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Analysis of User Demand for Campus Electric Bicycle Charging Station

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Abstract

Electric bicycles have gradually become the means of transportation for college students, and the construction of matching charging facilities on campus is not perfect. For the needs of college students for electric bicycle charging stations, KANO model and Better-Worse coefficient analysis method are applied to users. The demand is analyzed, and the user demand attribute and priority order are obtained, which provides reference for the design of the campus electric bicycle charging station.

Keywords

Electric bicycle charging station, User demand, KANO model, Better-Worse.

1. Introduction

Electric bicycles are an efficient, convenient and relatively inexpensive means of transportation. In recent years, it has become a trend for college students to purchase electric bicycles as a means of campus transportation.What followed is the problem of charging electric bicycles. The university campus is different from ordinary residential quarters, and the electric bicycle charging equipment is not complete. Therefore, there is a phenomenon that the student dormitory randomly pulls the private wires to charge the electric vehicles. There are great security risks in this phenomenon.In May 2018, the Office of the Security Council of the State Council issued a notice on the comprehensive management of electric bicycle fire safety[1]. The notice mentioned that it is necessary to regulate parking charging, encourage the setting of centralized parking places and have regular charging, automatic power failure, and failure. Intelligent charging control facility for functions such as alarms. Therefore, setting up a smart charging control facility on campus is the key to effectively solving the problem of charging electric bicycles on campus. This paper will take the campus electric bicycle charging station as the research object, start from the user's demand, combine the KANO model to carry out the demand analysis, and finally get the function definition and priority order of the campus electric bicycle charging station, which provides reference for the design of the campus electric bicycle charging station.

2. Theoretical Basis

2.1 Kano Model

The KANO model was proposed by the Japanese quality management master and professor of the Tokyo Institute of Technology, Kano Kisho in 1984, It is a tool for user demand classification and prioritization [2]. The KANO model believes that when product quality characteristics meet user needs, user satisfaction may not increase. Therefore, the KANO model analyzes user needs and user satisfaction, establishes the relationship between demand satisfaction and user satisfaction, and thus divides user needs into: Must-be Quality（M）、One-dimensional Quality（O）、Attractive Quality（A）、Indifferent Quality（I）、Reverse Quality（R）[3].

(1) The Must-be Quality is the attribute or function that the user thinks must have the product. When such demand is satisfied, the user satisfaction will not increase; otherwise, the user satisfaction will be greatly reduced.

(2) The One-dimensional Quality is that the user expects the product to have attributes or functions. When such demand is satisfied, the user satisfaction will increase; otherwise, the user satisfaction will decrease.

(3) The Attractive Quality is a product attribute or function that the user feels pleasantly surprised. When such demand is satisfied, user satisfaction will rise sharply; on the contrary, user satisfaction will not decrease.

(4) The Indifferent Quality refers to product attributes or functions that have no impact on user satisfaction.

(5) The Reverse Quality is the product attribute or function that the user is dissatisfied or disliked. To meet such demand, the user satisfaction will decrease.

2.2 KANO Questionnaire

The KANO questionnaire is a form of questionnaire based on the kano model and is the basis for realizing the classification of user needs. The Kano questionnaire sets the question for each requirement from the satisfaction or not, invites the user to evaluate the satisfaction, and the satisfaction evaluation sets five gradient levels: Like, Should be so, Indifferent, Tolerable, Dislike, and then based on the evaluation result And the KANO demand category assessment form to determine the demand category.

2.3 User Satisfaction Index

The User Satisfaction Index is an indicator of improving the quality of a product or service based on the Kano model, and indicates the degree of impact on user satisfaction when a design attribute is implemented or not [4]. The user satisfaction index is divided into the Satisfaction Increment Index (SII) and the Dissatisfaction Decrement Index (DDI) after the design attribute is increased. The satisfaction index is calculated as:

$$SII = (A + O)/(A + O + M + I) \tag{1}$$

$$DDI = -(O + M)/(A + O + M + I) \tag{2}$$

The value of the satisfaction increase index is usually between 0 and 1, indicating that providing this service is more important to improve user satisfaction.The closer the positive value is to 1, the greater the impact on the user's satisfaction level, and the stronger the user satisfaction level is; The closer the positive value is to 0, the smaller the impact on the user's satisfaction level, and the weaker the user satisfaction is. The value of the dissatisfaction decrement index is usually between -1 and 0, indicating that if the service is not provided adequately, the impact on the degree of user dissatisfaction is strong, indicating that if a certain functional attribute is not provided, User satisfaction will decrease. The closer the negative value is to -1, the greater the impact on the user's dissatisfaction, and the greater the effect of reducing user dissatisfaction. The closer the negative value is to 0, the smaller the impact on the degree of dissatisfaction of the user, and the weaker the effect of reducing the user's dissatisfaction. Therefore, according to the user satisfaction index, the attribute demand for the index with a higher absolute score should be prioritized.

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Table 1. KANO Demand Category Evaluation Form

	Function	The product does not have this feature				
		Like	Should be so	Indifferent	Tolerable	Dislike
The product has this function	Like	Q	A	A	A	O
	Should be so	R	I	I	I	M
	Indifferent	R	I	I	I	M
	Tolerable	R	I	I	I	M
	Dislike	R	R	R	R	Q

3. User Demand Analysis

The KANO model is used to analyze the user demand of the campus electric bicycle charging station. The research process is as follows: Firstly, the user's demand for the charging station is obtained through the investigation, and then the KANO questionnaire is used to let the selected research users evaluate the satisfaction of the user's needs, and analyze the statistical data. The user demand classification is obtained, and the user demand satisfaction index under each demand category is finally calculated, and the user demand is prioritized.

3.1 Get User Needs

The college students who have electric bicycles are selected as the research objects. The questionnaire survey, interview method and focus group method are used to investigate the user needs of 45 research objects. The user demand information obtained for the first time is messy and fuzzy, and needs to be demanded. Information is standardized and refined. After using the KJ method to sort out and refine the User Demands, the 19 User Demands of the campus electric bicycle charging station were finally determined.

3.2 KANO Questionnaire Survey and Demand Classification

For each secondary function requirement, the user satisfaction evaluation is carried out from the two directions of having this function and not having this function. The satisfaction evaluation adopts five levels: Like, Should be so, Indifferent, Tolerable, Dislike. In the form of a paper questionnaire, 45 respondents were invited to conduct the evaluation. After collecting and arranging the evaluation data, the number of people who count M, O, A, I, and R in the KANO demand category evaluation table is the percentage of the number of people surveyed, and the category with the largest proportion among the demand categories is selected as the demand category of the functional demand. Take " Multi-model charging interface " as an example, the evaluation results are shown in the table, in which the Must-be Quality (M) accounted for the largest proportion, so the demand category of "Multi-type charging interface" is the Must-be Quality. The results of the evaluation of each user's needs are collated and classified, and the results of the demand classification of each user's demand are shown in the table 4.

Table 2. Campus electric bicycle charging station user demand **list**

Serial number	Primary demand	Secondary demand
C1	Charging function	Fast charging
C2		Multiple charge
C3		Multi-model charging interface
C4		Charging completes automatically
C5		Manually end early
C6	Auxiliary function	Time consuming prediction
C7		Process display
C8		Voice and light reminders
C9		App operation and reminders
C10		App vacancy query
C11		App reservation queue
C12	Safety protection	Battery overheat automatically stops and reminds
C13		Abnormal charging reminder
C14		Vehicle security lock
C15	Payment method	Cash, campus card, mobile payment
C16	Regional construction	Waiting area seats
C17		Free near field WiFi
C18		Self-service rain gear rental cabinet
C19		Electronic advertising display

Table 3. "Multi-type charging interface" Demand category assessment form

Multi-type charging interface		The product does not have this feature				
		Like	Should be so	Indifferent	Tolerable	Dislike
The product has this function	Like	0	0	3	7	11
	Should be so	0	0	1	0	16
	Indifferent	0	0	3	0	1
	Tolerable	1	0	0	1	1
	Dislike	0	0	0	0	0

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Table 4. User demands classification table

User demand	M	O	A	I	R	Q	Demand attribute
C1	0.18	0.33	0.22	0.24	0.02	0.00	O
C2	0.11	0.11	0.31	0.42	0.04	0.00	I
C3	0.40	0.24	0.22	0.11	0.02	0.00	M
C4	0.47	0.20	0.20	0.11	0.00	0.02	M
C5	0.51	0.11	0.18	0.20	0.00	0.00	M
C6	0.11	0.36	0.29	0.22	0.02	0.00	O
C7	0.33	0.24	0.22	0.20	0.00	0.00	M
C8	0.16	0.33	0.27	0.24	0.00	0.00	O
C9	0.18	0.42	0.22	0.18	0.00	0.00	O
C10	0.29	0.13	0.44	0.13	0.00	0.00	A
C11	0.18	0.22	0.40	0.18	0.00	0.02	A
C12	0.07	0.20	0.38	0.36	0.00	0.00	A
C13	0.09	0.20	0.40	0.31	0.00	0.00	A
C14	0.11	0.18	0.38	0.33	0.00	0.00	A
C15	0.20	0.36	0.22	0.22	0.00	0.00	O
C16	0.00	0.18	0.36	0.47	0.00	0.00	I
C17	0.07	0.13	0.31	0.49	0.00	0.00	I
C18	0.04	0.04	0.31	0.60	0.00	0.00	I
C19	0.02	0.04	0.18	0.73	0.02	0.00	I

3.3 User Satisfaction Index Analysis

After determining the type of demand for each user's needs, the user needs under the same demand type need to be analyzed for priority. The user demand importance can be calculated according to the Better-Worse coefficient analysis method. According to formulas (1) and (2), the user satisfaction increase index and the user dissatisfaction reduction index of each user's demand are calculated respectively. Taking the “multi-type charging interface” as an example, the user satisfaction increase index is:

$$SII = \frac{0.22 + 0.24}{0.22 + 0.24 + 0.40 + 0.11} = 0.47$$

The user dissatisfaction decrement index is:

$$DDI = -\frac{0.24 + 0.40}{0.22 + 0.24 + 0.40 + 0.11} = -0.64$$

Perform a Better-Worse coefficient analysis for each user's needs. The calculation results of each user's demand satisfaction index are shown in the table 5:

Table 5. User satisfaction index analysis table

Demand attribute	User needs	SSI	DDI
M	C3	0.47	-0.64
	C4	0.40	-0.67
	C5	0.29	-0.62
	C7	0.47	-0.58
O	C1	0.56	-0.51
	C6	0.64	-0.47
	C8	0.60	-0.49
	C9	0.64	-0.60
	C15	0.58	-0.56
A	C10	0.58	-0.42
	C11	0.62	-0.40
	C12	0.58	-0.27
	C13	0.60	-0.29
	C14	0.56	-0.29
I	C2	0.42	-0.22
	C16	0.53	-0.18
	C17	0.44	-0.20
	C18	0.36	-0.09
	C19	0.22	-0.07

4. Analysis Result

After analyzing the User Demands through the KANO model and the Better-Worse coefficient analysis method, the demand attribute and user satisfaction index of the user's demand are obtained. User Demands are prioritized according to demand attributes and user satisfaction index, and the ordering follows the KANO model priority principle: Must-be Quality〉One-dimensional Quality〉Attractive Quality〉Indifferent Quality〉Reverse Quality, Combine the user satisfaction index to sort the demand under the same attribute. The end User Demands are prioritized as:

There are 4 Must-be Qualities, and the priority order is: Charging completes automatically > Multi-model charging interface > Manually end early > Process display.

There are 5 One-dimensional Qualities, and the priority order is: APP operation and reminder > Time-consuming forecasting > Voice and light reminder > Cash, Campus card, Mobile payment > Fast charging.

There are 5 Attractive Qualities, and the priority order is: APP reservation queuing > Charging abnormal reminder > APP vacancy inquiry > Battery overheating automatically stops and reminds > Vehicle anti-theft lock.

There are 5 Indifferent Qualities, and the priority order is: Waiting area seat>APP vacancy inquiry>Multiple charge>Self-help rain gear rental cabinet>Electronic advertisement display.

According to the research and analysis results, it can be found that the automatic completion of charging and the multi-model charging interface are Must-be Qualities, which is the basis for realizing User Demands. The requirements of APP operation and reminder, multiple payment methods, etc. belong to the One-dimensional Qualities, reflecting the user's current demand. There is a willingness to upgrade products, APP reservation queuing, APP vacancy query and other requirements are Attractive Qualities, it can be inferred that users are interested in the combination of mobile and products. According to the analysis of the user's needs, the user's

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expectation for the campus electric bicycle charging station can be tapped, and the designer can provide reference for the user to meet the user's needs and improve the user satisfaction.

5. Conclusion

This study starts with the demand of college students for electric bicycle charging station, analyzes the user demand through Kano model, and analyzes the priority of user demand through the battery worse coefficient analysis method, and finally obtains the demand attribute and priority order of each user demand. This paper aims to provide a demand analysis method for campus electric bicycle charging station design. The analysis results can provide reference for charging station design, further optimize the design, and build a campus electric bicycle charging station that is more suitable for users.

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