in the market and the public's mind, reflecting the public's understanding and evaluation of the brand, and reflecting the quality and strength of the brand. Currently, enterprises are increasingly valuing their own brand design and image building. A good brand visual recognition system plays a crucial role in the sales of the industry and the brand communication of the enterprise. Bruzzone et al. [1] conducted testing and optimization of virtual reality scenes and interactive functions to ensure a good user experience on different hardware and platforms. Virtual reality (VR) technology has a wide range of applications

in product brand design. It can provide a rich visual and tactile experience, enhancing the brand's attractiveness and visibility. Virtual reality technology (VR) has developed rapidly in recent years with the development of society. VR hardware devices have gradually become civilian, and the practical application of mobile VR is becoming more frequent and mature. It is precisely because of the rapid development of computer hardware that more people are exposed to VR technology. The gradual maturity of timing and technology has promoted the better integration and application of VR technology in the display of scientific and technological achievements. The obstacle faced by small and medium-sized enterprises in the face of competition is their ability to design brands and provide good packaging. Fahrunnisa and Verawati [2] guided the plan to achieve its goals, particularly in terms of sustainability after improving product quality. The physical packaging obtained through this plan has the characteristic of improving product quality.

Under traditional conditions, the visual communication design of product brands usually uses text and graphics within the plane to convey information. Nowadays, in the context of the rapid development of digital new media technology, visual communication design also needs to improve its dissemination and catch people's attention through more innovative ways. Feng [3] clarified the positioning of digital multimedia brands, including target audiences, core values, competitive advantages, etc. This helps to establish a brand image and stand out in the market. Designed a unique brand image, including logos, logos, visual elements, etc. These elements should align with the brand positioning and be able to attract the attention of the target audience. Istrefi et al. [4] conducted a digital analysis of mobile applications for brand promotion using CAD assisted marketing. It evaluated the impact of digital marketing (DM) and digital transformation (DT) technologies on the brand promotion and positioning process of Kosovo enterprises. At the same time, for the rapid development of brand digitization promotion process, the moderating effect is used to test whether the scale of company brand influence is related to the use of DM and DT. The survey results of Kim and Heo [5] indicate that the shaping and enhancement of digital multimedia brand visual image requires comprehensive consideration of brand positioning. Only by fully considering and implementing these aspects can a successful digital multimedia brand be created. In addition to 3D technology, visual communication design also incorporates elements of time, and thus develops from 3D to 4D, expanding the concepts of space and time at a higher level. More and more graphic and textual designs that were once flat have been integrated into dynamic design, transforming the original 2D into 3D or even more. At the same time as the initial focus on dynamism in design, visual communication design has gradually adopted dynamic expression techniques in interactive interfaces, such as presenting more wind, waves, and other natural motion patterns and sounds in the interface, or reflecting more "human" elements, by endowing the interface with dynamic interaction effects to bring users a more intimate and realistic feeling and experience.

Based on this background, this article extracts demand features based on user comment data, and then uses the user's emotional inclination and emotional level to calculate demand satisfaction. Finally, combined with the Kano model, the demand satisfaction results are classified, achieving the transformation from qualitative text information to quantitative data information, which to some extent enriches the quantitative analysis method model of demand mining. The full text is mainly divided into 5 chapters. Chapter 1 mainly introduces the object-oriented brand design requirements and the arrangement of paper chapters; Chapter 2 introduces virtual reality and product brand design, and explores the relationship between the two; Chapter 3 mainly proposes the identification of opinion leaders in virtual brand communities and conducts demand mining; Chapter 4 mainly designed a virtual service platform for product brand design, and conducted experimental verification on the platform's usage and efficiency. Chapter 5 mainly summarizes the work of the entire article and provides ideas for the next steps of work.

2 STATE OF THE ART

2.1 Product Brand Design

Product brand design is composed of two parts: basic element design and application element design. The basic elements are the foundation, and the application elements are developed and extended under the guidance of the basic elements. The design system of the basic elements is rigorous and rigorous, and the design of the application elements is rich and colorful. It is a stage for designers to play and express themselves, and often designers are more enthusiastic about application design. Kwon et al. [6] through advertising and promotion, brands and businesses can make their products and services more accessible to consumers. This can increase consumers' awareness and interest in the brand, thereby increasing their willingness to purchase and participation. Consumers can learn about the discounts and discounts offered by new products and services through advertising and promotions, and decide whether to purchase or use these products or services based on this. The second type is elements that cannot be visually seen, such as its brand story, moral, etc. These two elements are integrated into the design of the brand's visual recognition system. CAD immersive technology refers to the use of virtual reality technology by Lorusso et al. [7] to bring users into a three-dimensional virtual environment created by computer-aided design (CAD) software, allowing users to more intuitively experience and manipulate design objects, thereby improving design efficiency and quality. With the continuous development and popularization of CAD technology, immersive CAD technology has also experienced rapid growth and application. As a computer simulation system for creating and experiencing virtual worlds, 3D digital virtual reality technology uses computers as media to simulate real or imagined scenes. It is a system simulation based on diverse information fusion for interactive 3D dynamic vision and entity behavior. Li [8] explored a method of using virtual reality based visual art design for visual art design. Lara et al. [9] introduced a compromise bibliometric method to study brand personality, identify the theoretical basis and potential research topics in the field of marketing science. Compare research trends related to marketing science organizations with current analysis and discover new research topics. Further research should adopt and improve bibliometric methods and multiple correspondence analysis, despite their heterogeneity.

VI shapes a company's image through a standardized and unified visual image, which includes business philosophy and culture. In terms of marketing, the competitiveness of the 1950s and 1960s was mainly reflected in the price of goods; The competitiveness of the 1970s and 1980s was mainly reflected in the quality of goods; With the development of technology and social progress, the current competitiveness lies not only in price, quality, but also in industrial design. This so-called product competition is based on the VI design of the enterprise, or its extension. The impact on brand culture shaping is usually achieved through text, images, and colors, allowing more people to remember the brand. Therefore, we believe that the influence of VI in brand culture shaping can capture the audience's perspective, gain more love from the audience, and promote the brand's secondary sales after establishing a certain level of popularity.

2.2 Virtual Reality Technology

Virtual reality technology is a new comprehensive information technology that gradually emerged at the end of the 20th century. It is supported by high-tech technologies such as computer technology, AI technology, sensing technology, and simulation technology. With the help of glasses and tactile devices, the virtual reality world is simulated in 3D, providing users with an immersive and interactive experience. The survey results of Mahaputra and Saputra [10] indicate that brand development also needs to be based on product quality. Only by continuously improving product quality can we meet market and user needs, thereby gaining greater market share and development space. Parker and Saker [11] analyzed the process of art exhibition in the virtual reality state. The study drew inspiration from the development of art virtual digital space and conducted environmental analysis and exploration of virtual reality. It analyzes the various artistic purposes and effects of VR exhibitions in art design.

Qiao et al. [12] analyzed the importance of virtual brands and the impact of different electronic word-of-mouth. Users in virtual brand communities often have positive and positive reviews of the brand, and they are willing to share their positive reviews of the brand. This positive word-of-mouth will have a positive impact on other potential users, thereby promoting the enhancement of brand image and the formation of positive word-of-mouth. That is to say, in the same way as feeling the real world, people come to experience the virtual world generated by computers, thereby obtaining the same feeling as in the real world. Figure 1 shows the overall framework of a virtual reality service platform for automotive product design.

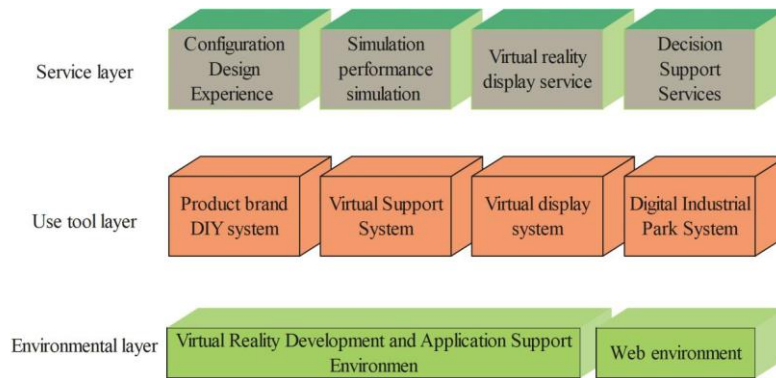


Figure 1: Overall functional structure of VR service platform.

The importance of VR technology in the field of visual communication design is mainly reflected in: Rahi et al. [13] investigated the effects of website design, customer service, and brand image on customers' willingness to adopt online banking. The results of this study indicate that the motivation for Pakistan to adopt online banking is a series of specific factors (i.e. website design, electronic customer service, customer satisfaction, and brand image). Moreover, the multi-dimensional display of the work's life has shifted from static to dynamic, not only utilizing text and graphics, but also carrying sound. This is an opportunity for product brand design.

As an important component of virtual social networks, virtual brand communities not only have a positive and negative impact on brand word-of-mouth communication, but also have a certain impact on the dissemination of neutral word-of-mouth. Robertson et al. [14] explored the analysis of personalized differences between social media brands. Currently, with the continuous development of virtual reality technology as the ultimate application form of multimedia technology, there are various differences between brand social media. It studied the brand personality differences between high ranked and low ranked brands, as well as between high rated and low rated brands, based on online written reviews. Rajaobelina et al. [15] strengthened the attention and management of virtual brand communities for brands, actively taking measures to address the spread of negative word-of-mouth, in order to protect their own brand image and reputation. Retail services can increase the consumer value of products. The value of a product not only includes the material costs of the product itself, but also includes the benefits and satisfaction brought by its use. Sagasti et al. [16] explored the correlation between virtual reality and the techniques of artistic painting. By searching for a CAD based virtual reality painting experience for visual creativity in virtual reality space simulation. After exploration, it has determined the expansion direction between the expression of painting art and virtual reality. Wong et al. [17] believe that there is a mutual influence and promotion relationship between product consumption value and retail service efficiency. Only by providing high-quality retail services can we increase the consumer value of products, improve the efficiency of the retail industry, and achieve commercial success. Zhao et al. [18] believe that there are multiple factors that affect customers' willingness to participate in the value co creation of virtual brand communities. Including individual

factors, environmental factors, brand factors, and perceived value factors. Brands need to comprehensively consider these factors and take corresponding measures to enhance customer engagement and loyalty.

3 METHODOLOGY

In the design process of product brands, it is necessary to understand the effectiveness of product brand image in the dissemination process, and use virtual reality technology to create a multi-functional virtual brand community that integrates social, experiential, and service. The emergence of virtual brand communities has become an important channel for enterprises to obtain user needs. Users can express their product experience and put forward new expectations on the community platform, and enterprises can also obtain user needs and the degree of satisfaction of existing needs from the feedback information left by users, and carry out a new round of targeted product research and development and improvement, provide guidance for enterprises to improve product brands from the perspective of user demand mining.

3.1 User Needs of Virtual Brand Communities

The progress of information technology and the rapid development of the economy have driven the improvement of people's consumption levels. More and more consumers are paying attention to brands and have developed a certain degree of brand dependence. The emergence of brand awareness has led to the emergence of brand communities, and the participation and interaction of consumers in the brand community has to some extent enhanced brand awareness. The arrival of the Internet era has made consumers and users occupy an increasingly important position in the actual production and sales activities of enterprises. Due to the encouragement of enterprises and the active participation of users, more and more users are participating. In this situation, the position of opinion leaders gradually emerged and attracted a large number of researchers to conduct research on opinion leaders.

As shown in Figure 2, Maslow's hierarchy of needs divides people's needs from high to low into five kinds: self-realization needs, respect needs, love and belonging needs, security needs and physiological needs. This article is based on Maslow's hierarchy of needs theory, which suggests that users' needs are also hierarchical. Therefore, it is necessary to classify users into hierarchical categories in order to develop different satisfaction plans based on different levels of user needs, in order to achieve maximum utilization of resources.

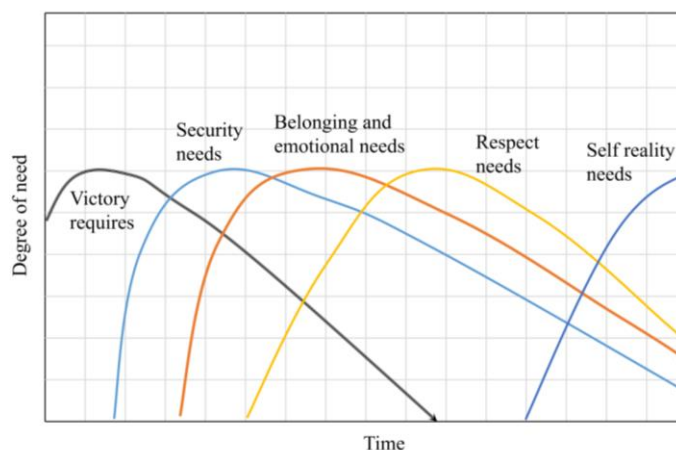


Figure 2: Schematic diagram of hierarchy theory required.

3.2 Virtual Brand Community Opinion Leader Identification and Needs Mining Model Construction

Obtaining requirements from feedback information and reverse acting on the source of product development and improvement can provide guidance for enterprises to carry out targeted product development and improvement. This chapter proposes to use the posting information of representative users - opinion leaders in virtual brand communities for rapid demand mining, and uses various theories and methods to construct a virtual brand community opinion leader identification and demand mining model. The model construction in this article mainly includes two parts: one is the construction of an opinion leader identification model, and the other is the construction of a requirements mining model. The overall idea of building a specific model is shown in Figure 3.

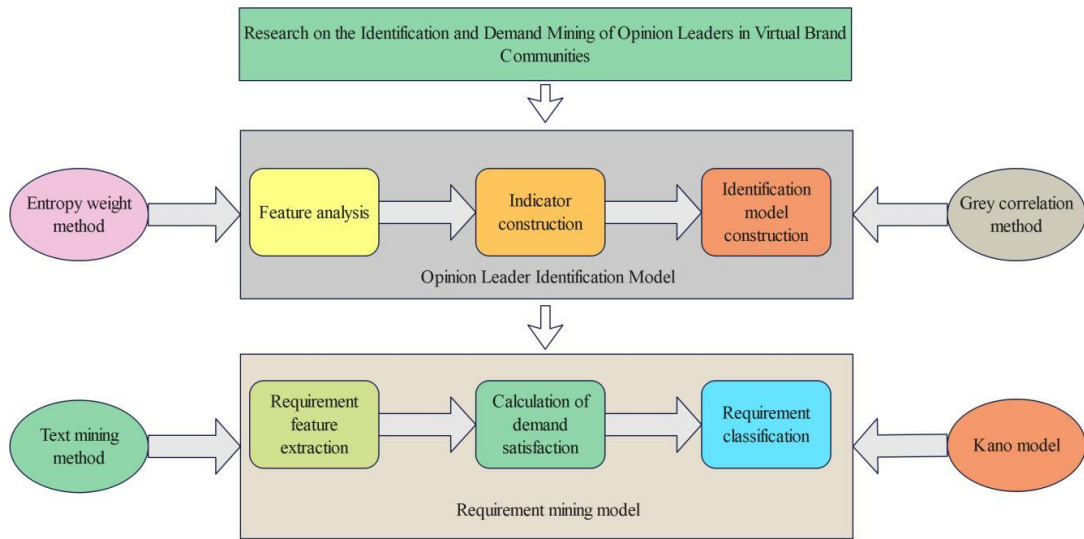


Figure 3: Schematic diagram of hierarchy theory required.

The opinion leader recognition method constructed in this article includes two levels of indicators, where each level of indicator is calculated from multiple attribute features. Among the different attribute features of users, the value represented by each attribute feature is different. Therefore, it is necessary to assign individual weights to each attribute feature to reflect the importance of different attribute features in influencing opinion leaders. This article mainly uses the entropy weight method to determine the weights of different attribute features of users. Assuming there are a total of M evaluated objects, with a total of N evaluation indicators for each evaluated object, the indicator dataset can be represented by a matrix L :

$$L = \begin{bmatrix} l_{11} & l_{12} & \cdots & l_{1N} \\ l_{21} & l_{22} & \cdots & l_{2N} \\ \cdots & \cdots & \cdots & \cdots \\ l_{M1} & l_{M2} & \cdots & l_{MN} \end{bmatrix} \quad (1)$$

Due to the different meanings of evaluation indicators and possible differences between dimensions, it is necessary to first determine whether the data needs to undergo dimensionless standardization based on the dimensional differences in matrix L .

$$l'_{mn} = \frac{l_{mn} - \min l_{mn}}{\max l_{mn} - \min l_{mn}} \quad (2)$$

$$L' = \begin{bmatrix} l'_{11} & l'_{12} & \cdots & l'_{1N} \\ l'_{21} & l'_{22} & \cdots & l'_{2N} \\ \cdots & \cdots & \cdots & \cdots \\ l'_{M1} & l'_{M2} & \cdots & l'_{MN} \end{bmatrix} \quad (3)$$

Secondly, calculate the proportion of indicator values for each evaluated entity under each indicator, as shown in the equation below:

$$P_{mn} = \frac{l'_{mn}}{\sum_{m=1}^M l'_{mn}} \quad (4)$$

Then use equations (5) and (6) to calculate the entropy value H of the nth indicator:

$$p = \frac{1}{\ln(M)} \quad (5)$$

$$H_n = -p \sum_{m=1}^M \ln(p_{mn}) \quad (6)$$

Where, p represents the index information entropy coefficient, and p is often taken as the inverse of the logarithm of the number of all evaluation subjects. Finally, use equation (7) to calculate the entropy weight of the nth indicator.

$$\omega(n) = \frac{1 - H_n}{N - \sum_{n=1}^N H_n} \quad (7)$$

The weight satisfaction formula of n indicators:

$$\sum_{n=1}^N \omega(n) = 1 \quad (8)$$

Weight can to some extent reflect the usefulness and competitive strength of various indicators in calculating evaluation results. The entropy weight method uses the original dataset to calculate the weights of various indicators, effectively suppressing the interference of subjective factors in the subjective weighting method.

The essence of grey correlation analysis is to compare the degree of similarity between the two by drawing curves and graphs of comparison and reference sequences, and to determine the degree of correlation between the two. The specific calculation method is as follows:

The first step is to determine the reference sequence X0 and the comparison sequence Xi. Set the original data set to X as shown in equation (9)

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad (9)$$

The second step is to perform dimensionless standardization on the original dataset. If there are significant dimensional differences between various indicators in the original dataset, normalization processing is required:

$$x'_{ij} = \frac{x_{ij} - \min x_{ij}}{\max x_{ij} - \min x_{ij}} \quad (10)$$

$$X' = \begin{bmatrix} x'_{11} & x'_{12} & \cdots & x'_{1n} \\ x'_{21} & x'_{22} & \cdots & x'_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ x'_{m1} & x'_{m2} & \cdots & x'_{mn} \end{bmatrix} \quad (11)$$

The second step is to perform dimensionless standardization on the original dataset. If there are significant dimensional differences between various indicators in the original dataset, normalization processing is required.

$$\varphi = |x_{0j} - x'_{ij}| = \begin{bmatrix} |x_{01} - x'_{11}| & |x_{02} - x'_{12}| & \cdots & |x_{0n} - x'_{1n}| \\ |x_{01} - x'_{21}| & |x_{02} - x'_{22}| & \cdots & |x_{0n} - x'_{2n}| \\ \cdots & \cdots & \cdots & \cdots \\ |x_{01} - x'_{m1}| & |x_{02} - x'_{m2}| & \cdots & |x_{0j} - x'_{mn}| \end{bmatrix} \quad (12)$$

The fourth step is to calculate the grey correlation coefficient, as shown in equation (13).

$$\xi_{ij} = \frac{\min \min \varphi + \rho \max \max \varphi}{\varphi + \rho \max \max \varphi} \quad (13)$$

Step 5: Calculate the weighted grey correlation degree of each indicator. Due to the fact that the grey correlation coefficient cannot accurately represent the similarity between various comparison sequences and reference sequences, it is necessary to use grey correlation degree to concentrate the scattered grey correlation coefficients onto a single value.

$$\gamma_i = \sum_{j=1}^n \omega_j \times \xi_{ij} \quad (14)$$

$$\sum_{j=1}^n \omega_j = 1 \quad (15)$$

The weight value can be subjectively set by humans, or determined through methods such as entropy weight, coefficient of variation, factor analysis, analytic hierarchy process, expert scoring, etc.

In virtual brand communities, a large amount of user comment information is generated every day, which includes feedback and suggestions from users on certain functional attributes of brand products, reflecting the most practical needs of users, and is an important source of intelligence for enterprises. By mining user comment information in virtual brand communities, enterprises can quickly obtain the practical needs of users, thereby determining the direction of improvement in new product development and brand building. This is also the original intention of establishing brand communities for enterprises.

4 RESULT ANALYSIS AND DISCUSSION

4.1 Data Collection and Preprocessing

This chapter mainly selects 10% of users with higher influence as opinion leaders based on the list of user influence obtained from the previous section, and takes the content of their posts as the research object of user demand mining in this chapter. Due to the large number and uneven quality of user comments in virtual brand communities, it may affect the subsequent deviation of

user demand mining results. Therefore, further processing of user posted comment data is still needed to reduce noise and ensure the value of comment data.

4.2 Experimental Data and Analysis

First of all, because of the advantages of virtual reality technology, researchers can create different scenarios to import products into the virtual reality scene interaction design research, and analyze whether users' interaction behaviors on the same product are different in different scenarios. Through a survey of user experience in scenarios, 43.84% and 26.03% of users respectively believe that different virtual scenarios have a significant or certain impact on user behavior when using the product. At the same time, about 13.7% of users believe that the impact is significant, while only 16.4% of users believe that the impact is minimal or almost non-existent. Based on this set of data, it can be concluded that product usage scenarios have a significant impact on human-machine interaction between users and the product, It includes a variety of physical and psychological influences, so designers should fully consider product use scenarios and use scenarios when designing product interaction behavior, and explore different processes of interaction design for different scenarios. Figure 4 shows the impact of different virtual scenarios on user usage of the product.

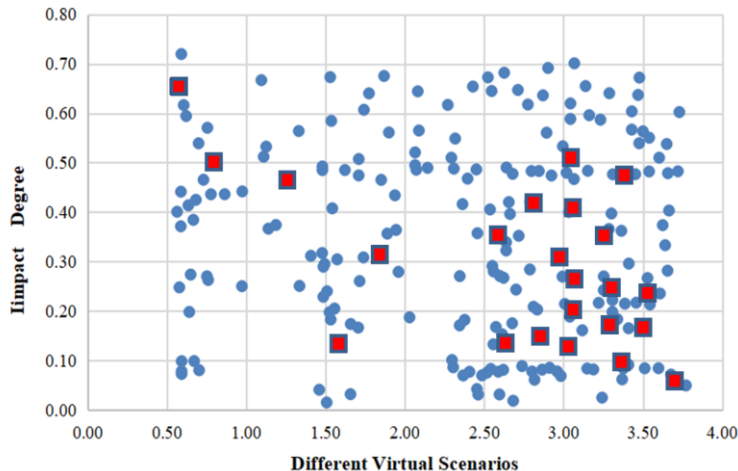


Figure 4: Impact of different virtual scenarios on user usage of products.

After the user experience analysis, the research methods are summarized. Through the survey of users' views on the interactive experience of virtual reality scenes, it is found that 56.17% of users believe that the interaction design method in virtual scenes has a positive impact on improving users' interactive experience, 23.29% of users hold a neutral attitude that has a certain impact, and the rest 20.55% of users think that the impact is very small. Figure 5 shows the impact of interaction design methods on improving user experience in a virtual scene.

4.3 Platform Response Time Testing

For cloud service platforms, the first thing that each user comes into contact with is the platform's login page, so the platform's access speed is the first concern for users. Therefore, to verify the advantages of the three platforms, a comparative test was conducted on the speed of user access to the system under single machine and cluster conditions. This experiment consisted of three computers forming a cluster, while the single machine server consisted of one computer. Using JMeter to test the response speed of the platform, simulate 100 users using JMeter. Each user

visits the system every 1 minute, and 100 users are divided into 5 visits each time. The average value is taken, and the comparison results are shown in Figure 6.

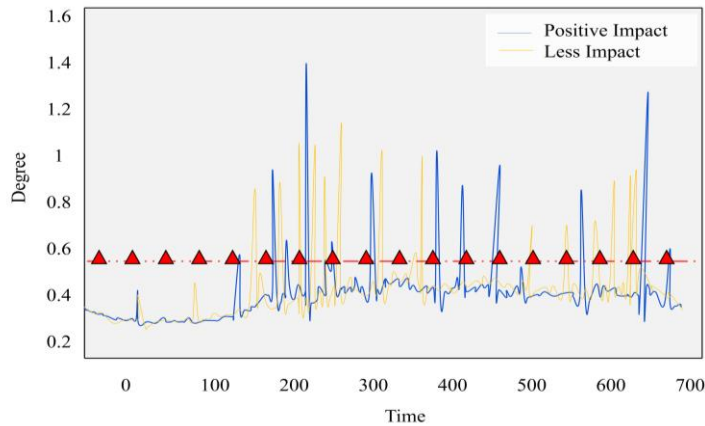


Figure 5: Impact of interaction design method in virtual scene on improving user experience.

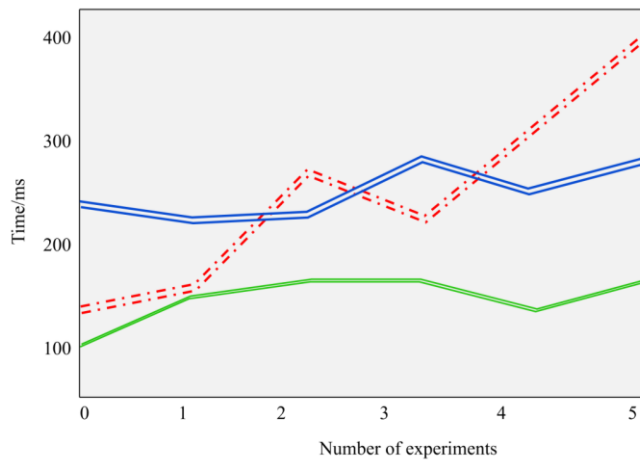


Figure 6: Comparison of platform response time test results.

In Figure 6, the thin solid line represents the platform of this design; The thick solid line represents a laboratory security access platform based on virtual simulation technology; The dashed line represents a cloud service platform based on the Internet of Things. From Figure 6, it can be seen that cloud service platforms based on the Internet of Things require a longer access time to access the homepage of the matching website after 100 concurrent users. Obviously, such access speed is difficult for users to accept; The response time of the laboratory security access platform based on virtual simulation technology is relatively stable, but the overall response time is longer, which is more than the method designed this time. It can be seen that the platform designed this time has superior response performance during the login process.

To verify the superiority of the three methods in storing massive data files, the upload speed was tested. This experiment tested files of different sizes. In order to obtain more accurate results,

after multiple experiments, the average value was taken for comparison. The comparison results are shown in Figure 7.

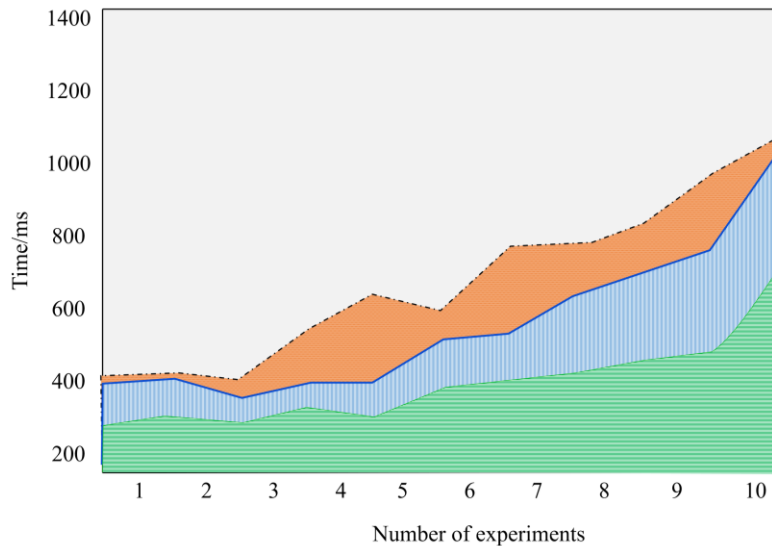


Figure 7: Comparison of platform file upload speed.

As shown in Figure 7, when the file size is small, all three platforms have faster upload speeds and are able to leverage their own platform advantages. As the file size increases, the performance advantage of the designed method significantly increases. Taking writing a 10 GB file as an example for analysis, this method takes about 600 seconds. When the file size ranges from 5 to 10 GB, the time spent by this method does not significantly increase; However, traditional cloud service platforms based on the Internet of Things and laboratory security access platforms based on virtual simulation technology have a significant increase in file upload time as the number of files increases, resulting in a significant difference in file upload speed compared to when there are fewer files.

5 CONCLUSION

The application of digital technologies such as VR in the digital design of visual recognition systems has become a trend. The deep cooperation between new media technology and product brand design and experience is unstoppable, and new media technology is gradually replacing traditional media as the main carrier of brand voice. By combining the advantages and characteristics of new media technology and establishing interactive relationships with a broad audience, the brand experience and dissemination can be maximized, and the brand personality can be fully displayed and deeply rooted in people's hearts. Building a virtual reality service platform for product brand design can not only provide convenience for practitioners in professional fields, but also create an immersive experience for the public, allowing them to actively participate in brand communication and improve their aesthetic ability, brand recognition ability, and brand cohesion. In the future, in the process of visual communication design and brand experience development, the characteristics and advantages of new media technology can be appropriately combined to develop brand experience and communication strategies, and create a unique path for brand development.

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