Identification of Demand Type Differences and Their Impact on Consumer Behavior: A Case Study Based on Smart Wearable Product Design

Jialei Ye[1], Xiaoyou He[2], and Ziyang Liu[3*]
[1] Design Post-Doctoral Research Station, Nanjing University of the Arts, Nanjing, 210013, China
[e-mail: 532102483@qq.com]
[2] School of Industrial Design, Nanjing University of the Arts, Nanjing, 210013, China
[e-mail: b314666@nua.edu.cn]
[3] Kyonggi University, Suwon-si, Gyeonggi-do, 16227,South Korea
[e-mail:morninglzy@hotmail.com]
*Corresponding author: Ziyang Liu

Received November 28, 2023; revised March 18, 2024; accepted April 2, 2024; published April 30, 2024

Abstract

Thorough understanding of user demands and formulation of product development strategies are crucial in product design, and can effectively stimulate consumer behavior. Scientific categorization and classification of demands contribute to accurate design development, design efficiency, and success rates. In recent years, e-commerce has become important consumption platforms for smart wearable products. However, there are few studies on product design and development among those related to promoting platform product services and sales. Meanwhile, design strategies focusing on real consumer needs are scarce among smart wearable product design studies. Therefore, an empirical consumer demand analysis method is proposed and design development strategies are formulated based on a categorized interpretation of demands. Using representative smart bracelets from wearable smart products as a case, this paper classifies consumer demands with three methods: big data semantic analysis, KANO model analysis, and satisfaction analysis. The results reveal that analysis methods proposed herein can effectively classify consumer demands and confirm that differences in consumer demand categories have varying impacts on consumer behavior. On this basis, corresponding design strategies are proposed based on four categories of consumer demands, aiming to make product design the leading factor and promote consumer behavior on e-commerce platforms. This research further enriches demand research on smart wearable products on e-commerce platforms, and optimizes products from a design perspective, thereby promoting consumption. In future research, different data analysis methods will be tried to compare and analyze changes in consumer demands and influencing factors, thus improving research on impact factors of product design in e-commerce.

A preliminary version of this paper was presented at APIC-IST 2023, and was selected as an outstanding paper.

Keywords: Product design, consumer demand, consumer behavior, e-commerce, smart wearable products.

1. Introduction

In recent years, smart wearable products have seen significant growth in consumption among electronic and digital products. Being a class of mobile smart devices combining modern mobile smart technology and daily wearable products, they often integrate into consumers' daily life in the form of glasses, bracelets, wristwatches, gloves, shoes, accessories, and other products [1]. The mainstream functions of these products are carried out around sports guidance, medical rehabilitation, health monitoring, and other areas, aligning with the mainstream demands and trends of modern consumers [2]. In recent years, smart wearable products have taken the consumer world by storm, attracting strong interest from all age groups. This surge in demand has prompted various technology companies to integrate smart wearable products into their core businesses, ranking second only to smartphones and tablets. As an extension of the Internet of Things (IoT) technology, these products boast significant market potential and value [3]. With smart wearable products as the case, this research delves into consumer demands, intentions, and attitudes in e-commerce.

Product design is an oriented study in the art design discipline that focuses on industrial consumer goods and strives to enhance additional value of products through various means, such as product appearance modeling, service systems and procedures, and interaction methods [4]. Nowadays, the design process prioritizes consumers and is consumer demand-oriented. During the design process, efforts are made to reconcile any conflicts and issues arising throughout the life cycle of products, from design and manufacturing to disposal and recycling, fostering harmony between products and the environment [5]. Product manufacturers today pay close attention to the application of product design knowledge in product R&D and promotion. Well-designed products not only enhance product value but also attract consumers more effectively. The brand and product image created through design leave a lasting impression on consumers [6]. This research analyzes consumer demands from the perspective of product design and explores their relationship with consumer consumption attitudes.

Consumer behavior in e-commerce reveals consumers' psychological activities, including consumer demand, purchasing motivations, and consumption intentions in real behavior [7]. Well-designed products and services not only meet consumer demands but also provide a good user experience, acting as a powerful driver of e-commerce consumer behavior [8]. This paper analyzes from the demand perspective, and explores the logical connection between consumer demands for products and consumer behavior. Moreover, it leverages relevant design knowledge to make the products effectively meet demands, enhance product attractiveness and value, and stimulate consumer behavior.

This research utilizes TEXTOM, a big data semantic mining program, to identify consumer demands in e-commerce, and uses the KANO model to assess consumer demands and to rank

and categorize them [9,10]. The research leverages the big data semantic analysis tool TF-IDF to analyze and extract core vocabulary related to consumer demands [11]. Subsequently, a questionnaire based on the KANO model is designed and information is collected. With the help of the SPSS program, quadrant analysis is conducted to divide consumer demands into five dimensions, and product design strategies conducive to promoting consumer behavior are formulated according to the results [12].

The main contributions of this paper are as follows:

1. Combined application of data analysis techniques can effectively delve into consumer demands.
2. There are logical and sequential relationships between different consumer demands. Strategically considering these attributes during product design can enhance the relevance of design.
3. Product design centered on consumer demands can positively influence consumers' purchasing intentions in e-commerce.

Taking smart wearable products as the research object, this research interprets consumer demands in e-commerce from the perspective of product design, and formulates design strategies to promote consumer consumption.

2. Background and Methodology

2.1 Research Background

Accurate analysis of consumer demands is a necessary condition for driving consumer behavior in the market, and it is considered an important research area in design and related industries. Systematic analysis of consumer demands can effectively enhance the market competitiveness of products [13]. Many studies related to e-commerce aim to promote product distribution through scientific identification of demands, with most of the content focusing on operational models, distribution channels, and service systems. Although product R&D is generally involved, there is a lack of research specifically focused on demand identification and product design [14]. Levin, Y. analyzed the features of sustainable demand formation in the e-commerce market, identified weak links that constrain growth, and proposed methods for product sales promotion based on consumer behavior and formulation of regulatory frameworks. He proposed methods in product industry organization and strategic marketing through systematic modeling comparison of consumer demands [15]. Jain, A. proposed a method for demand forecasting from e-commerce product data and the establishment of a hierarchical structure of demand based on performance, scalability, execution time, accessibility, and convenience, and pointed out that the adoption of means such as product design, information design, and interaction design around demand hierarchies can enhance product distribution [16]. Nayyar, J.S. once highlighted the critical role of consumer demand satisfaction in driving industrial development from the perspective of e-commerce trends, and proposed measures to optimize service systems and improve demand satisfaction, including product design and development [17]. Product design can leverage comprehensive demand analysis to formulate product planning and development strategies, which typically involves the exploration of new demands and the proposal of solutions to meet demands. However, demand classification often relies on observed problems and subjective judgments from designers. Therefore, empirical classification studies grounded in real consumer demands have significant scientific value [18]. Wang, Y. pointed out that empirical classification research on consumer demands is a complex process, involving multi-dimensions, multi-hierarchy, and

correlation of demands, thus the selection of scientific research methods is particularly important [19]. Sun, F. regarded demand type classification as a primary reference indicator in product classification methods based on empirical research, and confirmed that demand analysis is an effective way to establish equal communication between consumers and designers [20]. Agouridas, V. emphasized that accurate market positioning and targeted product planning can be achieved through product demand analysis [21]. There is a close relationship between consumer demands and behavior. Consumers of smart wearable products progressively identify, evaluate, and purchase these products based on their needs [22]. Liu, W.M. pointed out that for smart wearable products, objectively understanding consumer demand types is beneficial for accurately grasping demands during product design, enabling users to achieve both psychological and physiological satisfaction [23]. Product design centered on demands can become a reliable means to enhance the added value of smart wearable products, boost consumer satisfaction, and promote market growth [24, 25].

Overall, product design can serve as an effective way to meet the consumer demands of e-commerce products. Scientific classification of demands helps establish accurate design schemes and drives consumption growth. However, previous research has not adequately emphasized the role of product design in e-commerce systems, while merely considering product design and development as a component of the system. This paper will conduct product design research based on empirical demand classification, and formulate corresponding design strategies according to the consumer demand types of e-commerce products.

2.2 Research Framework

This research takes smart bracelets among smart wearable products as a case study, and develops a research framework based on relevant literature, as shown in **Fig. 1** [26, 27, 28]. The research process is mainly divided into two stages: the first stage involves semantic analysis to acquire demand information, while the second stage uses KANO analysis to classify demands and finally summarizes applicable design strategies based on demand classification characteristics.

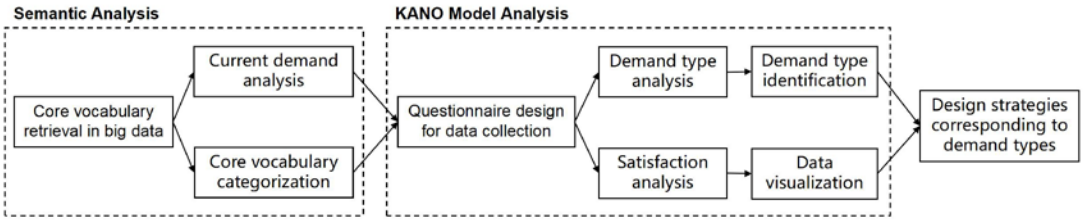

Fig. 1. Research Steps

2.3 TF-IDF

Semantic analysis is an effective method for extracting consumer demands. Consumer demands can be objectively reflected by summarizing users' evaluations, feedback, and recommendation information about the products [29]. The TF-IDF technology in semantic analysis can be an effective way to deeply understand core consumer demands in the context of e-commerce platforms [30]. TF-IDF is a weighted technique commonly used in information retrieval and data mining in the process of big data semantic analysis, where the values obtained can be used to evaluate the importance of words [31]. Wu, X.Y. used TF-IDF to extract customer demands during the product concept stage, and used it as a driving factor for

design [32]. Liu, Q.Y. used the TF-IDF algorithm to accurately recommend product keywords for different user portraits in e-commerce, enabling users to accurately obtain product information consistent with their demands [33].
Given the differences in focus within semantic analysis, there are many scientific methods available. In this paper, the TEXTOM big data mining platform is selected for analysis. By virtue of its advantages of obtaining results quickly and easily, it is often used by the design industry. The platform features a certain degree of social coverage in terms of its information sources, and can reflect the contact and communication data of the general public, making it a reliable survey tool [34]. It has been used as an effective survey method in research on product features, product styles, and service experiences [35, 36, 37].

2.4 KANO Model

The KANO model analysis is a structured questionnaire analysis approach developed by Noriaki Kano based on the segmentation of customer demands. This qualitative analysis approach is used to identify the acceptance level of functions by users, to help enterprises understand user demands at different levels, to find points of contact between customers and enterprises, and to clarify the important factors that satisfy customers [38]. Martin, B. considered the KANO model as one of the important universal design methods used for objective evaluation of products, which is recognized by the design industry [39]. Zhao, S. believed that the KANO model is a reliable method for transforming user demands into design basis [40]. Research by Neira-Rodado, D. revealed that the KANO model plays an important role in the design process of smart products and enables effective optimization of design schemes [41]. Liu, P.D. also suggested that using the KANO model in the product design process of e-commerce is an important way to enhance product competitiveness and promote industry development [42]. The KANO model is a reliable way to observe and analyze the degree of correlation, positive influence, satisfaction and intention between consumers' attitudes toward product demands and consumer behavior. It aids in understanding user requirements by scientifically classifying demands and enhancing the market conversion rate of product value through design [43, 44]. This research uses this method to evaluate and classify different consumer demands in e-commerce. The KANO analysis in this paper starts by defining the objects of study and comparison. Then, evaluation data are collected through questionnaires for analysis. This analysis classifies product features into five types: must-be attribute, one-dimensional attribute, attractive attribute, indifferent attribute and reverse attribute, as shown in **Fig. 2**.

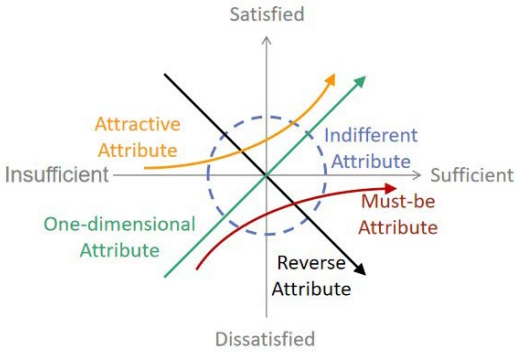

Fig. 2. KANO Model Analysis

Must-be attribute (M): optimizing such requirements will not enhance user satisfaction, while their absence will lead to a significant decline in user satisfaction.
One-dimensional attribute (O): user satisfaction will increase when such requirements are provided and will decrease if they are not provided.
Attractive attribute (A): these are unexpected by users; if such requirements are not provided, user satisfaction will not decrease, but if they are provided, user satisfaction will improve significantly.
Indifferent attribute (I): user satisfaction remains unchanged regardless of whether such requirements are provided or not; users are indifferent to them.
Reverse attribute (R): users do not have such requirements, and user satisfaction will decrease if they are provided.
Based on the nature of these five attributes, the product attributes are linked correspondingly, as shown in **Fig. 3** [45].

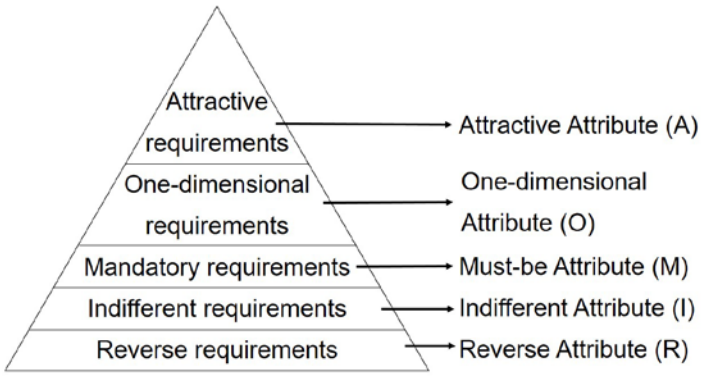

Fig. 3. Classification of Attributes

3. Materials and Methods

3.1 Semantic Analysis

3.1.1 Research Objectives

This research aims to extract TF-IDF core vocabulary centered on "smart wearable products in e-commerce" through text mining, then summarize and organize consumers' product demand information based on this and guide the classification through relevant theories. This section aims to confirm:
1. Smart wearable products have a positive development state in the current market.
2. Smart wearable products have gained consumer recognition and attracted widespread attention.

3.1.2 Text Mining

The semantic analysis function of TEXTOM was used in this research to mine relevant texts. Data collection spanned from October 1, 2020, to October 1, 2022, with the keyword being "smart wearable products in e-commerce". Original text data were collected from sources such as "CNKI", the world's largest Chinese academic literature retrieval platform, "Baidu", the world's largest Chinese search engine, "Sina Weibo", the world's largest Chinese social media platform, "Wanfang", China's largest comprehensive information service platform, and

"WeChat", the world's largest Chinese instant messaging platform, including academic literature, news reports, and online documents. The TF-IDF values of relevant terms were statistically analyzed.

With the help of the TEXTOM program, a total of 1,183 relevant words were extracted. After filtering out invalid data such as numbers, single characters, repeated or synonymous words, irrelevant words, enterprise and company names, geographical locations, conferences, and events, 837 valid words remained. The top 10 words are shown in **Table 1**. Vocabulary related to consumer demands and user requirements is summarized in **Table 2**.

Table 1. Top 10 TF-IDF

Ranking	Vocabulary	Ranking	Vocabulary
1	Chips	6	Design
2	E-commerce	7	Market
3	Company	8	Bracelets
4	Heart Rate	9	Scenarios
5	Data	10	Monitoring

Table 2. Top 20 words Related to Consumer Demand or User

Ranking	Vocabulary	Ranking	Vocabulary
1	Heart Rate	11	Service
2	Data	12	Style
3	Monitoring	13	Features
4	Exercise	14	Tips
5	Health	15	Medical
6	Analysis	16	Experience
7	Operation	17	Convenience
8	Quality	18	Life
9	Image	19	Privacy
10	Price	20	Sound

3.1.3 Data Processing

The following can be seen from the vocabulary in **Table 1**:

1. The presence of terms such as "e-commerce", "company", "design", and "market" confirms the high popularity of smart wearable products in the e-commerce consumption field today, and also reflects the close relationship between design and these products. This aligns with the judgment of relevant scholars on the market trends and potential of such products, as well as the role of design in promoting such product trends [46].

2. Terms like "chips", "data", "scenarios", and "monitoring" represent the characteristic attributes of smart wearable products. Supported by chip technology, smart wearable products are a type of mobile data reception and computing system that breaks the limitations of traditional smart product applications in terms of operational environments and control methods and passively collects data for user behavior, state detection and statistics [47].

3. Terms like "heart rate", "bracelet", and "exercise" best reflect consumers' understanding of smart wearable products. The most common smart wearable products nowadays are the smart bracelets, which are widely purchased by consumers on e-commerce platforms due to their affordability. The primary functions of such products are to detect heart rate and movement status, and then calculate and display data related to exercise consumption [48]. Hence, this research also takes the representative sports bracelets among smart wearable products as the

design research object.

Analyzes demand types by interpreting the vocabulary in **Table 2** to guide the development of the subsequent KANO model questionnaire. Ou, J., et al. analyzed the multi-sensory interaction method for wearable products, and defined the classification of sensory requirements for smart wearable products [49]. Li, A. defined the recognition principle of product design in his research [50]. Berry, L.L. created a service convenience model that scientifically divides the service functions and systems of products [51]. Guided by these theories, the vocabulary is classified, as shown in **Table 3**.

Table 3. Classification of Demands and Definition

Variable	Definition	Vocabulary	Bibliography
Sensory Requirements	To categorize the ways in which product information is communicated. Mainly: visual, auditory and tactile.	Image, reminders, experience, sound	Ou, J., Tan, Y, Fang, J.Y., Kang, Q.C., Xu, Y. (2022).
Appearance Identifiability Requirements	To evaluate the product from two perspectives: identifiability of the product's appearance and features and users' trust to use.	Exercise, health, quality, style, medical, portability, life	Li, A. (2007).
Functional Service Requirements	The functional services of the product are evaluated from four perspectives: ease of decision making, ease of access, ease of benefit, and ease of maintenance of the product.	Heart rate, data, monitoring, analysis, operation, price, service, function, privacy	Berry, L.L., Seiders, K., & Grewal, D. (2002).

3.2 KANO Model Analysis

3.2.1 Research Objectives

This section aims to classify consumer demands in e-commerce using the KANO model (see **Fig. 3**) to provide design references based on the attribute types of consumer demands. Literature has already confirmed that consumer demands can influence consumer behavior [52]. Therefore, this research aims to further confirm the relationship between consumer demand attitudes and behavior in e-commerce.

3.2.2 Questionnaire Structure

This research adopts a questionnaire method. With this method, opinions and relevant information can be directly obtained from the respondents. After ensuring the return rate, validity, and response quality, objective and scientific analysis is conducted to obtain results. The questionnaire content is designed based on the information retrieved and organized through text mining in the previous section, and accurate research data are obtained through the questionnaire.

The questionnaire consists of 36 questions in total. It is divided into two parts: the first part collects basic demographic information of the respondents, while the second part investigates consumers' "sensory requirements", "appearance identifiability requirements", and "functional service requirements" for smart bracelet products, as shown in **Table 4**. The second part sorts out 16 evaluation indicators and adopts a 5-point Likert scale to categorize them into "quite enjoy", "should be so", "do not care", "barely acceptable" and "dislike", with

assigned values ranging from 5 to 1 during coding.

Table 4. Evaluation Objectives

Requirement	Objectives	Content
Sensory Requirements	Vision	D1 Look for Information
	Hearing	D2 Listen for Message
	Touch	D3 Vibrating Alert
Appearance Identifiability Requirements	Convenience	D4 Easy to Wear, D5 Compact Size
	Product CMF	D6 Fashionable Color, D7 Lightweight Material, D8 Sturdy Structure
	Product Shape	D9 Simple Shape
Functional Service Requirements	Function	D10 Real-Time Monitoring, D11 Information Prompts, D12 Ease to Recharge
	Interactive Mode	D13 Operating Mode, D14 Voice Control, D15 Personalized Settings
	Privacy Protection	D16 Data Security Management

3.2.3 Hypothesis

The following hypotheses are proposed based on the questionnaire content:
H1: *Sensory requirements are must-be requirements (M).*
As smart wearable products, bracelets must possess the basic attributes of modern mobile electronic products. Identifying product information through visual, auditory, and tactile senses is a common attribute of current electronic products [53].
H2: *There are no attractive requirements in appearance identifiability requirements (A).*
Smart bracelets are function-driven products, and consumers pay more attention to functional services when purchasing them. The demand for product appearance is evaluated based on practicality. At the same time, the functional attributes of such products limit the selection of elements in appearance design, making it difficult to create ground-breaking highlights that impress users [54].
H3: *There are attractive requirements in functional service requirements (A).*
When the limitations of hardware products are difficult to overcome, design and innovation in services become an effective way to improve product market attention [55]. Innovation in service systems and interaction modes is gradually becoming a new competitive track for modern mainstream technology companies [56].

3.2.4 Satisfaction Analysis

After determining the research dimensions, demand preferences in e-commerce are studied based on the KANO model. A five-point Likert scale bi-directional questionnaire is designed, with two relative questions of “existence” and “non-existence” set under each demand option. Respondents score their 5 attitudes based on their satisfaction level. According to the KANO model evaluation system, the scores of positive and negative questions are correspondingly filled in, with the point positions in the table being used as the type attributes of the demand item, as shown in **Table 5**. Finally, the types and frequencies of all valid questionnaires are recorded, and the item with the highest frequency score is used as the classification basis for the attributes to classify consumer demands of smart bracelets.

Table 5. KANO Model Evaluation

—		Requirement Satisfied				
		Quite enjoy	Should be so	Do not care	Barely acceptable	Dislike
Requirement Dissatisfied	quite enjoy	Q	A	A	A	O
	should be so	R	I	I	I	M
	do not care	R	I	I	I	M
	barely acceptable	R	I	I	I	M
	Dislike	R	R	R	R	Q

Note: M is mandatory requirement; O is one-dimensional requirement; A is attractive requirement; I is indifferent requirement; R is reverse requirement; Q is questionable item, which is generally eliminated.

To more accurately identify the categories and importance of demand items, the traditional KANO model should be optimized. Consumer satisfaction coefficients are introduced based on the traditional KANO model to assist in identifying demand types. That is to say, the Better-Worse coefficient method is adopted to quantitatively evaluate the weight of each demand item. The satisfaction coefficient reflects the impact of increasing or decreasing demand items on satisfaction. Satisfaction index (SI) represents the proportion of attractive requirement (A) and one-dimensional requirement (O) in the overall requirements. The larger the value, the more significant the requirements. Dissatisfaction index (DSI) represents the proportion of one-dimensional requirement (O) and must-be requirement (M) in the overall requirements. The larger the absolute value, the more significant the impact of such requirements on overall satisfaction, making them a key item to achieve customer satisfaction.
The calculation formula is:
Satisfaction index (Better):

$$SI = \frac{A + O}{A + O + M + I}$$

Dissatisfaction index (Worse):

$$DSI = \frac{M + O}{A + O + M + I}$$

3.2.5 Analysis Result

The questionnaire was distributed through the program “WJX.cn” on the Internet on October 15, 2022, in Nanjing City, Jiangsu Province. A total of 102 questionnaires were sent out, and 102 valid ones were obtained after screening, with a validity rate of 100%, meeting the required quantity for analysis. With the help of the SPSS software, further reliability testing was conducted, with a Cronbach’s α value of 0.781, where the positive questions scored 0.835 and the negative ones scored 0.742, indicating relatively good reliability of the research results. The demographic characteristics of the sample population in the first part are shown in **Table 6**.

Table 6. Demographic Characteristics

Items	Options	Frequency	%
Sex	Male	39	38.2
	Female	63	61.8
Age	20 and below	20	19.6
	21-30	7	6.9

	31-40	26	25.5
	41-50	24	23.5
	51-60	16	15.7
	61 and above	9	8.9
Education	Junior high school and below	4	1
	Senior high school	20	4.9
	Junior college	216	52.7
	Bachelor	130	31.7
	Master	40	9.8
Marital Status	Married	24	23.5
	Single	78	76.5
Ever Used Before	Yes	89	87.3
	Never	13	12.7

While the classification and analysis results of the second part on consumers' "sensory requirements", "appearance identifiability requirements", and "functional service requirements" for smart bracelet products are shown in **Table 7**.

Table 7. Classification of Smart Bracelet Consumers' Requirements

Categories	No.	A	O	M	I	R	Categories
Sensory Requirements	D1	0.118	0.029	0.451	0.402	0.000	M
	D2	0.128	0.108	0.451	0.314	0.000	M
	D3	0.177	0.088	0.441	0.294	0.000	M
Appearance Identifiability Requirements	D4	0.147	0.088	0.441	0.324	0.000	M
	D5	0.196	0.382	0.226	0.196	0.000	O
	D6	0.157	0.039	0.137	0.608	0.059	I
	D7	0.265	0.422	0.010	0.108	0.196	O
	D8	0.137	0.049	0.441	0.324	0.049	M
	D9	0.098	0.020	0.088	0.726	0.069	I
Functional Service Requirements	D10	0.147	0.010	0.402	0.373	0.069	M
	D11	0.118	0.039	0.451	0.333	0.059	M
	D12	0.088	0.020	0.059	0.784	0.049	I
	D13	0.049	0.265	0.363	0.098	0.226	M
	D14	0.490	0.039	0.049	0.422	0.000	A
	D15	0.559	0.029	0.069	0.304	0.039	A
	D16	0.431	0.039	0.118	0.333	0.078	A

To accurately grasp the impact of requirement attributes on consumer satisfaction, indicator coefficients of each demand item were calculated based on the KANO analysis results, as shown in **Table 8**.

Table 8. Analysis of Consumer Satisfaction with Smart Bracelets

Categories	No.	SI	DSI	Optimized Classification
Sensory Requirements	D1	0.147	0.480	M
	D2	0.235	0.559	M
	D3	0.265	0.529	M
Appearance Identifiability Requirements	D4	0.235	0.529	M
	D5	0.578	0.608	O
	D6	0.208	0.188	I
	D7	0.854	0.537	O
	D8	0.196	0.516	M
	D9	0.126	0.116	I

Functional Service Requirements	D10	0.168	0.442	M
	D11	0.167	0.521	M
	D12	0.113	0.083	I
	D13	0.405	0.810	O
	D14	0.529	0.088	A
	D15	0.612	0.102	A
	D16	0.511	0.170	A

A scatter plot was drawn to present the indices in **Table 8** more intuitively, as shown in **Fig. 4**. In the figure, satisfaction index values and dissatisfaction index values were used as the x-axis and y-axis, respectively, with their mean values as the critical lines. A scatter plot of consumer demand satisfaction in four quadrants was drawn. The position of each coordinate point in the four-quadrant diagram provides an intuitive judgment of consumer satisfaction with each indicator, facilitating the optimization and classification of demand types.

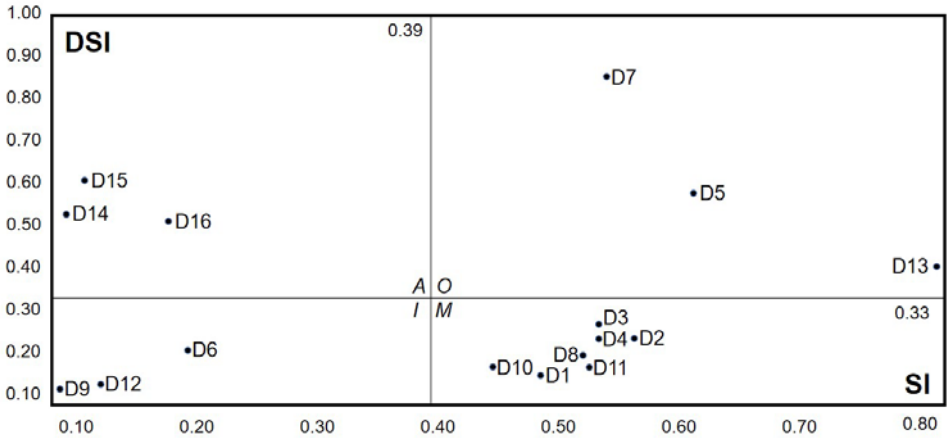

Fig. 4. SI-DSI Requirements Satisfaction Scatter Plot

3.2.6 Hypothesis Testing

Based on the aforementioned analysis, the hypotheses are tested as follows:
H1 is supported. Sensory requirements D1, D2, and D3 are all distributed in the fourth quadrant, i.e., the range of must-be requirements (M).
H2 is supported. Appearance identifiability requirements D5 to D9 are all outside the second quadrant, i.e., the region of attractive requirements (A).
H3 is supported. D14, D15, and D16 are functional service requirements, and they are all distributed in the second quadrant, belonging to the attractive requirements (A).

4. Discussion

4.1 Summary of Results

This research has scientifically classified consumer demands for smart bracelets in e-commerce through three methods: semantic analysis, KANO analysis, and satisfaction analysis, as shown in **Table 9**.

Table 9. Requirements Classification Table

Requirements Classification	Attributes of the Requirements	Items
Attractive Requirements	A	Voice control, personalized settings, data security control
One-dimensional Requirements	O	Small size, light material, operating and control mode
Mandatory Requirements	M	Information observation, listening to information, vibration alert, easy to wear, sturdy structure, real-time monitoring, message alert
Indifferent requirements	I	Fashionable color, simple shape, convenient to recharge

The results of the research are obtained with the help of multiple datasets and analysis methods, ensuring scientific rigor. The research results confirm the hypotheses proposed by the author at the beginning of the research. It can be learned from the comprehensive analysis that there is a category relationship among consumer demands in e-commerce for smart bracelets, and different classification indicators have different impacts on consumer attitudes.

4.2 Consumer Demand

This research categorizes consumer demands into four types, and different design methods are adopted for different demand categories to form sustainable consumer behavior in e-commerce. Attractive requirements: use attractive requirements to guide differentiated product design to attract the attention of new users. Consumers' evaluation of attractive requirements correlates with product attractiveness. Design strategies based on attractive requirements, such as styling and service design, can differentiate products from similar products [57], for example, the voice control requirement in consumer requirements. Current electronic products are developing in the direction of the Internet of Things (IoT), where various products communicate and are controlled via the Internet. After introducing the voice control function to smart bracelets, their functions can be expanded in the IoT. Voice control is not limited to the function control of the smart bracelet itself, but is positioned as a portable joint control system for multiple products. Becoming a remote control unit for multiple products through smart bracelets not only aligns with modern technological trends but also broadens consumers' product interests.

One-dimensional requirements: use one-dimensional requirements to guide targeted product design to maintain user loyalty. Low satisfaction with one-dimensional requirements can have negative impacts, leading to user attrition when consumer demands are not met. Targeted design addressing one-dimensional requirements can enhance services, thereby retaining consumers and fostering consumer loyalty [58]. Targeted design is a method specifically aimed at finding reasonable solutions for consumer demands [59]. For instance, in the iPhone 14 Pro launched by Apple in 2022, which faced hardware limitations preventing a complete screen display, the "Dynamic Island" UI design method was adopted to seamlessly integrate the defective screen area with the functional status during product use, achieving a hidden effect, as shown in **Fig. 5**. Adopting targeted design solutions to address issues and enhance product services meets consumer expectations, thereby maintaining their loyalty to products.

Fig. 5. Display of Functions of Dynamic Island

Must-be requirements: optimize products with must-be requirements as the foundation to make products meet mainstream trends. Must-be requirements represent the evaluation criteria of most consumers for products, and only products with these attributes can be deemed qualified. They constitute the baseline for consumer product evaluation attitudes [60]. Paying attention to changes in such requirements enables continuous improvement of products, and makes products meet consumer expectations, thereby maintaining competitiveness in the market without being eliminated. With the R&D and investment of new technologies today, product iterations and updates are accelerating, leading to evolving consumer demands [61]. Continuous attention to changes in consumers' must-be requirements during product design and development is essential to ensure alignment with mainstream trends in the ever-changing evaluation criteria. For example, the widespread concept of environmental protection in recent years has prompted major auto manufacturers to shift their product focus accordingly. The previous product strategy in the auto industry that emphasizes "power and service regardless of energy consumption costs" is gradually being phased out. Instead, companies are focusing on accumulating energy-saving and emission-reduction technologies, with new electric vehicles rapidly occupying market share. This is the result of the fact that the energy economy is gradually becoming the must-be requirements of consumers for auto products.

Indifferent requirements: such requirements help improve product distinctiveness. Indifferent requirements mean that their criteria do not affect consumer attitudes. From another perspective, they are icing on the cake, and allow relatively large space for design innovation. Design efforts on indifferent requirements can deepen consumers' product impressions, thereby enhancing product distinctiveness. Focusing on these requirements is more likely to directly impact user satisfaction through design [62]. For example, in terms of color requirements, the Nokia 3100 mobile phone (**Fig. 6**) released in 2003 broke consumers' inherent cognition of mobile phone colors by its vibrant and stylish display color combinations, and successfully formed a trend and gained widespread consumer attention. Similarly, the iMac G3 computer (**Fig. 7**) released by Apple Inc. in 1998 introduced a variety of fashionable colors, changing consumers' inherent impression of computer colors, thereby becoming an iconic product for Apple Inc. in that period.

Fig. 6. Nokia 3100, 2003

Fig. 7. Apple iMac G3, 1998

4.3 Design Strategy

It is necessary to center on consumer demand, and scientifically use data analysis to guide product design, thereby achieving sustainable consumption of products.

The research confirms that design research based on the data analysis techniques can be a way to comprehensively and deeply understand consumer demand, and can sort out and classify information in combination with different influencing factors to provide design inspiration. Scholar Liu, G. proposed that the design process should be “realistic and truth-seeking”, and explained that being “realistic” is to identify and define problems [63]. Data analysis, as a means of research and observation, is objective and comprehensive when facing research objectives. There is a close relationship between consumer demand and sustainable consumer behavior. It is necessary to sort out and classify consumer demands with data analysis to identify issues, and take design as a tool to address the core contradictions in consumer demands, thus satisfying consumer demands and promoting sustainable consumer behavior.

Consumer demands directly influence consumer behavior, so the evaluation criteria for product excellence should be formulated around consumer demands.

The research confirms the significant impact of consumer demands on consumer behavior. Design can influence the way and extent to which consumer demands are met, thereby

positively impacting consumer behavior [18]. Nowadays, in the face of commercial product design, diverse and scientific methods are needed to assess design efficiency, prevent ineffective investment during product development, and save costs for enterprises during product R&D. Therefore, for design purposes, feedback on consumer behavior results can serve as an evaluation indicator for product design.

It is necessary to guide the direction of consumer demand development to form positive sustainable consumer behavior.

The formation of consumer demand is closely linked to the services provided by current products. Designing around consumer demands guides consumers to generate new demands and form expectations for new products [19]. This helps maintain the connection between products and consumers, helps promote the spread of new services through new demands, and helps gain consumer recognition through new services, thus forming a mutually reinforcing relationship. Scientist Simon, H. once defined that "to design is to devise courses of action aimed at changing existing situations into preferred ones with knowledge and experience" [64]. Interpreting consumer behavior through data analysis will redefine the meaning of design. By predicting consumer demand based on data analysis results, consumers can be guided to change the current situation in a targeted manner. The role of design is no longer to create what satisfies existing user demands but to set goals in advance and guide user demands towards the realization of such goals. Therefore, guiding consumer demand through design can stimulate consumer behavior, and foster sustainable consumer behavior over time.

5. Conclusion

5.1 Main Results

This research takes smart wearable products as a case study to investigate the relationship between consumer demands and consumer behavior in product design. Semantic analysis, KANO analysis, and satisfaction analysis are used to obtain a classification chart of consumer demands. Relying on objective and scientifically grounded results, the research confirms the initial hypotheses.

At the same time, the research formulates corresponding smart wearable product design methods based on consumer demand types to give full play to the value of analysis results. Finally, it summarizes and concludes product design strategies centered on consumer demands, aiming to enhance consumers' recognition of products through design and promote consumer behavior in e-commerce.

The findings of this research are as follows:

1. The combined application of data analysis techniques is an effective way to deeply explore consumer demands. Analyzing data collected from surrounding design objectives allows for comprehensive interpretation and precise identification of target demands.
2. Data analysis allows for the classification of consumer demands, with different categories having varying impacts on consumer satisfaction, which means that there is a correlation between consumer demand and consumer experience. Strategically focusing on these attributes and applying them in product design can improve product service quality.
3. Product design centered on consumer demands positively influences sustainable consumer behavior. Guiding product design and development based on analysis results, focusing on categorized consumer demands, and logically selecting and addressing issues and contradictions under specific demand items can serve as an effective means to stimulate consumer behavior.

These findings are consistent with the views and research results of relevant scholars. Consumers have diverse product demands for smart wearable products, which have considerable market value [13, 14, 19, 29]. Attention to consumer demands can foster a favorable user experience and stimulate sustainable consumer behavior [24, 25]. KANO analysis can be a reliable method for analyzing consumer demand in design research [12, 41, 42, 43, 44].

5.2 Contributions

This research uses multiple data analysis techniques to analyze consumer demands, and confirms their relationship with product design and consumer behavior. The research methods, including big data semantic analysis, KANO analysis, and satisfaction analysis, and the step-by-step research means adopted in this paper can serve as references for multi-directional and multi-disciplinary research in the future. In the context of the increasingly fierce commercial competition today, the research provides insights and pathways for enhancing competitiveness through product design. Product design centered on consumer demands is an effective means to improve consumer product experience and stimulate consumption desire. The design strategies proposed in this paper have scientific guiding significance for the future promotion and development of smart wearable products, and are worth being borrowed and applied by many technology companies in their product development and promotion. The data analysis methods and results utilized in this research can also be applied to analyze other types of products, and guide design as a means of user demand analysis. The application methods and thinking logic of data technology in the research provide references for promotion and application in different design fields, such as advertising design and marketing strategies.

5.3 Limitations and Future Research Directions

This research, based on big data analysis and questionnaires, has certain limitations. Data analysis is time-sensitive, and limited data retrieval platforms may not fully represent the situation of the data analysis objects. In the questionnaires, the number of respondents is limited and may not reflect the attitudes of consumers as a whole. Moreover, the questionnaire was distributed online in a specific region, which can only represent the consumer demand differences of the population in the research region and may not reflect the characteristics of the entire population. Meanwhile, the analysis method used in the research is only one of many data analysis methods, while combination with multiple analysis methods to obtain the results may further improve the research accuracy.

In the future, the author hopes to conduct more in-depth research by diversifying research methods, and incorporating different algorithms to assess consumer demands from multiple dimensions and perspectives. At the same time, the author will purposefully limit the research sample scope and conduct studies on specific population demands, such as gender, age, and consumption capacity, to ensure research differentiation. With the continuous advancement and application of new technologies, consumer demands will change accordingly. Collecting data from different periods and conducting comprehensive studies on changing trends also have academic value.

References

[1] D. Zhou, “The Design of Wearable Smart Products Based on Big Data,” in *Proc. of IEEE Asia-Pacific Conference on Image Processing, Electronics and Computers (IPEC)*, pp. 1348-1351, 2022. Article (CrossRef Link)

[2] E.M. Ghazali, R.A. Rahman, M.M. Waqas, and Z.L. Hamzah, "Consumer repurchase intention of smart wearable devices: an extension of the technology integration model," *International Journal of Technology Marketing*, Vol. 17, No.1, pp. 78-98, 2023. Article (CrossRef Link)
[3] C. Ntumba, S. Aguayo, K. Maina, "Revolutionizing Retail: A Mini Review of E-commerce Evolution," *Journal of Digital Marketing and Communication*, Vol. 3, No.2, pp. 100-110, 2023. Article (CrossRef Link)
[4] D. E. Robinson, "Fashion theory and product design," in *Fashion Marketing*, 1st ed., London, U.K.: Routledge, 2023, pp. 433-450.
[5] H. Bar-Isaac, G. Caruana, and V. Cuñat, "Targeted product design," *American Economic Journal: Microeconomics*, Vol. 15, No. 2, pp. 157-186, 2023. Article (CrossRef Link)
[6] H. Burke, A. Zhang, and J.X. Wang, "Integrating product design and supply chain management for a circular economy," *Production Planning & Control*, Vol. 34, No. 11, pp. 1097-1113, 2023. Article (CrossRef Link)
[7] C. Wang, T. Liu, Y. Zhu, H. Wang, X. Wang, and S. Zhao, "The influence of consumer perception on purchase intention: Evidence from cross-border E-commerce platforms," *Heliyon*, Vol. 9, No. 11, 2023. Article (CrossRef Link)
[8] S.B. Utomo, H. Jamali, I. Arief, M.N. Saputra, C.G. Priambodo, S. Tinggi, I. Ekonomi, I. Surabaya, S.B. Makassar, S. Widya, and D. Husada, "Analysis of The Influence of Hedonic Digital Lifestyle on Consumptive E-Shopping Behavior of Generation Z Through E-Commerce Applications," *Journal Sistim Informasi dan Teknologi*, Vol. 5, No. 3, pp. 85-91, 2023. Article (CrossRef Link)
[9] M. Li, and J. Zhang, "Integrating Kano Model, AHP, and QFD Methods for New Product Development Based on Text Mining, Intuitionistic Fuzzy Sets, and Customers Satisfaction," *Mathematical Problems in Engineering*, Vol. 2021, pp. 1-17, 2021. Article (CrossRef Link)
[10] D. Baier, T.M. Rausch, and T.F. Wagner, "The Drivers of Sustainable Apparel and Sportswear Consumption: A Segmented Kano Perspective," *Sustainability*, Vol. 12, pp. 2788, 2020. Article (CrossRef Link)
[11] H. Miao, "Integrating Technology-Relationship-Technology Semantic Analysis and Technology Roadmapping Method: A Case of Elderly Smart Wear Technology," *IEEE Transactions on Engineering Management*, Vol. 69, pp. 262-278, 2022. Article (CrossRef Link)
[12] X. Kang, and Z. Zhao, "A study on kansei attraction of products' online reviews by using text mining and kano model," *Journal of Advanced Mechanical Design, Systems, and Manufacturing*, Vol. 18, No. 2, 2024. Article (CrossRef Link)
[13] J. Zhuo, "Consumer Demand Behavior Mining and Product Recommendation Based on Online Product Review Mining and Fuzzy Sets," *Mathematical Problems in Engineering*, Vol. 2022, 2022. Article (CrossRef Link)
[14] C. Wang, "An E-Commerce Economic Dynamic Data Evaluation Model Based on Multiuser Demand Constraints," *Wireless Communications and Mobile Computing*, Vol. 2021, pp. 1-9, 2021. Article (CrossRef Link)
[15] Y. Levin, and D. Bagmanyan, "Features of Supply and Demand Formation in the E-Commerce Market," *Scientific Research and Development. Economics*, Vol. 10, No.4, 2022. Article (CrossRef Link)
[16] A. Jain, V. Karthikeyan, B. Sahana, B. Shambhavi, T.K. Sindhu, and S. Balaji, "Demand Forecasting for E-Commerce Platforms," in *Proc. of 2020 IEEE International Conference for Innovation in Technology (INOCON)*, pp. 1-4, 2020. Article (CrossRef Link)
[17] J.S. Nayyar, T. Khosla, and V.K. Saini, "Trend Analysis of E Commerce," *International Journal for Research in Applied Science and Engineering Technology*, Vol. 11, No. 5, 2023. Article (CrossRef Link)
[18] J. Roosen, C.M. Neubig, M. Staudigel, and H. Agovi, "Product appeal, sensory perception and consumer demand," *European Review of Agricultural Economics*, Vol. 50, No. 4, pp. 1338-1363, 2023. Article (CrossRef Link)
[19] Y. Wang, and S. Lin, "Product Design Decision Oriented by Hierarchical Relevance of User's First Perceptual Demand," *Proc. of IOP Conference Series: Materials Science and Engineering*, Vol. 5, pp. 573, 2019. Article (CrossRef Link)

[20] F. Sun, D. Luh, Y. Zhao, and Y. Sun, "Product Classification with the Motivation of Target Consumers by Deep Learning," *IEEE Access*, vol. 10, pp. 62258-62267, 2022. Article (CrossRef Link)
[21] V. Agouridas, A. McKay, H. Winand, and A. Pennington, "Advanced Product Planning: a Comprehensive Process for Systemic Definition of New Product Requirements," *Requirements Engineering*, Vol. 1, No. 13, pp. 19-48, 2007. Article (CrossRef Link)
[22] E.K. Kkonko, N. Chiliya, T. Chuchu, and T. Ndoro, "An Investigation into the Factors Influencing the Purchase Intentions of Smart Wearable Technology by Students," *Int. J. Interact. Mob. Technol*, Vol. 13, No. 5, pp. 15-29, 2019. Article (CrossRef Link)
[23] W.M. Liu, and H.B. Huang, "Application of Artificial Intelligence Technology in Wearable Product Design," in *Proc. of 2020 International Conference on Innovation Design and Digital Technology (ICIDDT)*, pp. 194-197, 2020. Article (CrossRef Link)
[24] P. Minaoglou, N. Efkolidis, A. Manavis, and P. Kyratsis, "A Review on Wearable Product Design and Applications," *Machines*, Vol. 12, No.1, 2024. Article (CrossRef Link)
[25] S. Bakhshian, and Y. Lee, "Influence of Extrinsic and Intrinsic Attributes on Consumers' Attitude and Intention of Using Wearable Technology," *International Journal of Human-Computer Interaction*, Vol. 39, No. 3, pp. 562-574, 2023. Article (CrossRef Link)
[26] P. Wu, and Y. Chen, "Product Demand Forecasting in Ecommerce Based on Nonlinear Autoregressive Neural Network," *PREPRINT*, 2021. Article (CrossRef Link)
[27] M. Mizuno, H. Aoyama, and Y. Fujiwara, "Untangling the complexity of market competition in consumer goods-A complex Hilbert PCA analysis," *PLoS ONE*, Vol. 16, No. 10, 2021. Article (CrossRef Link)
[28] H. Song, C. Chen, and Q. Yu, "Research on Kano model based on online comment data mining," in *Proc. of 2018 IEEE 3rd International Conference on Big Data Analysis (ICBDA)*, pp. 76-82, 2018. Article (CrossRef Link)
[29] M.M. Taye, and S. Ghoul, "An Approach towards Goal-Oriented Requirements Ontology: Consistency and Completeness Based Requirements Analysis," *Journal of Software Engineering and Applications*, Vol. 16, No. 2, pp. 31-49, 2023. Article (CrossRef Link)
[30] A.M.A. Jamea, L. Jing, X. Peng, J. Li, and S. Jiang, "Modification and development of product concept design based on the product customers life environmental and social habits backgrounds' diversity requirements," in *Proc. of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, 2023. Article (CrossRef Link)
[31] S. Qaiser, and R. Ali, "Text Mining: Use of TF-IDF to Examine the Relevance of Words to Documents," *International Journal of Computer Applications*, vol. 181, pp. 25-29, 2018. Article (CrossRef Link)
[32] X. Wu, Z. Hong, Y. Feng, M. Li, S. Lou, and J. Tan, "A semantic analysis-driven customer requirements mining method for product conceptual design," *Scientific Reports*, Vol. 12, 2022. Article (CrossRef Link)
[33] L. Yang, and Z. Qiuxiang, "Research on E-Commerce User Interest Recommendation Method Based on TF-IDF Algorithm," in *Proc. of 2022 2nd Asia-Pacific Conference on Communications Technology and Computer Science (ACCTCS)*, pp. 291-295, 2022. Article (CrossRef Link)
[34] H. An, and M. Park, "Approaching fashion design trend applications using text mining and semantic network analysis," *Fashion and Textiles*, Vol. 7, pp. 1-15, 2020. Article (CrossRef Link)
[35] E.H. Lee, H.E. Lee, and J.W. Choi, "A study on the current status of DIY clothing products related to fabric using text mining," *Journal of the Korea Fashion and Costume Design Association*, Vol. 25, No. 2, pp. 111-122, 2023. Article (CrossRef Link)
[36] J. Jeong, and S. Yun, "Perception and Trend Differences between Korea, China, and the US on Vegan Fashion-Using Big Data Analytics," *Journal of the Korean Society of Clothing and Textiles*, Vol. 47, No. 5, pp. 804-821, 2023. Article (CrossRef Link)
[37] E. Shin, and H.S. Hwang, "Exploring the Key Factors that Lead to Intentions to Use AI Fashion Curation Services through Big Data Analysis," *KSII Trans. Internet Inf. Syst.*, Vol. 16, No. 2, pp. 676-691, 2022. Article (CrossRef Link)

[38] Q. Meng, and J. Dong, "Future Direction and Visual Analysis of Kano Model: A Literature Review," *Journal of Service Science and Management*, Vol. 11, No. 4, pp. 399-413, 2018. Article (CrossRef Link)
[39] B. Martin, and B.M. Hanington, "KANO Analysis," in *Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Innovative Ideas, and Design Effective Solutions*, 1st ed., Beijing, China: Central Compilation and Translation Press, 2013, pp. 106-107.
[40] S. Zhao, Q. Zhang, Z. Peng, and Y. Fan, "Integrating customer requirements into customized product configuration design based on Kano's model," *Journal of Intelligent Manufacturing*, Vol. 31, pp. 597-613, 2020. Article (CrossRef Link)
[41] D. Neira-Rodado, M.A. Ortíz-Barrios, S. Hoz-Escorcia, C. Paggetti, L. Noffrini, and N. Fratea, "Smart Product Design Process through the Implementation of a Fuzzy Kano-AHP-DEMATEL-QFD Approach," *Applied Sciences*, Vol. 10, No. 5, pp. 1792, 2020. Article (CrossRef Link)
[42] P. Liu, K. Zhang, X. Dong, and P. Wang, "A Big Data-Kano and SNA-CRP Based QFD Model: Application to Product Design Under Chinese New E-commerce Model," *IEEE Transactions on Engineering Management*, Vol. 71, pp. 4246-4260, 2022. Article (CrossRef Link)
[43] L. Du, H. Chen, Y. Fang, X. Liang, Y. Zhang, Y. Qiao, and Z. Guo, "Research on the Method of Acquiring Customer Individual Demand Based on the Quantitative Kano Model," *Computational Intelligence and Neuroscience*, Vol. 2022, pp. 1-12, 2022. Article (CrossRef Link)
[44] M. Ingaldi, and R. Ulewicz, "How to Make E-Commerce More Successful by Use of Kano's Model to Assess Customer Satisfaction in Terms of Sustainable Development," *Sustainability*, Vol. 11, No. 18, pp. 4830, 2019. Article (CrossRef Link)
[45] H. Liu, Z. Ren, and Y.J. Li, "Research on the Evaluation of Customer requirement Importance of Smart Products Based on Online Comments and Improved Quantitative Kano Model," *Archives*, Vol. 2021, No. 5, pp. 382-392, 2021. Article (CrossRef Link)
[46] H. Yen, "Smart wearable devices as a psychological intervention for healthy lifestyle and quality of life: a randomized controlled trial," *Quality of Life Research*, Vol. 30, pp. 791-802, 2021. Article (CrossRef Link)
[47] H.K. Raad, *Fundamentals of IoT and Wearable Technology Design*, 1st ed., New York, NY, USA: John Wiley & Sons, 2020.
[48] Z. Hu, C. Chang, R. Shen, S. Wu, and D. Hou, "Smart bracelet based on the Internet of Things," in *Proc. of 2023 International Conference on Consumer Electronics-Taiwan (ICCE-Taiwan)*, pp. 65-66, 2023. Article (CrossRef Link)
[49] J. Ou, Y. Tan, Y.J. Fang, Q.C. Kang, and Y. Xu, "Alzheimer's Old-Fashioned Wearable Product Design Research based on Multi-Sensory Interaction," *Packaging Project*, No. 10, pp. 116-124, 2023. Article (CrossRef Link)
[50] A. Li, "Explore the Origin of Product Recognition," *Decorate*, Vol. 3, No. 7, pp. 66-67, 2007.
[51] L.L. Berry, K. Seiders, and D. Grewal, "Understanding Service Convenience," *Journal of Marketing*, Vol. 66, No. 3, pp. 1-17, 2002. Article (CrossRef Link)
[52] V. Griskevicius, and D.T. Kenrick, "Fundamental Motives: How Evolutionary Needs Influence Consumer Behavior," *Journal of Consumer Psychology*, Vol. 23, No. 3, pp. 372-386, 2013. Article (CrossRef Link)
[53] S.P. Kapil, N. Pandey, and P. Garg, "IoT-Based Smart Wristband," in *Proc. of International Conference on Communication and Artificial Intelligence*, pp. 171-180, 2021. Article (CrossRef Link)
[54] V. Inget, "Designing Ambi-Bracelet- an Interactive Bracelet for Ambient Communication between Partners," in *Proc. of IASDR 2023: Life-Changing Design*, pp. 1-11, 2023. Article (CrossRef Link)
[55] S. Wang, Z. Wang, and X, Zhao, "Smart Bracelet Design and Function Improvement," *Science and Technology of Engineering. Chemistry and Environmental Protection*, Vol. 1, No. 5, 2024. Article (CrossRef Link)
[56] S.I. Dinulescu, N. Tummala, G. Reardon, B. Dandu, D.T. Goetz, S. Topp, and Y. Visell, "A Smart Bracelet Supporting Tactile Communication and Interaction," in *Proc. of 2022 IEEE Haptics Symposium (HAPTICS)*, pp. 1-7, 2022. Article (CrossRef Link)

[57] J.X. Wang, H. Burke, and A. Zhang, "Overcoming barriers to circular product design," *International Journal of Production Economics*, Vol. 243, 2022. Article (CrossRef Link)
[58] Z. Aripin, U. Supriatna, and M.S. Mahaputra, "THE INFLUENCE OF POSSESSIVE BRAND NAMES ON CONSUMER DECISIONS AND PREFERENCES: AN EXPLORATION OF THE ROLE OF PERCEIVED CONTROL," *Journal of Economics, Accounting, Business, Management, Engineering and Society*, Vol. 1, No. 2, pp. 50-66, 2024. Article (CrossRef Link)
[59] H.N. Ngoc, G. Lasa, and I. Iriarte, "Human-centred design in industry 4.0: case study review and opportunities for future research," *Journal of Intelligent Manufacturing*, Vol. 33, pp. 35-76, 2022. Article (CrossRef Link)
[60] D. Das, A. Sarkar, and A. Debroy, "Impact of COVID-19 on changing consumer behaviour: Lessons from an emerging economy," *International Journal of Consumer Studies*, Vol. 46, pp. 692-715, 2022. Article (CrossRef Link)
[61] T. Hewei, and L. Youngsook, "Factors Affecting Continuous Purchase Intention of Fashion Products on Social E-commerce: SOR Model and the Mediating Effect," *Entertainment Computing*, Vol. 41, 2022. Article (CrossRef Link)
[62] S.H. Koo, and Y. Chae, "Wearable Technology in Fashion," in *Leading Edge Technologies in Fashion Innovation*, 1st ed., New York, NY, USA: Springer International Publishing, pp. 35-57, 2022. Article (CrossRef Link)
[63] G.Z. Liu, and H.S. Li, "Design Affairs: Abstraction and Concrete of Goals," *Packaging Project*, No.12, pp. 1-6+31, 2021. Article (CrossRef Link)
[64] S. Herbert, *Science about Human Beings*, Beijing, China: PLA Press, 1985.

Jialei Ye: He received the B.A. degree and M.A. degree in Art Design from Nanjing University of the Arts, China, in 2013 and 2016, respectively, Ph.D. degree in Fine Arts from Kyonggi University, Korea, in 2021. He is currently working at Nanjing University of the Arts in Design Doctor's Post-Doctoral Research Station. He is interested in Product Design, Service Design, Data Analysis and Design, Universal Design etc.

Xiaoyou He: He received the B.A. degree in Wuxi Light Industry College, China. The M.A. degree in The CORNWALL Art Design of the School of Higher Education in The U.K. The Ph.D. degree in Nanjing University of the Arts, China. He is a professor, doctoral supervisor, and former vice president of Nanjing University of the Arts. He is currently a researcher at the China Institute of Arts of China, a member of the executive director and expert committee of the China Industrial Design Association, a member of the Industrial Design Art Committee of the Chinese Artists Association. The main directions are traditional Chinese equipment design research, product design procedures and methods, etc.

Ziyang Liu: He received the B.A. degree in Management from Army superintend institute of Shijiazhuang China PLA, China, in 2006, M.A. degree and Ph.D. degree in Management from Kyonggi University, Korea, in 2010 and 2013, respectively. He is currently an Assistant Professor in the Global Business Kyonggi University. He is interested in Quality Management. Management Information Systems, International economics, E-business etc.