THE FACTORS INFLUENCING CUSTOMER SATISFACTION WITH STEREO PARKING SYSTEMS－A CASE STUDY OF SHANGHAI

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AN INDEPENDENT STUDY SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF BUSINESS ADMINISTRATION
GRADUATE SCHOOL OF BUSINESS
SIAM UNIVERSITY
2024

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This Independent Study has been approved as a Partial Fulfillment of the Requirements for the Degree of Master of Business Administration

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Date 4/Feb/2025

Title: The Factors Influencing Customer Satisfaction with Stereo Parking Systems—A Case Study of Shanghai

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Degree: Master of Business Administration

Major: International Business Management

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.....14../.....Dec...../.....2024.

ABSTRACT

The design and development of stereo parking systems involve a comprehensive set of functional requirements, manufacturing processes, user operational comfort, and environmental friendliness. However, the current market of stereo parking systems primarily focuses on product-centered design and functional achievement, without adequately considering and meeting user needs. The design philosophy lags behind the demands of contemporary development.

The objectives of this study are: 1) To explore the key factors affecting the use of stereo parking systems; 2) To examine the impact of the basic attributes of the product, customer expectation attributes, and product attractiveness attributes on customer satisfaction with the product. This study selected the stereo parking systems in Shanghai, China, as the case study area and collected user data through a questionnaire survey, with a sample size of 400. Quantitative research methods were used to analyze the data.

The research results indicate: 1) Customer satisfaction with stereo parking systems is influenced by the basic attributes of the product, customer expectation attributes, and product attractiveness attributes; 2) The three factors of product basic attributes, customer expectation attributes, and product attractiveness attributes have a significant positive impact on customer satisfaction with stereo parking systems.

Studying customer satisfaction with stereo parking systems has practical value in shifting the design philosophy from product-centered to user-centered. This means that, in addition to considering the basic functional elements of stereo parking systems, it is essential to research how to fully meet the needs of user groups and comprehensively design and develop stereo parking systems.

Keywords: stereo parking systems, customer satisfaction, influencing factors

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to my advisor , Dr. Jidapa Chollathanrattanapong, for her invaluable guidance, support and encouragement throughout my independent study. Her insightful comments and constructive criticism have significantly improved the quality of my work.

Additionally, I am grateful to Associate Professor Dr.Jomphong Mongkhonvanit, Dean of the Graduate School of Business, for his continuous support and encouragement throughout my studies. His dedication to the graduate program and commitment to excellence have inspired me to strive for academic excellence.

Finally, I would like to extend my appreciation to all the faculty members and staff of Siam University who have contributed to my growth and development as a student. Their unwavering support and encouragement have been a source of inspiration and motivation for me.

Xue Rongwei

DECLARATION

I, XUE RONGWEI, certify that the work embodied in this, independent study entitled **"The Factors Influencing Customer Satisfaction with Stereo Parking Systems－A Case Study of Shanghai "** *is a result of original research and has not been submitted for a higher degree to any other university or institution.*

(Xue Rongwei)
JUNE 8, 2024

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Chapter 1 Introduction

1.1 Background of the Study

With the development of the automobile industry and the increase in car ownership per capita, urban land resources are becoming increasingly scarce. Parking difficulties have become a significant social issue that urgently needs to be addressed in modern cities. Developing stereo parking systems is a primary solution to this contradiction and a necessary demand of social development (Liu, Fei & Wang, 2020). However, despite the continuous improvement and maturation of product design technology and production processes, the actual market acceptance of stereo parking systems remains low. High vacancy rates in stereo parking parkings are common, resulting in significant resource waste and hindering industry development (Yi, 2020).

Compared to major countries worldwide, China still has considerable growth potential in car ownership per capita, leading to an ongoing increase in parking space demand (Liu, Fei & Wang, 2020).

Currently, China faces a parking space shortage of at least 80 to 95 million spaces (Yao & Liu, 2020). Parking difficulties have garnered widespread social attention and urgently need resolution in modern cities (Yi, 2020). In contrast to the growing car ownership and the resulting substantial parking space demand, urban land resources are finite and non-renewable. In recent years, the Chinese government has emphasized focusing on existing land and controlling new land use. Under this backdrop, vigorously developing stereo parking equipment has become the most effective solution to parking difficulties (Yi, 2020). Consequently, governments at various levels in China have introduced policies from the perspectives of planning, construction, fees, and standards, promoting the standardized construction of stereo parking systems to alleviate parking difficulties in urban areas (Xiong, 2018).

Currently, the development of stereo parking systems in China has reached a certain scale and market presence. The design technology and production processes of stereo parking equipment are increasingly sophisticated and mature. However, market acceptance of stereo parking equipment in China remains persistently low, and the current situation is not optimistic (Luo & Cheng, 2019). Many cities experience high vacancy rates and low average utilization rates in stereo parking parkings. Reports of stereo parking parkings being left unused for years, or even being demolished after construction while surface parking remains scarce, are not uncommon (Jie, 2018).

Taking the mechanical stereo parking parkings in Shanghai as an example, a practical survey analysis reveals that users believe existing stereo parking systems have numerous deficiencies in usability, visual and psychological comfort, user experience and operating habits, management and operation methods, space dimensions, and safety and durability.

The primary reason for these issues lies in the product-centered design and

development approach of existing stereo parking systems, focusing on functional realization and economic efficiency in design evaluation and selection. This approach fails to fully meet user requirements, with design concepts lagging behind contemporary development needs. Therefore, it is necessary to shift to a user-centered approach, aiming to fully satisfy user needs and harmonize human-machine interactions, and conduct research on customer satisfaction with stereo parking systems.

1.2 Questions of the Study

Compared to surface parking, stereo parking systems have many differences in usage, leading to different psychological and physiological responses from users during operation. Existing stereo parking systems primarily focus on technology, structure, and processes, with little research on actual user practices, usage environments, and psychological habits. Research on human-machine environment systems and interactivity is particularly weak. Economically, to pursue higher efficiency, stereo parking systems are developing towards large-scale, intensive models, resulting in high costs, expensive maintenance, complex installations, and complicated management models. These issues directly lead to the product failing to fully meet user needs, causing high vacancy rates and significant resource waste.

Based on the current usage status of stereo parking systems and existing research, this study aims to explore the following research questions:

1. What are the key factors affecting customer satisfaction with stereo parking systems?

2. Are basic product attributes, customer expectation attributes, and product attractiveness attributes have a positive impact on customer satisfaction in using stereo parking systems?

1.3 Objectives of the Study

The acceptance of stereo parking systems varies among customer groups as they continue to develop. This study focuses on mechanical stereo parking parkings in Shanghai as the research subject. Drawing on the user-centered design theory, the design cognitive theory, and the sensory engineering theory, and combining the current status of user usage of stereo parking systems, this study aims to construct a theoretical framework for customer satisfaction with stereo parking systems. It explores the intrinsic connections and mechanisms of user-centered satisfaction with stereo parking systems, taking the three levels of basic product attributes, customer expectation attributes, and product attractiveness attributes as independent variables, with customer satisfaction in using stereo parking systems as the dependent variable. The goal is to provide theoretical and empirical evidence for the planning and development of stereo parking systems based on the research results of this paper.

Identifying existing issues, proposing targeted improvement strategies, and offering guidance for the improvement and development of stereo parking systems are the specific research purposes outlined as follows:

1. To explore the factors influencing customer satisfaction with stereo parking systems.

2. To examine the impact of product basic attributes, customer expectation attributes, and product attractiveness attributes on customer satisfaction with stereo parking systems.

1.4 Scope of the Study

This study conducted surveys in three types of stereo parking parkings in Shanghai through on-site visits and online channels. The survey was conducted continuously for three months, from January 2024 to March 2024, spanning a period of 91 days.

According to the "Standards for the Design of Architectural Engineering Traffic and Parking parkings (Lots)" regulations, the survey categorized parking environments based on usage, geographical location, and functional zoning, mainly including commercial venues, office buildings, and residential areas. Therefore, the survey questionnaires were distributed in three representative types of stereo parkings: residential areas - Guoxiang Road Stereo Parking parking (No. 75 Guoxiang Road, Yangpu District, Shanghai); office building - Tongji Planning Building Parking Lot (No. 1111 Zhongshan North Second Road); commercial venue - Songjiang Wanda Plaza Underground Parking Lot (No. 658 Guangfulin Road, Songjiang District, Shanghai).

A total of 482 questionnaires were collected, and after excluding invalid responses, 400 valid questionnaires were obtained, with an effective rate of 82.99%.

1.5 Significance of the Study

1. This study helps provide a comprehensive evaluation and decision-making basis for the design of stereo parking systems.

The theoretical significance of this study lies in evaluating and designing stereo parking systems with a user-centered approach, thereby changing the design philosophy prioritizing functionality and economic benefits. By focusing on human needs and experiences, and integrating modern design theories and methods, the study analyzes the complex factors and design proposals of stereo parking systems. Through the integration of modern computer technology and experimental methods, along with various quantitative experimental techniques, the study proposes new research processes, tool methods, and establishes evaluation decision-making models, providing a comprehensive theoretical basis for evaluating and making decisions about the design of stereo parking systems. This aims to enhance the rationality and comfort of product design, aligning with the developmental trends of future stereo parking system design research.

2.This study contributes to the effective survival and development of the stereo parking industry, enhancing enterprise competitiveness.

Customer satisfaction is fundamental to the sustained and healthy development of enterprises. This necessitates enterprises to uphold a user-centric business philosophy and a spirit of innovation, continuously meeting the diverse product demands of users and providing high-quality products and brand experiences to enhance the competitive

strength of stereo parking facilities. Major automobile manufacturing companies increasingly value customer satisfaction outcomes, implementing corresponding enhancement strategies to ensure their effective survival and development in the market. The research results can be applied to the evaluation and decision-making of practical design schemes, effectively improving the rationality and comfort of product design while meeting economic, structural, functional, and technological prerequisites. This reduces subjective biases of decision-makers, meets the diverse needs of users of stereo parking systems, enhances product utilization rates and market acceptance, and finds solutions for mutual cooperation to promote the healthy development of the stereo parking industry. Additionally, it can provide objective reference for the continuous revision of industry standards in China.

1.6 Definition of key Terms

1. Product Basic Attributes

The product basic attributes are mainly reflected in its structural characteristics and functional features. The system makes use of multi-storey vertical or horizontal space to store vehicles, and realises vehicle access through mechanical actions (such as lifting, traversing, etc.). The main purpose of such a system is to effectively save urban space, improve the efficiency of car park usage and reduce traffic congestion. Therefore, its basic attributes include high space utilisation, large storage capacity, easy and fast operation as well as safety and reliability.

2. Customer Expectation Attributes

Customer expectation attributes refer to the level of quality or satisfaction that a customer expects to achieve when purchasing a product or service. These expectations are usually based on the customer's personal needs, experiences, values, and knowledge of the product or service.Customers' desired attributes usually include product quality, performance, price, after-sales service and other aspects.

3. Product Attractiveness Attributes

Attractive product attributes are those product features or functions that can exceed customer expectations and bring surprise and pleasure to customers. These attributes are usually not essential for customers to purchase a product, but their presence can significantly increase customer satisfaction and loyalty to the product. Attractive product attributes may include unique design, innovative features, quality experience, etc.

4. Customer Satisfaction

Customer satisfaction refers to the user's feelings after using a product or service and comparing its actual performance with expectations. It is a direct feedback from users on the quality of a product or service, and an important indicator of the success of a product or service. Customer satisfaction is usually collected and assessed through questionnaires, user feedback, online evaluations and other means.

5. Stereo Parking System

An automated parking system is a parking facility that uses mechanical equipment

to store vehicles on multiple levels, designed to enhance land utilization and parking efficiency. This system typically includes various types such as vertical lifts, horizontal movement, and aisle stackers, allowing flexible configurations based on site conditions and needs. The system not only saves space but also reduces the time vehicles spend searching for parking spots, thereby improving overall traffic flow efficiency.

Chapter 2 Literature Review

2.1 Introduction

The literature review of this study is based on the user-centered design theory, the design cognitive theory, and the sensory engineering theory to analyze the factors influencing customer satisfaction in the use of stereo parking systems. The literature is reviewed and analyzed to understand the relationship between this study and existing literature, grasp the development context of research, and establish a theoretical foundation for subsequent studies.

2.2 Literature Review

2.2.1Basic Attributes of the Product

The design and operation of stereo parking systems involve various fundamental attribute factors. Among them, management time efficiency, labor cost, and operation mode directly affect the implementation of operational management. In terms of production, factors such as production efficiency, product structure complexity, and product qualification rate are significant. Installation and maintenance focus on product safety, convenience of installation and maintenance, and product qualification rate. Therefore, the secondary factors related to user assistance include management time efficiency, labor cost, operation mode, production efficiency, product structure complexity, product qualification rate, safety and reliability, installation and maintenance, and product qualification rate.

1. Operational Management Factors

Operational management is the core link of stereo parking systems, directly related to operational efficiency and cost control. Management time efficiency, labor cost, and operation mode are important secondary factors in operational management (Zhang et al., 2018). Increased time efficiency significantly enhances volume of use, reduces user waiting time, and increases customer satisfaction. Controlling labor costs helps lower overall operating expenses and improve economic efficiency. The choice of operation mode determines the flexibility and adaptability of the entire system.

2. Production and Manufacturing Factors

During the production phase, stereo parking systems need to consider factors such as production efficiency, product structure complexity, and product qualification rate (Zhang, et al., 2020). Optimizing production efficiency can shorten production cycles and reduce costs. Meanwhile, the complexity of the product structure directly affects production difficulty and maintenance work in the later stage. Product qualification rate is a key indicator of production quality, with a high rate reducing rework and after-sales maintenance, ensuring product quality.

3. Installation and Maintenance Factors

The installation and maintenance of stereo parking systems are related to system stability and maintenance costs after deployment. Product safety and reliability are

paramount, ensuring the safety of users and their property (Wang & Chen, 2019). The convenience of installation and maintenance determines the efficiency of later services and system availability. The product qualification rate is also an important indicator for evaluating installation and maintenance work, ensuring the long-term stable operation of the system.

4. Safety of Use

The safety of use is crucial in stereo parking systems, involving both personnel and vehicle safety (Xu & Zhao, 2021). System design should adhere to strict safety standards, including but not limited to measures against falling objects, pinching hazards, and fire hazards. Additionally, emergency response capability is part of safety of use, requiring the system to respond rapidly and handle emergencies effectively.

5. Comprehensive Consideration of Influencing Factors

In addition to the aforementioned basic attributes, user experience should also be considered. This includes satisfaction with management mode structure and safety of use, among other factors, with optimization designs based on these factors (Yang et al., 2017). Improving user experience not only enhances customer loyalty but also attracts new users through word-of-mouth effects. Therefore, the design of stereo parking systems should be user-centric, considering various factors comprehensively to achieve efficiency, safety, convenience, and economy.

In conclusion, the design, production, installation, operation, and maintenance of stereo parking systems involve a complex process requiring consideration of multiple attribute factors. In practice, continuous optimization of these factors is necessary to ensure that system performance meets user needs while maintaining economic and sustainable operation.

2.2.2 Customer Expectations Attributes

When discussing the customer expectations attributes of stereo parking systems, we need to consider the influences of usage environment, spatial layout, and consumer factors. The following literature review analyzes in detail how these aspects shape customers' expectations of stereo parking systems.

1. Influence of Usage Environment

The usage environment is one of the important factors that customers consider when choosing stereo parking systems. The convenience, safety, and comfort of the environment all affect customers' expectations. For example, whether the stereo parking system is located in the city center or near transportation hubs directly impacts users' frequency of use and satisfaction (Chen & Huang, 2015). Additionally, the safety of the environment, such as the completeness of lighting, surveillance, and emergency response facilities, is also a key consideration for users (Lin, et al., 2016). The cleanliness and maintenance of the environment also affect users' experience and, consequently, their expectations and overall satisfaction (Lu & Skoog, 2017).

2. Influence of Spatial Layout

Spatial layout includes the design of the stereo parking system, the size of parking spaces, the accessibility of parking spaces, and the clarity of directional signs . An

efficient design can maximize space utilization, provide more parking spaces, and ensure that vehicles can enter and exit quickly (Wang & Huang, 2018). The size of parking spaces is crucial for accommodating different types of vehicles, while the accessibility of parking spaces affects the convenience of parking and retrieval for users (Xu & Wu, 2019). Clear directional signs help users quickly find parking spaces and exits, enhancing the overall user experience (Tsai & Huang, 2020).

3. Influence of Customer Factors

Customer factors mainly involve cost-effectiveness, payment diversity, and the provision of additional services. Users expect stereo parking systems to provide reasonable prices and cost-effective services (Chiu et al., 2014). The flexibility of payment methods, such as support for mobile payments, season passes, or monthly passes, can meet the needs of different users (Kuo & Yang, 2016). In addition, value-added services such as vehicle cleaning and maintenance reminders can enhance customer satisfaction and loyalty (Su & Chen, 2017).

In summary, the customer expectations attributes of stereo parking systems result from the interaction of multiple factors. The convenience, safety, and comfort of the usage environment, the efficiency, rationality, and humanization of spatial layout, and the cost-effectiveness, payment convenience, and richness of additional services in terms of consumer factors are all important elements of customer expectations. Therefore, the design and operation of stereo parking systems should comprehensively consider these factors to meet or even exceed customer expectations, thereby enhancing customer satisfaction and the system's market competitiveness. Future research can further explore how to enhance the overall user experience of stereo parking systems through technological innovation and service optimization.

2.2.3 Product Attractiveness Attributes

When exploring the attractiveness attributes of stereo parking systems from the perspective of customers, it is essential to consider factors that exceed user expectations and provide users with a sense of "delight" in their experience. These factors not only influence users' actual usage experiences but also involve their physiological and psychological responses. The following literature review analyzes these attractiveness attributes and their application in the design of stereo parking systems.

1. Human-Machine Interaction Impact

Human-machine interaction is a crucial dimension in stereo parking systems, directly affecting users' physiological perception and operational experience. The application of electroencephalogram (EEG) testing techniques can help designers understand users' cognitive load and emotional changes when using stereo parking systems (Zhang et al., 2020). By optimizing human-machine interfaces, such as simplifying operation processes and providing intuitive feedback and guidance, designers can reduce users' psychological cognitive load, enhance operational intuitiveness, and increase pleasure (Li & Wang, 2019).

2. Product Perception and Physiological Changes

Users' physiological perceptions play a vital role in the use of stereo parking systems. Product design needs to consider the impact of multiple sensory channels, such as vision, hearing, and touch. For example, factors like the noise level during system operation, lighting design, and clarity of signage can affect users' emotions and satisfaction (Tang et al., 2018). EEG testing techniques can reveal users' physiological reactions, such as attention allocation and emotional fluctuations, providing scientific evidence for design decisions (Chen & Lin, 2021).

3. Psychological Cognitive Load

The design of stereo parking systems should minimize users' psychological cognitive load to make the parking process more relaxed and enjoyable. Designers can achieve this by providing clear instructions, simplifying operation processes, and implementing intelligent user interfaces (Wu & Chiang, 2020). Additionally, introducing smart assistant functions, such as automatic parking and vehicle positioning, can further enhance the user experience and reduce operational complexity (Xu & Zhao, 2017).

In summary, the attractiveness attributes of stereo parking systems are achieved through a deep understanding of users' physiological and psychological needs and the optimization of human-machine interaction design. Future research can further explore how to enhance the user experience of stereo parking systems through technological innovation and service design, making them not only functional facilities but also spaces that provide pleasure and surprises.

2.3 Research Theory Basis

2.3.1 User-Centered Design Theory

In the field of product design and human-computer interaction, User-Centered Design (UCD) has become a core concept, especially suitable for the development of vertical parking systems. The concept of UCD was first elaborated in the book "The Design of Everyday Things" (Norman, 1986), while the international standard ISO 13407 further defined the process of human-centered interactive system design. Subsequently, the ISO 241-210 standard updated and supplemented these concepts, emphasizing key design steps, including understanding the usage environment, clarifying user requirements, generating design solutions, and evaluating designs (ISO, 2010).

In the development of vertical parking systems, the concept of user-centered design is crucial as it directly relates to user experience and satisfaction with the system. The user-centered design concept highlights the importance of continuously collecting user feedback during the design process to ensure that design solutions accurately reflect user needs (Lu, 1998). Applying the ISO 13407 theoretical prototype to the entire design research process, vertical parking systems have been optimized through surveys and usability evaluations (Liu, 2005).

The deductive analysis method provides guidance for software development processes by deeply analyzing user behaviors and needs, which is also applicable to the

design of vertical parking systems (Light & Smith, 2008). Applying user experience throughout the product development process and conducting comprehensive evaluations of furniture product design schemes based on customer satisfaction surveys provide valuable references for the user interface and interaction design of vertical parking systems (Hu, 2010).

Based on user consumption habits, interaction models are constructed for vending machines, and this user behavior-based design concept can be applied to vertical parking systems, especially in designing vehicle access processes and payment systems (Miao, 2012). Research on ergonomics in the intelligent era and the user-centered design concept explores user experience, innovative methods, and application design, providing new perspectives for the intelligence and user experience of vertical parking systems (Xu, 2015).

In conclusion, applied research on user-centered design mainly revolves around user experience requirements, customer satisfaction, experience testing, information interaction feedback, and result evaluation. These research findings provide target positioning and preliminary research foundations for the development of vertical parking systems. Future research can further explore how to more effectively apply these design concepts and methods to the practical development of vertical parking systems to enhance customer satisfaction and market competitiveness.

2.3.2 Design Cognitive Theory

In exploring the field of design cognition, scholars endeavor to optimize the interaction between users, products, and service systems by applying theories and methods of cognitive science to design practice (Cansev et al., 2019); This interdisciplinary research domain focuses on users' cognitive behaviors such as perception, thinking, and emotions during the use of products or services (Huang et al., 2020).

For example, through studying the emotional touch characteristics and their effects on the nervous system, design goals and standards for emotional touch interfaces have been proposed to meet specific psychological needs (Cansev et al., 2019). Addressing cognitive processing issues related to robot malfunctions, a model for processing robot malfunction information was developed to facilitate the development of user-centered fault handling strategies (Honig et al., 2019). Emphasizing the importance of graphic visualization, a model for aesthetic treatment of graphic visualization was proposed based on theories of user cognitive psychology (Huang et al., 2020).

In specific applications, Li and Zhang (2020) combined studies on user visual perception to explore the application of interface design (Li & Zhang, 2020), while Liu (2021) proposed new methods for car styling design based on the cognitive psychology of young consumers. The construction of a mental model for intelligent robot systems strengthened the connection between designers and users (Zhang et al., 2021). The relationship between cognitive psychology and user experience design was discussed, and empirical support was provided through case studies (Xie & Xin, 2021). Clustering analysis methods were used to extract user operation preference features, improving the

compatibility of software interfaces (Li & Zhao, 2021). The emotions of media users were reviewed based on cognitive science literature, summarizing research content, methods, and future directions (Zhang & Wu, 2021).

Furthermore, a model for adaptive thinking in product styling associations was established, providing a new approach to enhancing the ability to analyze user psychology (Liu, 2021). From the perspective of human-machine theory, the rearrangement of product control panels was undertaken to improve user operation convenience (Qian, 2021). Combining sensory engineering and knowledge engineering advanced the development of design solutions to meet both physical and psychological user needs (Wang, 2021). By transforming sensory analysis of user cognition into mathematical expressions, the issue of user fuzzy cognition was addressed (Yang, 2021). Product design experience factors were subdivided based on user cognition, guiding innovative product experience design (Zhang, 2021). A cognitive psychological model framework for service design conducive to enhancing brand value was constructed (Li, 2021).

In terms of technological applications, the integration of QFD and FBS methods converted user sensory cognition into technical requirements, validating the effectiveness of feature conversion (Chen, 2022). The importance of emotional cognition in influencing user preferences for humanoid robot appearance was confirmed through eye-tracking experiments (Li, 2022). A cognitive load model in virtual interaction systems was studied based on user behavior and environmental cognition frameworks (Xu, 2022). To improve user cognition fuzzy issues, a computer software system for product styling interaction design was developed (Zhou, 2022). Genetic algorithms were used to optimize color noise cognition models, enhancing the adaptability of color schemes (Zhang , 2022).

From the above research, it is evident that a user-intent-driven design engineering knowledge system can serve as a reference for in-depth research into the cognitive science of customer satisfaction with product operational experiences and product structures in the use of multi-story parking systems.

2.3.3 Sensory Engineering Theory

Sensibility is a comprehensive response of individual experience and spirit. Unlike the emphasis on logical deduction of rational thinking, sensibility cognition is a subjective response at the psychological level. It cannot be objectively grasped and explained solely from the level of sensory perception. Sensibility engineering is the study of harmoniously transmitting users' emotional needs to producers.

In the fields of product design and human-computer interaction, user-centered design has become a core concept, especially applicable to the development of stereo parking systems. The book "The Design of Everyday Things: Revised and Expanded Edition" first detailed the concept of User-Centered Design (UCD) (Donald, 1986), while the international standard ISO 13407 further defined the process of interactive system design centered on people. Subsequently, the ISO 241-210 standard updated and supplemented these concepts, emphasizing key design steps, including understanding

the usage environment, clarifying user requirements, generating design solutions, and evaluating designs.

In the development of stereo parking systems, the concept of user-centered design is crucial because it directly relates to the system's user experience and satisfaction. The user-centered design concept emphasizes the importance of continuously collecting user feedback during the design process to ensure that design solutions accurately reflect user needs (Lu, 1998). Applying the ISO 13407 theoretical prototype to the entire design research process, optimized design for stereo parking systems was achieved through surveys and usability evaluation analysis combined with specific cases (Luo, 2007).

The deductive analysis method proposed provides guidance for the software development process through in-depth analysis of user behavior and needs. This method is also applicable to the design of stereo parking systems (Light, 2008). Applying user experience to the entire product development process and conducting comprehensive evaluations of furniture product design schemes based on customer satisfaction surveys provide reference values for the user interface and interaction design of stereo parking systems (Hu, 2010).

Based on consumer habits, an interaction model was constructed using self-service vending machines as the object, which can be applied to stereo parking systems, especially in the design of vehicle access processes and payment systems (Miao, 2012). Research on ergonomics in the era of artificial intelligence and user-centered approaches explored user experience, innovative methods, and application design, providing a new perspective for the intelligence and user experience of stereo parking systems (Xu, 2015).

The SUM-IF EDM application research framework was built through qualitative and quantitative evaluations, providing scientific methodological support for research on user experience and functional optimization of stereo parking systems (Yu, 2018).

In conclusion, user-centered design research focuses on user experience requirements, customer satisfaction, experience testing, information interaction feedback, and result evaluation. These research findings provide a foundation for the development and positioning of stereo parking systems. Future research can further explore how to more effectively apply these design concepts and methods to the actual development of stereo parking systems to enhance customer satisfaction and market competitiveness. From the aforementioned studies, it is evident that a user-centric sensibility engineering knowledge system can serve as a reference for the design cognition science of the attractiveness attributes of stereo parking systems in terms of customer satisfaction.

2.3.4 Customer Satisfaction Theory

Customer satisfaction is the result of the interaction between factors such as supply and demand, product positioning, product functionality, and market environment. Users can intuitively perceive every aspect of the product or service provided during their experience (Bai & Liao, 2014). customer satisfaction management is a novel

management approach that emerged at the end of the last century. customer satisfaction reflects the comparison between the products and services provided by the supplier and the perceptions and expectations of the end demander, representing the individual feelings and expectations of users (Yi, 2003). customer satisfaction is an accumulative process, not merely evaluated based on a single experience. customer satisfaction theory reveals the issues existing in the products and services provided by enterprises, enabling them to analyze and address these difficulties with the goal of enhancing customer satisfaction.

Customer satisfaction refers to users' perceptions and evaluations of aspects such as performance, quality, and price while using a product or service. customer satisfaction can be divided into three levels: dissatisfied, moderately satisfied, and highly satisfied. The level of customer satisfaction directly impacts their loyalty, word-of-mouth communication, and purchase intention (Fornell et al., 1996).

Methods for measuring customer satisfaction mainly include questionnaire surveys, interviews, observations, and experiments. Among these, questionnaire surveys are the most commonly used method, typically employing 5-point or 7-point scales to rate customer satisfaction. Additionally, customer satisfaction indices (such as the American Customer Satisfaction Index, ACSI) can be calculated to measure customer satisfaction (Fornell et al., 1996).

Customer satisfaction is influenced by various factors, primarily including product quality, service quality, price, brand image, and user experience. Product quality forms the basis of customer satisfaction, while service quality and user experience directly affect perceived value. The influence of price and brand image on customer satisfaction mainly manifests in users' psychological expectations and cognitive evaluations (Anderson et al., 1994).

To enhance customer satisfaction, enterprises need to focus on several aspects: Firstly, improving product quality to ensure products meet user needs. Secondly, optimizing service processes to enhance service quality and improve user experience. Thirdly, setting reasonable prices to ensure product competitiveness. Fourthly, building a favorable brand image to increase user awareness and trust. Lastly, paying attention to user feedback and continuously improving products and services (Oliver, 1999).

The customer satisfaction theory is the study of users' satisfaction levels and influencing factors during the use of products or services. Through research on customer satisfaction, enterprises can better understand user needs, improve product or service quality, and thereby enhance customer satisfaction and loyalty.

2.4 Stereo Parking Systems

First, as an international metropolis, Shanghai faces severe parking challenges due to accelerated urbanization and the growing number of vehicles. To tackle this issue, Shanghai has actively introduced and promoted automated parking systems (Chen & Wang, 2020). These systems park vehicles on multiple levels, either vertically or at an incline, significantly enhancing land utilization. In several areas of Shanghai, such as

Minhang District and Fengxian New City, multiple automated parking garages have been built, effectively alleviating the parking pressure in surrounding areas (Chen & Wang, 2020). These parking facilities not only offer efficient parking solutions but also integrate modern design elements, becoming a distinctive feature of the city.

Second, Shanghai's automated parking systems are not only abundant but also diverse in type. From common lift-and-slide systems and simple lift systems to vertical and horizontal circulation systems, various types of automated parking equipment can be found across the city (Li, Liu, & Zhang, 2022). These facilities not only improve parking efficiency but also provide more convenient services through intelligent management. For instance, some parking garages are equipped with smart navigation systems that help drivers quickly find parking spaces, while others support remote reservations and payment options, offering drivers a more intelligent and streamlined parking experience (Chen & Wang, 2020).

Shanghai has also constructed large automated parking garages in several areas, such as commercial centers in Xujiahui and Lujiazui, as well as in densely populated residential areas. These parking garages use advanced automated equipment and intelligent management systems, making vehicle parking and retrieval more efficient (Li, Liu, & Zhang, 2022). Additionally, Shanghai encourages the use of idle spaces in old residential areas and public green spaces for constructing automated parking facilities, further easing parking pressure (Chen & Wang, 2020). In the future, with continuous technological advancements and policy support, the application of automated parking systems in Shanghai will become even more widespread, providing residents with more convenient and efficient parking services.

In conclusion, Shanghai has made remarkable progress in both the quantity and variety of automated parking systems, offering effective solutions to the city’s parking challenges.

2.5 Conceptual Framework

The literature review of this study is based on the user-centered design theory, the design cognitive theory, and the sensory engineering theory to explore the factors influencing customer satisfaction in the use of stereo parking systems.

To analyze the factors influencing customer satisfaction in the use of stereo parking systems, this study constructs a model with product basic attributes, customer expectation attributes, and product attractiveness attributes as independent variables. Customer satisfaction in the use of stereo parking systems is influenced by product basic attributes, customer expectation attributes, and product attractiveness attributes, as shown in Figure 2.1.

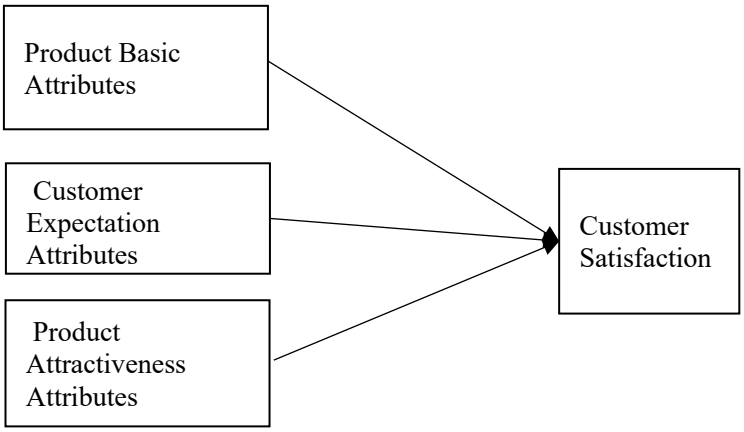

Figure 2.1 Conceptual Framework

Chapter 3 Research Methodology

3.1 Research Design

This study adopted a quantitative research approach. Based on existing theoretical foundations and previous studies, the independent variables in the model are product basic attributes, customer expectation attributes, and product attractiveness attributes, while the dependent variable is customer satisfaction in the use of stereo parking systems.A questionnaire survey was conducted with the users of stereo packing systems in Shanghai.

3.2 Questionnaire Design

The structural design of the survey questionnaire in the research is divided into three main parts:

The first part is acknowledgments and instructions for filling out the questionnaire. Firstly, the purpose of distributing this questionnaire is explained, then the terms appearing in the questionnaire are explained and clarified to ensure that the respondents fully understand the meaning of the items and provide the most authentic results. Finally, the confidentiality of the questionnaire data processing and the destination is explained, and gratitude is expressed to the respondents for their sincere answers.

The second part is the collection of personal information of the survey participants including gender, age, education background, and income range of the survey participants.

The third part is the scale measurements of the four variables of this study. The independent variables are product basic attributes, customer expectation attributes, and product attractiveness attributes, and the dependent variable is customer satisfaction. The scale items are derived from mature scales in related research areas, and adjusted according to the background of stereo parking systems in this study to ensure that the questionnaire content is suitable for the objective of this study, with a total of 24 items.

Since the answers corresponding to the screening items and the personal information of the respondents are clear, the principle of "no duplication or omission" is followed in the setting of options, presented in the form of multiple-choice questions. However, the items in the scale part are related to the personal attitudes of the respondents, which are difficult to quantify as latent variables and are not easy to measure. Therefore, this study uses a Likert five-level scale to describe the answers in the questionnaire. The subjective attitudes of the survey participants are quantified into specific scores ranging from 1 to 5, with options representing "very dissatisfied", "dissatisfied", "neutral", "satisfied", and "very satisfied", respectively. As the numerical value increases, the degree of agreement of the respondents with the item description also increases, thus achieving the quantification measurement of latent variables. The questionnaire consists of 24 questions, with questions 1-24 being scale questions, of which product basic attributes, customer expectation attributes, and product

attractiveness attributes each have 7 items, and customer satisfaction with 3 item. Items are designed for each variable, and are coded as shown in Table 3.1.

Table 3.1 Questionnaire Design

Variable	Measurement items	NO.
Product Basic Attributes	1. Satisfied with the ease of parking and picking up?	Q1
	2. Are you satisfied with the parking management system?	Q2
	3. Are you satisfied with the level of difficulty in operating the stereo parking system?	Q3
	4. Operate the stereo parking system parking and picking up process satisfaction?	Q4
	5. Satisfied with the ease of reversing when operating the stereo parking system?	Q5
	6. Are you satisfied with the structural design of the entrance/exit convenience and parking spaces?	Q6
	7. Are you satisfied with the safety of operating the stereo parking system in and out?	Q7
Customer Expectation Attributes	1. Are you satisfied with the overall colour scheme and environment of the parking?	Q8
	2. Are you satisfied with the location of the stereo parking for vehicle access?	Q9
	3. Are you satisfied with the size of the parking space in the stereo parking?	Q10
	4. Are you satisfied with the size of the vibration sensation of the car body when stopping and picking up the car?	Q11
	5. Are you satisfied with the eye-catching design of the entrance/exit guide signs?	Q12
	6. Satisfaction with the charging method and consumption level?	Q13
	7. Satisfied with the design in terms of sun protection, wind and rain protection?	Q14
Product Attractiveness Attributes	1. Are you satisfied with the human-machine interface for operating the stereo parking system?	Q15
	2. Are you happy with the ease and pleasure of operating a stereo parking system for parking?	Q16
	3. Are you pleased and surprised by the operation process of parking and picking up the car in the stereo parking?	Q17
	4. Are you satisfied with the overall functionality and physical and mental perception of the product design?	Q18

	5. Are you happy with the human-computer interaction experience of operating the stereo parking system?	Q19
	6.Were you pleasantly surprised by the overall mechanical feel of the stereo parking styling?	Q20
	6. Is it satisfactory in terms of the efficiency of installation and maintenance, and in dealing with faults?	Q21
Customer Satisfaction	1. Are you satisfied with the service of the automated parking system?	Q22
	2. Are you satisfied with the operation of the automated parking system?	Q23
	3. Are you generally satisfied with the stereo parking system?	Q24

3.3 Hypotheses

To analyze the factors influencing customer satisfaction, this study constructs a model with product basic attributes, customer expectation attributes, and product attractiveness attributes as independent variables.

Customer satisfaction is the evaluation of users. Stereoscopic parking production enterprises need to determine the needs of the target user group based on customer satisfaction, and use this as the direction of improvement, in order to provide users with a good product and service experience, ultimately gain their trust, and achieve the effect of the virtuous cycle of enterprise operation. Therefore, hypotheses are proposed as shown in Figure 3.1.

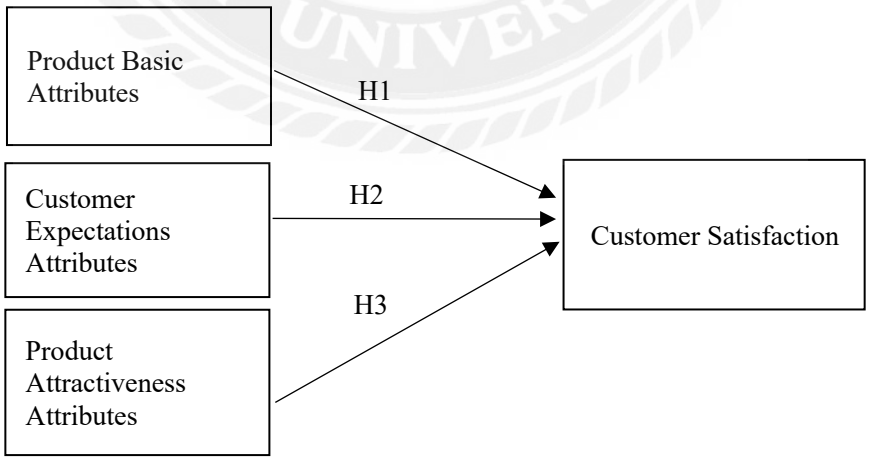

Figure 3.1 Hypotheses

H1: Product basic attributes have a positive impact on customer satisfaction with the stereo parking systems.

H2: Customer expectation attributes have a positive impact on customer

satisfaction with the stereo parking systems.

H3: Product attractiveness attributes have a positive impact on customer satisfaction with the stereo parking systems.

3.4 Population and Sampling

The population of this study is the users of the stereo parking systems,living in streaming rooms. The main subjects of this research are customers in live streaming rooms. The sampling research method employed in this study is the simple random sampling.

$$\mathrm{N} = \frac{r^2 * q^2}{E}$$

According to the sample formula calculation, the data collected are the quartiles of the standard normal distribution, with a typical confidence level of 95%. "q" represents the sample standard deviation, which is usually estimated as 0.5. The margin of error, denoted as "K" (i.e., the maximum allowable difference between the sample mean and the population mean), is set at 0.05. Applying this formula yields a sample size of 408 respondents.

3.5 Data Collection

Before conducting the questionnaire survey, this study conducted a pre-test. The questionnaire was precisely distributed to respondents through the "Credamo platform," and cash rewards were given to respondents with good questionnaire completion quality. The pre-test found that although the instructions given before the survey explicitly requested objective answers, respondents may still have formed subjective judgments of good or bad, right or wrong, leading to a tendency to choose extreme values in their responses. Therefore, in the formal survey questionnaire, questions were further elaborately described to prevent ambiguous statements. Due to the uncontrollability of respondents' answering situations when anonymously filling out the questionnaire online, online incentives were used to encourage respondents to complete the survey seriously, thereby stimulating their enthusiasm for participating in the survey through paid responses. According to the collected data, 482 individuals participated in the survey. After screening out cases of missed questions and extreme situations where all answers were the same, 400 valid questionnaires were obtained,with an effective of 82.99%.

3.6 Data Analysis

3.6.1 Reliability

Reliability refers to the consistency of a measure with the variable it is intended to measure. It assesses the extent to which scores can be trusted. The higher the reliability, the less error is introduced into scores from different items on the same scale. Therefore, scores on the scale move in a consistent manner among respondents, reflecting the true state of affairs. Greater consistency indicates higher reliability, and vice versa. In this

study, Cronbach's Alpha was used as the basis for assessing questionnaire reliability. Generally, Cronbach's alpha values range from 0 to 1. A higher Cronbach's alpha coefficient indicates higher questionnaire reliability. The survey data indicate good reliability of the questionnaire. The questionnaire consists of 24 items. The Cronbach's alpha value for product basic attributes is 0.824. For customer expectation attributes, it is 0.801, and for product attractiveness attributes, it is 0.879, cronbach alpha for customer satisfaction is 0.898. All values are greater than 0.8, indicating high stability and consistency of the scale. This demonstrates excellent questionnaire reliability in the present study, as shown in Table 3.2.

Table 3.2 Reliability Analysis

Variable	Cronbach Alpha	N of Items
Product Basic Attributes	0.824	7
Customer Expectation Attributes	0.859	7
Product Attractiveness Attributes	0.801	7
Customer Satisfaction	0.898	3

Validity refers to the examination of the validity of each variable in the questionnaire. Factor analysis is a commonly used method to test the validity of a questionnaire. The validity of the questionnaire is determined through factor analysis. The KMO test and Bartlett's sphericity test of the questionnaire need to be conducted before principal component factor analysis. Factor analysis can only be conducted if the KMO value is greater than 0.7. The survey data show that the overall KMO value is 0.877, with a significance of 0.000, which is less than 0.05, reaching a significant level, indicating that factor analysis can be performed. This study employed confirmatory factor analysis (CFA). The results of factor analysis on each variable indicate that the KMO and Bartlett's sphericity tests were conducted on the pre-test data to validate the structural validity of the scale. The results are shown in Table 3.3, with KMO values exceeding 0.8 and significant Bartlett's sphericity test, indicating good structural validity of the scale. This implies good independence of each dimension, indicating good overall validity of the questionnaire.

Table 3.3 KMO and Bartlett's Test

Kaiser -Meyer -Olkin Sampling Adequacy Measures		0.877
Bartlett's test of sphericity	Approx. CARTES	6942.00

	df	194
	organizations	0.000

Table 3.4 Factor Analysis (CFA)

Total Variance Explained								
unit	Initial eigenvalue		The extraction of square loads			Rotation of the square load		
	variance %	accrue %	total	Percentage of variance	accrue %	total	Percentage of variance	accrue %
1	21.623	21.623	4.656	22.523	22.523	3.732	15.330	16.334
2	12.017	33.640	3.104	12.017	34.640	2.721	12.284	28.615
3	9.753	42.393	2.188	9.753	43.393	2.833	12.039	36.653
4	6.716	58.185	1.779	6.716	68.185	2.475	8.900	68.011

The cumulative rate of product basic attributes, customer expectations attributes, and product charm attributes is 68.011%. Finally, data analysis indicates that the Cronbach's α for product basic attributes is 0.856, for customer expectations attributes is 0.880, and for product charm attributes is 0.895. All Cronbach's α values are greater than 0.7. They explain 68.011% of the total variance, as shown in Table 3.4. Both reliability and validity analyses were conducted for each variable, demonstrating good independence among dimensions. The final results indicate that the questionnaire has good reliability and validity.

3.6.3 Analysis of the Questionnaire Date

On the basis of the above data analysis, the relevant data of the questionnaire survey were analysed in detail in Chapter 4. Descriptive statistics, correlation analysis and multivariate reggression analysis were used to analyge the data and verify the research hypotheses.

Chapter 4 Findings

4.1 Introduction

This chapter validats the conceptual model of customer satisfaction constructed in Chapter 2 and verify the research hypotheses. Building upon the analysis of the questionnaire reliability and validity in Chapter 3, statistical analysis and hypothesis testing were conducted on the questionnaire data.

4.2 Descriptive Statistics of Variables

This study collected and screened a total of 400 valid questionnaires. To comprehensively understand the distribution of the sample demographic , this section described the descriptive statistical analysis using SPSS software on aspects such as gender, age, educational background, and monthly income level, as shown in Table 4.1.

Table 4.1 Descriptive Statistics of Sample

Characteristic	Options	Frequency	Percentage(%)
Gender	Male	213	53.25
	Female	187	46.75
Age	20 years old and below	75	18.75
	21 to 50 years old	237	59.25
	50 years old and older	88	22.00
Educational background	High school and below	35	8.75
	Junior college	37	9.25
	Undergraduate	221	55.25
	Bachelor's degree	70	17.50
	Doctoral degree	37	9.25
Monthly Income level	Less than 3000	50	12.50
	3000 to 5000	94	23.50
	5000 to 8000	162	40.50
	8000 to 12000	72	18.00

	12000 or more	22	5.50
Use of stereo parking systems	Never	33	8.25
	Infrequent	72	18.00
	General	69	17.25
	Regular	195	48.75
	Frequently	31	7.75

After conducting a descriptive statistical analysis of the respondents' personal information, it was found that the gender ratio is relatively balanced, indicating a reasonable distribution of gender in the questionnaire. A majority of the valid questionnaires come from male respondents, accounting for over 53%, indicating a higher level of interest and usage among male customers for the stereo parking systems as shown in Figure 4-1.

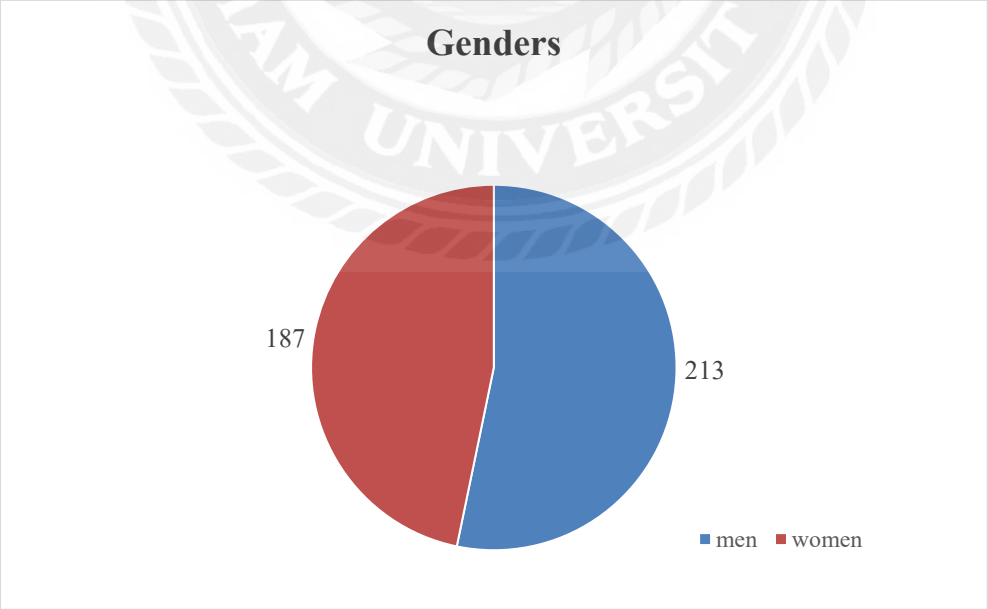

Figure 4.1Descriptive Statistics of Genders

From the perspective of age groups, almost all age groups are covered, but the main group consists of young and middle-aged individuals aged 21-50. This age group accounts for 60% of the total sample,representing the primary customers for the stereo parking systems. The reason for this may be that these individuals not only own private vehicles but also have a certain level of purchasing power, as shown in Figure 4-2.

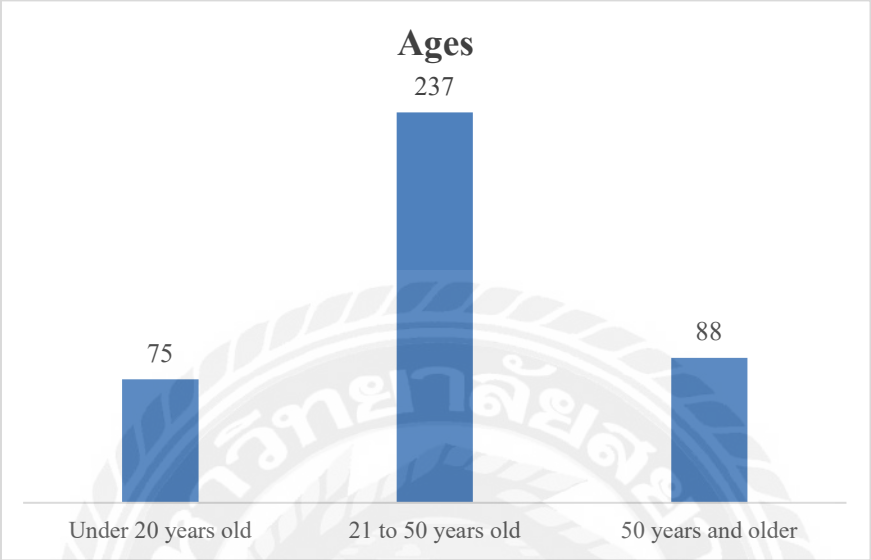

Figure 4.2 Descriptive Statistics of Ages

In terms of educational background, the survey covered individuals from high school to doctoral levels. However, the majority of respondents held a bachelor's degree, comprising over 50% of the total. The overall educational level of the respondents was relatively high, with the number of participants holding doctoral and master's degrees exceeding those with college or lower educational qualifications, as illustrated in Figure 4.3.

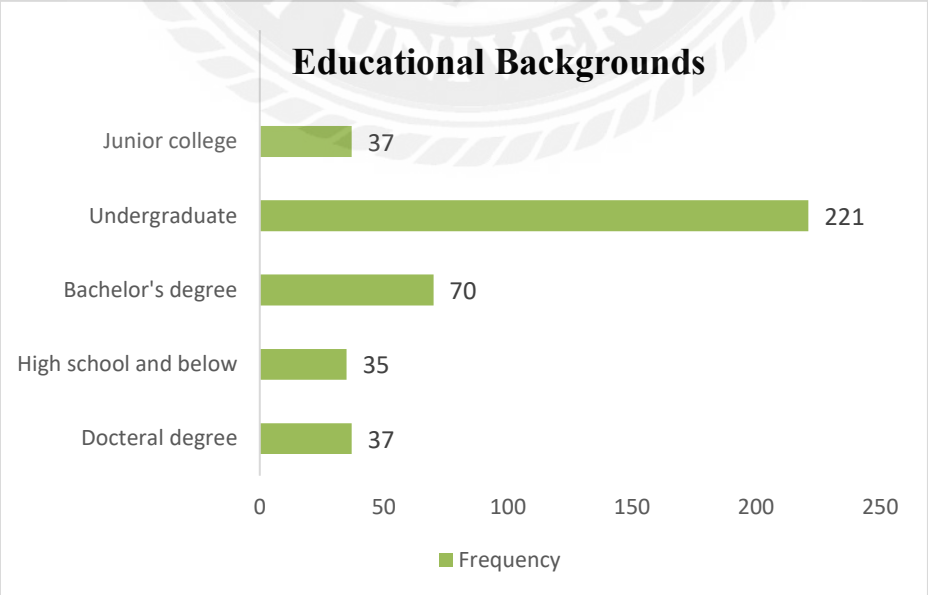

Figure 4.3 Descriptive Statistics of Educational Backgrounds

In terms of monthly income levels, the survey encompassed a broad range, with the majority falling within the moderate-income range of 5000-8000 per month, constituting 40% of the sample. The percentage of individuals with low incomes was relatively low, aligning with the target customer base of new retail enterprises, as depicted in Figure 4.4.

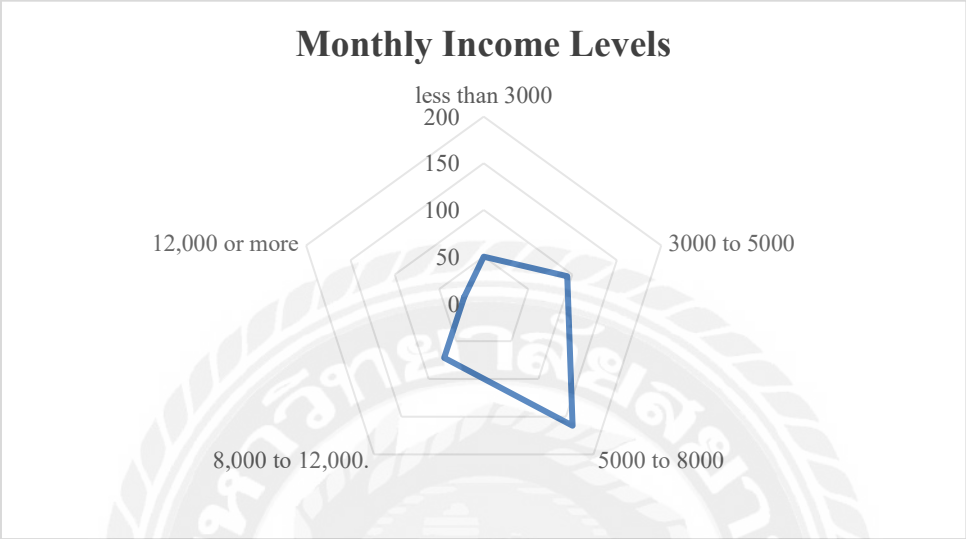

Figure 4.4 Descriptive Statistics of Monthly Income Levels

From the perspective of the use of the stereo parking systems, about 7.75% of the respondents indicated that they had purchased annual cards for frequent use of the system, while half of the respondents stated that they regularly used the stereo parking system. The combined proportion of frequent and regular users accounts for approximately 56.5% of the total, as shown in Figure 4-5.

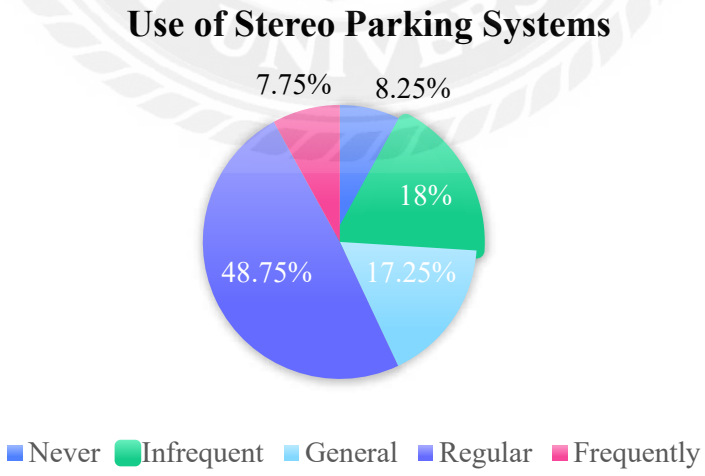

Figure 4.5 Descriptive Statistics of the Use of Stereo Parking Systems

4.3 Research Results

4.3.1 Correlation Analysis

Correlation analysis is primarily used to illustrate the relationships between

different variables. Pearson correlation analysis is used to describe the linear relationship between variables, with Pearson correlation coefficients ranging from -1 to 1. By employing Pearson correlation coefficient analysis, the relationships among the factors influencing use of stereo garage systems were analyzed. Based on Table 4.2, it can be concluded that the Pearson correlation coefficients for the product basic attributes, customer expectations, product attractiveness and customer satisfaction are all greater than 0.5 but less than 0.9, with a significance of level of $P < 0.01$, indicating that there are significant positive correlations among the variables.

Table 4.2 Correlation of Variables (Pearson correlation matrix)

Variable	Product Basic Attributes	Customer Expectation Attributes	Product Attractiveness Attributes	Customer Satisfaction
Product Basic Attributes	1			
Customer Expectation Attributes	0.591 * *	1		
Product Attractiveness Attributes	0.551 * *	0.665 * *	1	
Customer Satisfaction	0.547**	0.635**	0.565**	1

note:* p <0.05， ** p <0.01， *** p <0.001

From the table, it can be observed that the Pearson correlation coefficients for the product basic attributes, customer expectation attributes, and product attractiveness attributes are all greater than 0.5 but less than 0.9, with a significance level of $P < 0.01$, indicating a positive correlation between variables.

The Pearson correlation coefficient between product basic attributes and customer expectation attributes is 0.591, with $P < 0.01$, indicating a general correlation between these two variables.

The Pearson correlation coefficient between the product basic attributes and product attractiveness attributes is 0.551, with $P < 0.01$, suggesting a correlation between them, also of a general nature.

The Pearson correlation coefficient between product basic attributes and customer satisfaction is 0.547, $P<0.01$, indicating a correlation.

The Pearson correlation coefficient between customer expectation attributes and product attractiveness attributes is 0.665, with $P < 0.01$, indicating a general correlation between them.

The Pearson correlation coefficient between customer expectation attributes and customer satisfaction is 0.635, $P<0.01$, indicating a correlation. And it is a general correlation.

The Pearson correlation coefficient between product attractiveness attributes and customer satisfaction is 0.565, $P<0.01$, indicating a correlation. And it is a general correlation.

Based on the above research analysis, factors influencing customer satisfaction with the use of the stereo parking system include product basic attributes, customer expectation attributes, and product attractiveness attributes. Therefore, to improve customer satisfaction and cultivate loyal customers, it is necessary to focus on these three aspects and adopt appropriate and scientific management methods. The correlations of variables indicate that each variable plays a certain role in the model, reflecting the rationality of the model construction.

4.3.2 Multivariate Regression Analysis

The data underwent multiple regression analysis to ascertain the relationship between the dependent variable, customer satisfaction, and the independent variables: product basic attributes, customer expectation attributes, and product attractiveness attributes . The regression equation was significant, with an F-value of 142.172 and $p < 0.001$. The Durbin-Watson test yielded a value of 1.944, falling within the range of 1.8 to 2.2, indicating independence of data and meeting the requirements of linear regression. In covariance diagnostic results, the variance inflation factor (VIF) values were close to 1, with the product basic attributes VIF at 1.118, customer expectation attributes at 1.091, and product attractiveness attributes at 1.195, indicating no covariance in the data. Product basic attributes ($\beta=0.135$, $p < 0.05$), customer expectations attributes($\beta=0.217$, $p < 0.05$), and product attractiveness attributes($\beta=0.101$, $p < 0.05$) significantly and positively influenced customer satisfaction. These variables collectively explained 57.5% of the variance in customer satisfaction with the stereo parking systems.

Table 4.3 Multiple Regression Analysis

Item	Unstd. B	Std. Beta	t	Sig.	VIF	F	Durbin-Watson
Constant	3.209	-	7.506	0.000		142.172	1.944
Product Basic Attributes	0.135*	0.175	4.176	0.000	1.118		
Customer Expectation Attributes	0.217*	0.262	5.327	0.000	1.091		
Product Attractiveness Attributes	0.101*	0.130	2.753	0.006	1.195		
R-squared	0.579						
Adjusted R-square	0.575						

NOTE: * p <0.05， ** p <0.01， *** p <0.001

According to the multivariate regression analysis, the relationships among the variables are obtained:

Customer Satisfaction = 3.209 + 0.145 * product basic attributes + 0.217 * customer expectation attributes+ 0.101 * product attractiveness attributes.

Therefore, based on the data analysis results, in the study of factors influencing customer satisfaction with the stereo parking system, product basic attributes have a significant positive effect on customer satisfaction, supporting hypothesis H1;

Customer expectation attributes have a significant positive effect on customer satisfaction, supporting hypothesis H2; Product attractiveness attributes have a significant positive effect on customer satisfaction, supporting hypothesis H3.

Chapter 5 Conclusion and Recommendation

5.1 Conclusion

With the development of the automobile industry and the increase in per capita car ownership in China, parking difficulties have become a pressing issue in modern cities that urgently needs to be addressed. Developing stereo parking systems is the primary solution to this dilemma and is an inevitable requirement for social development. Currently, the development of stereo parking equipment in China has reached a certain scale and market. Although the design technology and production processes of stereo parking equipment are becoming increasingly sophisticated and mature, the current design and development of such systems are product-centered, with the goal of achieving functionality, but they do not fully meet the needs of users, and the design concepts lag behind the development demands of the times.

This chapter, based on the empirical analysis results of customer satisfaction with stereo parking systems in Chapter 4, proposes marketing strategies beneficial to the development of stereo parking systems from three aspects: product basic attributes, customer expectation attributes , and product attractiveness attributes. The aim is to guide enterprises in leveraging survey experiences to improve the promotion and usage of stereo parking systems.

The factors influencing customer satisfaction in the use of stereo parking systems in Shanghai.

Through correlation analysis and regression analysis, Pearson correlation coefficients for product basic attributes, customer expectation attributes, and product attractiveness attributes were obtained. The Pearson correlation coefficients are 0.591, 0.551, and 0.572, respectively. They are all greater than 0.5 but less than 0.9, with p-values less than 0.01, indicating the presence of correlation between variables. In the regression analysis, a regression model was constructed with coefficients of 0.145 for product basic attributes, 0.218 for customer expectation attributes, and 0.112 for product attractiveness attributes, indicating a positive correlation between each variable and customer satisfaction.

The research results demonstrate that product basic attributes, customer expectation attributes, and product attractiveness attributes influence customer satisfaction. These factors also have a positive impact on users' use of stereo parking systems.

Through research analysis, it is evident that factors affecting customer satisfaction include product basic attributes, customer expectations, and product attractiveness. Therefore, to improve customer satisfaction, it is necessary to address these three aspects and adopt reasonable and scientific management methods.

1. Basic product attributes have a positive impact on customer satisfaction.

The customer satisfaction of the stereo parking system in Shanghai is primarily determined by various basic attribute factors. If the operation and management are efficient, production quality is excellent, product structure design is reasonable, installation and maintenance are convenient, and usage is safe, then customer satisfaction is likely to be high. However, any deficiencies in any of these aspects may negatively impact customer satisfaction. Therefore, to improve customer satisfaction, it is necessary to comprehensively consider and optimize these key factors, ensuring that the stereo parking system meets high standards in operation, production, structure, installation and maintenance, as well as safety. Current research and practice indicate that the stereo parking system in Shanghai performs well in some aspects, but there is still room for improvement in others. Future design and optimization efforts should focus on enhancing performance in these areas to better serve users and ultimately increase overall customer satisfaction.

In summary, to achieve higher customer satisfaction with the stereo parking system in Shanghai, optimization and improvement are needed in various aspects such as management efficiency, management costs, operational models, production manufacturing, installation and maintenance, safety of use, and user experience.

2. Customer expectation attributes have a positive impact on customer satisfaction.

The customer satisfaction of the stereo parking system in Shanghai depends on the customer's expectations. In addition to being influenced by basic attributes, the customer satisfaction of the stereo parking system in Shanghai is also influenced by various factors in the expectations attributes, including the usability of the environment, spatial layout, and consumer demands. If the system performs well in terms of the convenience, safety, and comfort of the usage environment, the rationality and humanization of the spatial layout, as well as the economic benefits, payment convenience, and additional services of the consumer factors, then customer satisfaction is likely to be high. However, deficiencies in these aspects may lower customer satisfaction. Therefore, to improve customer satisfaction, it is necessary to comprehensively consider and optimize these key factors, ensuring that the stereo parking system meets high standards in operation, design, and service. Future research and practice should focus on enhancing the overall user experience of the stereo parking system through technological innovation and service optimization.

3. Product attractiveness attributes have a positive impact on customer satisfaction.

When analyzing the customer satisfaction of the Shanghai stereo parking system, we need to consider those attractiveness attributes that exceed user expectations and can provide users with a sense of "delight" in their experience. These attributes not only affect the actual user experience but also involve physiological and psychological reactions of the users. Considering these attractiveness attributes comprehensively, the customer satisfaction of the Shanghai stereo parking system is influenced by multiple factors. If the system excels in human-machine interaction design, considers the impact of sensory channels, reduces psychological cognitive loads, and analyzes relationships effectively, then customer satisfaction is likely to be high. However, deficiencies in

these aspects may lead to decreased customer satisfaction. Therefore, to improve customer satisfaction, it is necessary to comprehensively consider and optimize these key factors, ensuring that the stereo parking system meets high standards in operation, design, and service. Future research and practice should focus on enhancing the overall user experience of stereo parking systems through technological innovation and service design.

5.2 Recommendation

5.2.1 Continuous improvement of the service quality of the basic attributes of stereo parking systems from the customer's point of view.

Considering the basic attributes of the stereo parking system, the following are recommendations for improving the use of the stereo parking system in Shanghai:

1. Enhance operational efficiency: Optimize management operation modes using automation and intelligent technologies to improve management time efficiency and cost-effectiveness. For example, introduce intelligent scheduling systems and real-time monitoring technologies to reduce manpower requirements while increasing parking and retrieval speeds. Implement efficient resource allocation and scheduling strategies to ensure smooth operation during peak periods, avoid long waits, and enhance customer satisfaction.

2. Ensure high quality in product structure and installation maintenance: Focus on optimizing product structure design to ensure stability and safety while considering the impact of structural complexity on production efficiency and product qualification rates. Design should aim to simplify structures for ease of production and maintenance. Improve the convenience of installation and maintenance services to ensure the safety and reliability of the stereo parking system. Establish a professional maintenance team to provide rapid response maintenance services and enhance user confidence in system reliability.

3. Strengthen usage safety performance: The safety of using the stereo parking system is the foundation of user experience. Regular safety checks and updates to safety facilities such as emergency braking systems and anti-fall devices should be conducted to ensure user safety during use. Enhance user safety education by providing clear safety guidelines and increasing user safety awareness through training and promotion.

By implementing these recommendations, the stereo parking systems in Shanghai can not only meet high standards in operational management, product structure, and installation maintenance but also provide high-quality services in terms of usage safety and user interactive experience, thereby enhancing the overall customer satisfaction and the system's market competitiveness.

5.2.2 Continuous improvement of the quality of service in terms of the desired attributes of the stereo parking systems from the customer's point of view.

1. Optimize Usage Environment: The stereo parking system should be located in convenient locations such as city centers or near transportation hubs to increase user frequency and satisfaction. Ensure the system's safety by providing good lighting,

effective surveillance, emergency response facilities, and maintaining cleanliness and proper upkeep to offer a safe and comfortable user environment.

2. Improve Space Layout: Design efficient and user-friendly space layouts to maximize the number of parking spots and ensure quick vehicle entry and exit. Parking spaces should be appropriately sized and accessible to meet the needs of different users. Clear signage should be provided to help users quickly find parking spots and exits, enhancing the overall user experience.

3. Adjust Consumption Factors: Offer reasonable pricing and high-value services to meet users' cost-effectiveness needs. Support multiple payment methods, such as mobile payments, and provide flexible payment options like seasonal or monthly passes to accommodate different users' payment preferences. Additional services such as vehicle washing and maintenance reminders can further enhance customer satisfaction and loyalty.

Considering these factors comprehensively, if the system performs well in terms of convenience, safety, and comfort of the usage environment, the rationality and humanization of space layout, and the economic efficiency, payment convenience, and additional services of consumption factors, customer satisfaction will be higher. Therefore, to improve customer satisfaction, it is necessary to fully consider and optimize these key factors, ensuring that the stereo parking system meets high standards in operation, design, and service. Future research and practice should focus on enhancing the overall user experience of the stereo parking system through technological innovation and service optimization.

5.2.3 Continuous improvement of the overall quality of product and enhance brand value.

Based on the charm attributes of the product, it is recommended to enhance user surprise and satisfaction through innovative design and services. We need to consider those charm attributes that exceed user expectations and can provide a “surprise” experience. The following suggestions are made for the use of the Shanghai stereo parking systems:

1. Optimize the human-machine interface design: The stereo parking system should provide an intuitive and easy-to-understand operation interface, simplifying the user’s operation process and reducing cognitive load. For example, replacing traditional buttons and ticket systems with touch screens or smart mobile applications can make operations more convenient. Providing clear real-time feedback and guidance, such as informing users of parking space status and operation instructions through audio or visual signals, can enhance user intuitiveness and enjoyment.

2. Improve sensory experience: Considering users' physiological perceptual responses, the system design should focus on noise control and lighting arrangements. Using low-noise equipment and soft lighting can reduce interference and discomfort for users. Ensuring the clarity and visibility of signs, using high-contrast colors and large fonts, can help users quickly identify information and improve the overall experience.

3. Reduce psychological cognitive load: The system design should minimize the amount of information users need to process by adopting simplified instructions and guidance, as well as intelligent user interface design to reduce users' psychological cognitive burden. Introducing intelligent auxiliary functions, such as automatic parking and vehicle positioning systems, can reduce the difficulty of user decision-making and operations during the parking process.

4. Enhance human-computer interaction experience:Using advanced technologies such as brainwave testing, to deeply understand users' cognitive load and emotional changes when using the stereo parking system, and optimizing design based on this understanding. Exploring the application of augmented reality (AR) technology can provide users with virtual parking guidance and information display, increasing interactivity and fun.

By implementing these recommendations, Shanghai stereo parking systems can not only meet user needs in basic operations and safety performance but also provide a surprising experience in human-computer interaction, sensory experience, and psychological cognition, thereby significantly enhancing customer satisfaction and the market competitiveness of the system.

References

Bai, C., & Liao, W. (2014). Research on customer satisfaction based on customer perceived value. *Journal of Nankai: Philosophy and Social Sciences,* (6), 14-20.

Chen, S., & Huang, X. (2015). The impact of location on the utilization of mechanical parking facilities. *Journal of Urban Transport, 3*(4), 1-10.

Chen, Y., & Wang, H. (2020). Automated parking systems in Shanghai: A study on urbanization and transportation challenges. *Urban Transport of China, 18*(3), 45-58.

Chen, Y., & Zhou, L. (2020). Prediction model of car ownership based on exponential smoothing method and Markov chain. *Journal of Changchun Engineering College (Natural Science Edition), 21*(01), 124-128.

Chiu, C., Huang, S., & Tsai, M. (2014). Cost-benefit analysis of mechanical parking systems in urban areas. *Journal of Transportation Economics and Management, 9*(2), 163-174.

Chen, Y., et al. (2021). Analysis and design theory of emotional factors in human-computer interaction: Human-Computer Interaction. [N.P.].

Gan, Y., & Liu, X. (2010). Research on the guiding role of user Kansei cognition in product design. *Design Research, 3*(2), 44-50.

He, D., & Liu, J. (2000). Proposal for constructing the China Customer Satisfaction Index (CCSI). *World Standardization and Quality Management,* (10), 7-10.

Ji, W., Lü, J., et al. (2022). *Research on design methods based on cognitive and geometric matching: Design methods and theory*. [N.P.].

Kuo, P., & Yang, J. (2016). The role of payment methods in enhancing customer experience at stereo parking facilities. *Journal of Service Management and Marketing, 1*(4), 34-43.

Li, X., & Zhao, H. (2021). *Research on improving interactive interface compatibility based on user operation differences*. [N.P.].

Li, J., et al. (2022). *The impact of emotional cognition on humanoid robot appearance preferences based on eye-tracking experiments*. [N.P.].

Li, M., & Wang, T. (2019). The influence of human-machine interface on user experience in mechanical parking facilities. *International Journal of Mechanical Engineering, 13*(2), 156-164.

Li, M., Huang, H., & Chen, J. (2020). Optimization of production efficiency in stereo parking manufacturing. *Journal of Intelligent Manufacturing, 32*(2), 145-153.

Li, Z., Liu, X., & Zhang, J. (2022). Intelligent management of automated parking systems: Case studies from Shanghai. *Journal of Intelligent Transportation Systems, 16*(2), 123-134.

Lin, J., Li, M., & Wang, T. (2016). User perception of safety in stereo parking systems. *Journal of Parking Technology, 8*(2), 45-52.

Liu, C. (2021). *Research on car styling design methods based on the cognitive psychology and judgment experiments of young consumers*. [N.P.].

Liu, J., et al. (2021). *Constructing an adaptive model of product styling associative thinking*. [N.P.].

Liu, Y., Fei, Y., & Wang, J. (2020). Research on the current situation and development of stereo parkings in China. *Equipment Manufacturing Technology, 20*(05), 221-223.

Luo, Q., & Chen, J. (2019, August 25). Why are stereo parking facilities idle? *Beijing Daily*.

Lu, H., & Skoog, F. (2017). The influence of maintenance on customer satisfaction in parking facilities. In *Proceedings of the Parking Conference*. [N.P.].

Nagamachi, M. (1995). Theory of Kansei engineering and its application in product design. *Journal of Engineering Design, 15*(2), 34-40.

Qian, Y., et al. (2021). *Optimizing product control panel layout from the perspective of human-machine theory*. [N.P.].

Su, Y., & Chen, L. (2017). The effect of added services on customer loyalty in stereo parking systems. *International Journal of Service Innovation, 2*(1), 67-78.

Su, J., & Zhou, M. (2005). Research on product styling design methods based on Kansei images. *Design Science, 2*(1), 72-78.

Shi, F., & Xu, J. (2008). Kansei evaluation in automotive design based on fuzzy theory. *Automotive Engineering*, *40*(9), 823-828.

Shanghai Municipal Transportation Commission. (2021). *Annual report on Shanghai's transportation development*. Shanghai Municipal Transportation Commission.

Tang, J., Shao, L., & Ma, H. (2018). The impact of multisensory design on user perception in stereo parkings. *Journal of Parking Structure and Technology, 10*(3), 67-75.

Wang, T., & Chen, Y. (2019). Safety and maintenance issues in mechanical parking facilities. *International Journal of Mechanical Engineering, 17*(4), 78-85.

Wang, Y., & Huang, G. (2018). Space optimization design for stereo parkings. *Journal of Intelligent and Robust Systems, 9*(3), 569-582.

Wang, L., et al. (2021). *A design scheme generation model integrating Kansei engineering and knowledge engineering: Design theory and practice*. [N.P.].

Wu, J., & Chiang, Y. (2020). Reducing cognitive load in stereo parking operations through intelligent system design. *Journal of Intelligent Transportation Systems, 24*(4), 323-332.

Xu, J., & Zhao, X. (2021). Safety evaluation of stereo mechanical parking systems. *Journal of Parking Structure and Technology, 9*(1), 34-42.

Xu, W. (2015). Research on ergonomics and user-centered design concepts in the intelligent era. *Human Factors Engineering, 27*(4), 32-36.

Xu, J., & Gan, Y. (2009). Application of genetic algorithms in the study of quantitative relationships between Kansei images and product shape features. *Computer-Aided Design, 41*(11), 2241-2248.

Xu, X., et al. (2022). *Research on cognitive load model in virtual interaction systems*. [N.P.].

Yang, X., et al. (2021). *Design research on the transformation of user fuzzy cognition into rational factor sets*. [N.P.].

Yu, F., et al. (2018). Qualitative and quantitative evaluation of the EDM application framework SUM-IF. *Data Science and Applications, 17*(5), 122-130.

Yao, G., & Liu, X. (2020). Analysis and prediction of the limit value of urban car ownership. *Urban Traffic, 18*(05), 110-119.

Yi, Q. (2020). *"Parking difficulty" has become an important livelihood issue*. [N.P.].

Zhang, Y., Wang, X., & Liu, J. (2018). Research on the operation and management of mechanical parking systems. *Journal of Parking Technology, 4*(3), 56-60.

Zhang, Y., Wang, X., & Liu, J. (2020). Application of EEG-based usability evaluation in stereo parking systems. *Journal of Parking Technology, 12*(4), 78-85.

Zhao, C. (2017). The current status of standardization of mechanical parking equipment in China. *Construction Machinery,* (05), 28-31.

Zhu, J. (2018). *The stereo parking in this community in Wenzhou has been idle for 8 years, but residents have nowhere to park*. [N.P.].

Zhang, J., Wu, P., et al. (2021). *A literature review of media user emotion research*. [N.P.].

Zhang, N., et al. (2022). *Optimizing color noise cognitive models using genetic algorithms*. [N.P.].

Zhang, K., et al. (2021). *Subdividing factors of product design experience based on user cognition: Experience design research*. [N.P.].

Zhou, Z., et al. (2022). *Product development clustering strategies to improve user cognitive ambiguity: Design research and development*. [N.P.].

Appendix

Dear Sir/Madam,

Hello!

I am a graduate student at Siam University in Thailand, conducting a study on the factors influencing customer satisfaction with the stereo parking system in Shanghai. I am in need of relevant research data for this study. I kindly request that you fill out the following questionnaire truthfully based on your specific situation. The questionnaire is divided into two parts. This survey is solely for academic research and will not have any negative impact on you, so please feel at ease when answering. I sincerely thank you for your support! Thank you for participating in this survey. This survey will be conducted anonymously, and your information will be kept confidential. Once again, thank you for your cooperation!

PART Ⅰ:

1. Your gender:
   A.Male B.Female
2. Your age group?
   A. Below 18 years old B.21-50 C. Above 50 years old
3. Your highest education level?
   A. High school and below B. Bachelor's degree
   C. Master's degree D.Doctor's degree
4. Your occupational status
   A. Student B. Employed C. Unemployed
5. Your monthly income range?
   A3000 or below B. 3000~5000 C.5000~8000
   D.8000~12000 E.12000 or above
6. Have you had any experience with a stereo parking system?
   A. Yes B. No
7. How often have you used a stereo parking system?
   A never B occasionally C often D frequently

Part II: Please indicate the extent to which you agree with the following statements. Choose the most appropriate option and place a "√" on the corresponding number. The questionnaire uses a Likert scale, with scores ranging from 1 to 5. 1 indicates strongly disagree (or strongly disagree), 2 indicates somewhat disagree (or somewhat disagree), 3 indicates neutral, 4 indicates somewhat agree (or somewhat agree), and 5 indicates strongly agree (or strongly agree).

Measurement items	Strongly disagree	disagree	neutral	agree with	agree strongly
Product Basic Attributes					
1.Satisfied with the ease of parking and picking up?					
2.Are you satisfied with the parking management system?					
3.Are you satisfied with the level of difficulty in operating the stereo parking system?					
4.Operate the stereo parking system parking and picking up process satisfaction?					
5.Satisfied with the ease of reversing when operating the stereo parking system?					
6.Are you satisfied with the structural design of the entrance/exit convenience and parking spaces?					
7.Are you satisfied with the safety of operating the stereo parking system in and out?					
Customer Expectations Attributes					
1.Are you satisfied with the overall colour scheme and environment of the parking?					
2.Are you satisfied with the location of the stereo parking for vehicle access?					
3.Are you satisfied with the size of the parking space in the stereo parking?					
4.Are you satisfied with the size of the vibration sensation of the					

car body when stopping and picking up the car?					
5.Are you satisfied with the eye-catching design of the entrance/exit guide signs?					
6.Satisfaction with the charging method and consumption level?					
7.Satisfied with the design in terms of sun protection, wind and rain protection?					
Product Attractiveness Attributes					
1.Are you satisfied with the human-machine interface for operating the stereo parking system?					
2.Are you happy with the ease and pleasure of operating a stereo parking system for parking?					
3.Are you pleased and surprised by the operation process of parking and picking up the car in the stereo parking?					
4.Are you satisfied with the overall functionality and physical and mental perception of the product design?					
5.Are you happy with the human-computer interaction experience of operating the stereo parking system?					
6.Were you pleasantly surprised by the overall mechanical feel of the stereo parking styling?					

7.Is it satisfactory in terms of the efficiency of installation and maintenance, and in dealing with faults?					
Customer Satisfaction					
1. Are you satisfied with the service of the automated parking system?					
2. Are you satisfied with the operation of the automated parking system?					
3. Are you generally satisfied with the stereo parking system?					