Research on Smart Shopping Cart Modeling Design Based on Kansei Engineering

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Abstract. With the continuous development of intelligent technologies such as the Internet of Things, traditional supermarkets are also constantly exploring new ways of retailing. The smart shopping cart is a corresponding innovation. Through market and literature research, it is found that the existing design research of smart shopping cart focuses too much on the integration and implementation of technology, without fully considering the aesthetic and emotional needs of users for modeling. In this paper, the modeling design of the smart shopping cart is mainly based on the design method of Kansei Engineering. Firstly, the design positioning of the smart shopping cart is determined, that is, consumers aged 18–35 in large supermarkets are taken as the target users. Secondly, related product databases and perceptual vocabulary databases were established. After screening 40 groups of perceptual vocabulary by KJ method, 6 groups of vocabulary were obtained. Then the SD method is used to conduct a questionnaire survey on users. Finally, by drawing the intention scale map and analyzing the data, the three design elements of "simple and simple", "light and large capacity" and "friendly streamline" were summarized. Combined with the functional requirements and ergonomics, the shape design was carried out. Finally, the design practice was recognized by design experts and the public through the survey of satisfaction. This study is an effective practice and exploration of Kansei Engineering design methods, providing new design ideas for the development of the smart shopping cart industry, and further improving the competitiveness and user experience of supermarkets.

Keywords: Kansei Engineering · Smart shopping cart · Modeling design · Semantic scaling method

1 The Introduction

With the rapid development of Internet technology and mobile Internet terminals, people are more and more inclined to consume online shopping APP. Although the e-commerce market has tended to be saturated, it still poses a huge threat to offline supermarkets and other retail industries. In addition to the impact of the COVID-19, supermarkets urgently need to find countermeasures to improve profitability. Smart shopping cart is the medium between the supermarket and the customers. It is a service platform based on consumption data, user trajectory and geographical location that can set up the supermarket scene. Self-service can reduce the cost of enterprises to a certain extent, and send the data to the

background for processing, making the results more accurate and faster [1, 2]. Therefore, the innovative design of smart shopping cart will improve the shopping experience of users and promote the economic benefits of offline physical supermarkets, which has a certain design significance. Through the research of market research literature, it is found that the existing smart shopping cart pays more attention to the integration of emerging technologies to improve the intelligent experience, but ignores the users' personalized needs for product modeling. Therefore, this study adopts the semantic difference method to collect users' semantic preferences, conducts data analysis through the intention scale method and extracts design elements, thus concluding the innovative design scheme of the smart shopping cart, which is conducive to further promoting the development of the real economy of supermarkets.

2   Kansei Engineering and Smart Shopping Cart Modeling Design

2.1   Kansei Engineering

Kansei Engineering, originally known as "emotional engineering", is an emerging discipline that combines ergonomics, humanized design concepts and emotional design concepts [3]. Traditional ergonomics focuses on the interaction of product size and function, whether it meets the user's man-machine size and usage habits, etc., and more belongs to the research on physical characteristics. Kansei Engineering, on the other hand, pays more attention to the emotional experience of products on consumers' psychology and more to the study of spiritual experience. Researchers describe the image of products through the combination of adjectives, and consumers make choices according to their own emotional preferences, so that the unquantifiable and irrational emotional demands can finally be studied and discussed through data analysis [4]. Designers can make a comprehensive analysis from the dimensions of color, texture, shape and so on, so as to provide guidance for product shape design.
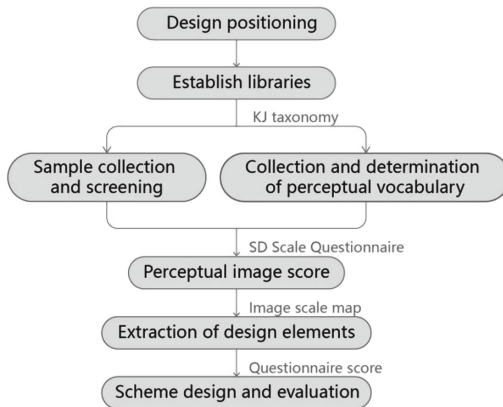
2.2   Smart Shopping Cart

However, smart shopping cart products still belong to the blue ocean market, and the design of this market is rarely implemented. The outstanding products at home and abroad mainly include "Eli" from South Korea and 7Fresh from Jingdong. Most of them use cameras, infrared sensing technology and advanced obstacle avoidance system, which can take corresponding measures immediately in case of emergency. When the customer no longer needs it, the cart can be automatically returned to the charging point for the next customer to use; Customers can use credit cards or other mobile payment terminals to check out; The shopping cart determines whether the items in the cart have been fully paid for by comparing the total weight of the items in the cart to the weight of the items actually paid for. Smart shopping cart design features not only intelligent shopping experience, but also needs to fully consider the fashion attributes. The appearance of the domestic supermarket shopping cart the same already unable to meet the demand of consumers personalized trend, therefore using the method of perceptual technology to explore the perceptual demand of consumer groups to the

shopping cart, will contribute to the innovation of the smart shopping cart design, but in the intelligent design also need to balance the sense of scale and the reasonable rendering function.

2.3   Research Process and Method

The value of a product can be divided into material value and spiritual value. When a product satisfies the material function value such as function, structure and operation mode, it should also enable users to obtain internal satisfaction and well-being such as culture, emotion, happiness and happiness in the process of use, and deliver positive use experience and emotions to consumers [5]. Quantitative analysis of perceptual preferences through SD questionnaire helps designers intuitively explore users' preferences, so as to introduce emotional elements into the design and enable users to have a positive emotional experience when using the product [6]. In this paper, the method of Kansei Engineering is introduced into the design of smart shopping cart. The following is the specific research route, as shown in Fig. 1.

Fig. 1.   Research steps of smart shopping cart of Kansei Engineering

The research procedure is divided into six steps. Step 1: The design and positioning of smart shopping cart. Step 2: Build libraries, including product libraries and semantic libraries. Collect the existing smart shopping cart on the market and select more beautiful and fashionable product pictures through KJ classification method, so as to improve the accuracy of subsequent design element extraction. Use brainstorming to build a vocabulary of anti-sense words. Step 3: SD questionnaire survey was used to score perceptual intention. After determining the attributes of the products, words were placed on the left and right ends of the scale, scores were divided into five to nine levels, and appropriate products were selected to form a questionnaire. Step 4: Design elements extraction. Data software is used to quantitatively analyze the results of the above questionnaire, obtain the weight of perceptual words and extract the design elements, so as to guide the design of subsequent programs. Step 5: Plan design and evaluation. Combined with

ergonomics and design elements to design the shape. Finally, a questionnaire survey on program satisfaction was conducted. A good score indicated that the program was of high usability.

3 Research on Perceptual Intention of Smart Shopping Cart Shape Design

3.1 Sample Collection and Screening

A total of 15 pictures of the smart shopping cart were collected through various channels. The pictures were screened according to the appearance features of the products, such as color, shape and material, and the products with similar properties were classified. Finally, five representative pictures were selected, as shown in Fig. 2.

Sample 1　　　　Sample 2　　　　Sample 3

Sample 4　　　　Sample 5

Fig. 2. Research steps of smart shopping cart of Kansei Engineering

3.2 Perceptual Intention Vocabulary Collection

In this paper, a total of nearly 40 pairs of antisense words were collected. After multi-layer screening by designers, the following six pairs of words were finally determined, as shown in Table 1. "Contracted – complex" reflect the characteristics of the product form, "affinity – cool" reflect product to the user's emotional colors, "light, heavy" consider the tolerance of users using psychological, "large capacity, small capacity" reflect the user demand for function, "- a rough texture" measure of texture and color characteristics of products, "streamline – hale" reflect product design language of refining.

Table 1. Determination of perceptual words

The serial number	The perceptual words	The serial number	The perceptual words
1	Minimalist – complex	4	High capacity – low capacity
2	Friendly – cool	5	Textured – rough
3	Light – heavy	6	Streamlined – tough

3.3   Research and Analysis of Smart Shopping Cart Based on SD Method

Each sample image corresponds to six groups of perceptual word pairs. A seven-level scale with scores of $-3, -2, -1, 0, 1$ and 3 is set to form a complete survey questionnaire. Users will rate the product pictures in turn according to their true feelings. The closer the choice is to the word, the more obvious this feature is.

A total of 125 questionnaires were sent out and 121 valid questionnaires were received, among which 31 were young designers with design background. The mean values of the 6 antonym pairs corresponding to the 5 samples are listed, as shown in Table 2.

Table 2. Average score of perceptual words

	Contracted	Friendly	Portable	High capacity	Textured	Streamlined
Sample1	−0.33	−0.14	1.1	0.05	−1.14	−1.29
Sample2	−0.48	−0.67	0.1	0.29	−0.76	−0.67
Sample3	−1.14	−0.71	−1.05	−1.52	0.95	1.1
Sample4	0.33	−0.95	0.52	−0.29	−1.24	−1.62
Sample5	−1.76	−0.71	−1.38	−2	−0.05	1.29

4   Smart Shopping Cart Modeling Design Practice

4.1   Design Elements Extraction Based on Perceptual Image Research

According to the mean value of perceptual words in Table 2, a quadrant graph is drawn. Put "minimalist – complex" at both ends of the X axis and "streamline – tough" at both ends of the Y axis. $(-0.33, -1.29)$ represents the mean value of minimalist and streamline corresponding to sample 1. Similarly, the remaining four adjectives are labeled in the quadrant using this method. Black circles represent "simple – complex" and "streamlined – tough", pink circles represent "textural – rough" and "intimate – cool", and green circles represent "light – bulky" and "large – small", as shown in Fig. 3.

According to Fig. 3, it can be concluded that the third quadrant has the highest sample mean ratio. Therefore, the priority of the design elements of the smart shopping cart is as follows: the first is simple and streamlined; the second is textured and friendly material; the third is portable and large-capacity.
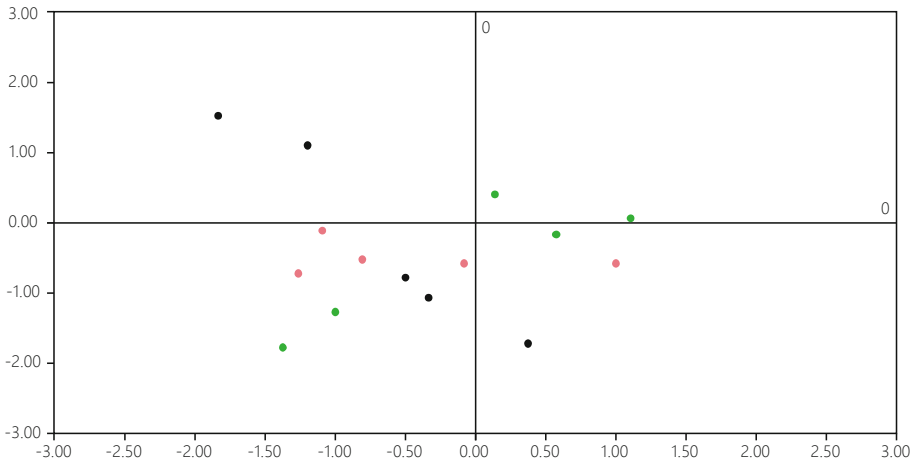
Fig. 3. Intention scale chart

4.2   Scheme Design and Evaluation

According to the perceptual intention screened out in Fig. 4 and the corresponding sample pictures, the reference of design elements is extracted and the final innovative design practice is carried out, including sketch design, three-dimensional modeling and intelligent terminal design, etc.

Streamlined side brackets serve as the main body of the smart shopping cart, including an intelligent terminal and a code scanning port. Intelligent terminal for the 9.7 in. screen size, tilted 45°, is suitable for people look down at reading, considering the stability of the element, directly to the screen fixed on the bracket, no longer can adjust any Angle, and code directly on the right side, customer finish cleaning a commodity, can immediately swept to the information on the screen, in line with people's behavior habits. The bracket connecting plate is engraved with the brand logo, which connects the letter "T" with the straight line, making the whole harmonious and smooth. The hole basket that uses crisscrosive among, break depressing feeling, but also with before stainless steel bar type shopping cart basket differs somewhat, appear more light and fashionable. The wheels are universal wheels, which can rotate freely in 360°. No longer the previous shopping wheel, this design is more plump shape, especially the base and the wheel connected part, increased the stability layer, considering the use of different materials and colors, so that the chromatography is more clear, more stable.

The selection of the right materials can increase the attractiveness of the product and enhance the user's interactive experience with the shopping cart. Different materials, due to their different colors and textures, will give people different visual feelings, tactile feelings and psychological feelings.

Through the research and summary of the current supermarket shopping cart, most of the shopping cart are made of stainless steel, although stainless steel material corrosion resistance, formability is very excellent, but too much stainless steel material will cause a cold hard visual psychology. Therefore, change to ABS plastic material, not only the physical and chemical properties are stable, but also in the sense of more warm

and friendly. Handlebars are made of rubber and plastic with the effect of imitation aluminum wire drawing, reducing the discomfort of pushing and pulling, reflecting the people-oriented design concept and strengthening the user's tactile feeling. The bottom frame and bearing pipe are made of stainless steel, which are wear-resistant and strong. The following is the display effect of the specific innovative design, as shown in Fig. 4.

Fig. 4. Smart shopping cart design display

Finally combining the particle scale to satisfaction survey design, seven points represent very satisfied, 6 points represent relatively satisfied, five points represent satisfaction, four points on behalf of the state of compromise, three representative are not satisfied, two points represent more dissatisfied, 1 points represent very dissatisfied, said the average user satisfaction of design scheme evaluation [7]. Eighty-six questionnaires were sent out and 80 were received. The assessors ranged in age from 18 to 35. According to the data, the final satisfaction is estimated to be 5.88 points, which indicates that the subjects are generally satisfied with the design scheme.

5   Conclusion

Research methods in this article, through the perceptual engineering, SD for younger users survey questionnaire, collecting and quantify the sensibility of smart shopping cart vocabulary, through further analysis it is concluded that target users, the perceptual

demand for smart shopping cart, finally established have qualitative feeling "contracted", "portable large capacity", "affinity streamline of the" three design elements. At the same time, users' functional needs and scene characteristics should also be taken into account, so as to meet users' expected emotional experience in appearance, and to be intelligent and convenient in operation, in line with consumers' usage habits and meet offline supermarket scenes. Finally combining the basic principles of ergonomics in the final smart shopping cart innovative design practice, also passes through the design experts and public recognition, this suggests that the design method based on perceptual technology, not only provides a new design idea for smart shopping cart direction, also for emotional intention of such products increased worthy of reference and the method.

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