

Design of Electric Bicycle for Take-Away Delivery Based on KANO Model and TRIZ Theory

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ABSTRACT

With the huge variable “epidemic” ushered in in China’s food delivery market, more sinking user markets are pouring in, and the food delivery industry is booming. After the outbreak of the meaning of the word “takeaway”; extended by food to food, medicine, send all kinds of necessities of life, in the whole delivery service system, with the increasing of delivery personnel, but the use of delivery electric bicycle is still normal commuting electric bicycle, lack of foreign sellers use behavior and the use of scene demand consideration and design. This study introduces KANO model and TRIZ theory, early through the questionnaire, understand the whole service process after receiving the order, thoroughly investigate the real needs of users, based on the KANO model framework classification and priority, to analyze the impact of user demand on user satisfaction, to find out the nonlinear relationship between product function and user satisfaction. Understand the product and service needs from the user’s point of view, design and publish an effective questionnaire questionnaire, summarize and classify the survey results, establish a quality model, and prioritize it. Then, according to the technical principles of TRIZ theory, the principle of corresponding innovative design and invention, combined with the emotional design principle, to provide innovative design ideas and research basis for the optimization and upgrading of the food delivery service system in the future.

Keywords: Takeout delivery of electric bicycle, Kano model, Hierarchical analysis method, Triz theory, Emotional design

INTRODUCTION

With the rapid development of digital economy era, extended by the Internet to takeaway food, food and other business increasingly thriving, created a huge economic value of industry, but also created very heavy social problems, under the background of the new national standard policy, there are still many takeaway members use their modified electric bicycle delivery, there are great safety risks, such as often because delivery orders need to call and answer the call in cycling, and a bike, a call, very dangerous. Therefore, in this context of times, it is of social value to consider the innovative design ideas of this product, research the human-machine environment and its user use behavior, and clarify its pain points and needs.

The KANO model, proposed by Professor Kano at the Tokyo University of Technology, to reflect the relationship between service quality and

satisfaction, is widely used in user demand analysis and acquisition. TRIZ theory is “invention problem solving theory”, is by the former Soviet inventor root rich atschule team by collecting, organize a large amount of literature, and induction, refining establish a system to solve invention problem theory, can be designers creatively find and solve problems to provide effective theory and method tools (Fengli. 2019).

In China, Zhou Qi (2020) used triz model to discuss and design atomization inhalers for children, Xu Yuwen et al. (2017) and others used KANO model for smartphone APP user interface design research for the elderly, Zhang Jing (2021) conducted in-depth investigation, classification and research on coffee machines, and used KANO model for emotional design. Tour (2018) visited children’s furniture on the market, summarizing the common principles of 40 invention principles in TRIZ theory in children’s furniture. In foreign countries, some scholars studied the use needs of urban identification system based on KANO model, and studied the service characteristics of libraries. This paper uses KANO model and TRIZ theory, KANO model to find and have insight into user needs, and uses TRIZ theory to quickly find design principle methods, to provide theoretical direction for the subsequent design and development.

ANALYSIS OF THE WORK STATUS AND PAIN POINTS OF THE TAKEOUT DELIVERY STAFF

After investigation and interview, learned that the current market delivery staff is mostly for hungry and Meituan platform work, daily work time an average of 9-10 hours, usually open electric bicycle to deliver the most worry is to no electricity, need temporary road rescue, also delayed the work, at the peak sometimes go to the toilet, the car locked on the road, and lost delivery, I don’t know where to find. Encounter bad weather, the road is not convenient, and rainy day phone and mobile phone life often problems, the phone often out of power. In view of the above questions, I randomly interviewed 5 delivery workers near the company, school and restaurant. The interview time was 10min per person, and summarized the pain points according to the interview contents of Table 1.

According to the interview results, there are three main pain points: (1) poor endurance (2) poor safety and stability (3) the distribution box function is not perfect, and the storage experience is poor.

ANALYSIS OF TAKEOUT DELIVERY BASED ON KANO MODEL

The Kano model divides the user requirements into three levels: basic, expected, and excitatory requirements, as shown in Figure 1. Among them, the abscissa represents the realization degree of the user demand, and the vertical coordinate represents the user satisfaction. The three curves represent the relationship between the satisfaction of charm demand, expected demand and basic demand and user satisfaction from top to bottom respectively.

Table 1. User interview table.

Serial Number	Age	When are you busy during work hours?	What do you think is the downside of electric bikes for food delivery?	Think there is room for improvement	If you are willing to use it after the change
1	35	Usually busy at noon and evening meal times	Not enough battery life	You can use the battery swap station, which is more convenient	Neutral
2	24	11-13 pm, 5-7pm, 8-12 pm will be busy	Poor security, often prone to things	Increases its cmf stability and striking appearance	Willing
3	26	11-13pm, 5-7pm	The stability is not good, and the takeout is often spilled	Enhanced shock absorption	Willing
4	30	11-13pm, 5-7pm, 8-11pm	There is no special distribution box, it is all scattered	Integrated distribution box design	Willing
5	42	11-13pm, 5-7pm, 8-10pm	Poor shelter from rain	For hanging rain shelters	Willing

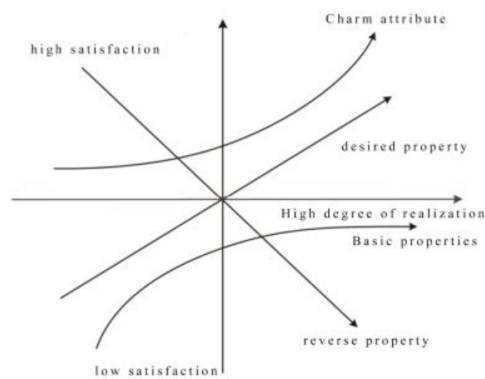


Figure 1: Schematic diagram of KANO model.

1. According to five dimensions, choose "I like it a lot", "It should be like this", "It doesn't matter", "Tolerable" and "I don't like it"

(1) If there is a groove on the right side of the meter of the electric bicycle for food delivery, which can place the mobile phone stably, then you will feel?

Like very much Of course Doesn't matter Tolerable Dislike

(2) If there is no groove on the right side of the meter of the electric bicycle for food delivery and delivery, which can place the mobile phone stably, then you will feel that

Like very much Of course Doesn't matter Tolerable Dislike

Figure 2: KANO questionnaire design.

Table 2. Demand classification.

Product Demand		Negative Problem				
		Like Very Much	Of Course	Doesn't Matter	Tolerable	Dislike
Positive problem	Like very much	Q	A	A	A	O
	of course	R	I	I	I	M
	Doesn't matter	R	I	I	I	M
	Tolerable	R	I	I	I	M
	Dislike	R	R	R	R	Q

Table 3. Questionnaire statistical results table.

User Needs	Quality Serial Number							Total	Satisfaction Coefficient Si	Dissatisfaction Coefficient Di	Kano Attribute
	A	O	M	I	R	Q					
1. Design of the groove to place the phone	19	1	12	15	5	4	56	0.43	0.28	A	
2. Wireless/wired charging	18	6	10	16	3	3	56	0.48	0.32	A	
3. Modular layered design of distribution box	12	5	14	18	6	1	56	0.35	0.38	M	
4. Visual difference	17	5	11	15	4	4	56	0.46	0.33	A	
5. Rental/battery replacement service	16	6	12	12	6	4	56	0.48	0.39	O	
6. Consistent design of safety helmets	12	3	15	22	4	0	56	0.29	0.35	M	

According to the pain points obtained by the user interviews, the corresponding solution function is proposed. When designing the questionnaire, the two directions of the demand indicators can be met and cannot be met. The questionnaire design is shown in Figure 2.

* Table A indicates excited demand, M indicates basic demand, O indicates expected demand, I indicates irrelevant demand, R indicates reverse demand, and Q indicates problem demand in Table 2. A total of 56 questionnaires were issued and 56 were valid questionnaires. The questionnaire set six demand indicators from four aspects: function, structure, pattern and appearance. Statistical results of the questionnaire are shown in Table 3. Formula (1) and (2) calculate each demand index satisfaction coefficient Si and dissatisfaction coefficient Di respectively to obtain the KANO attribute of each demand index.

$$S_i = (X_A + X_O) / (X_A + X_O + X_M + X_I) \quad (1)$$

$$D_i = (X_O + X_M) / (X_A + X_O + X_M + X_I) \quad (2)$$

Among them, XA indicates the frequency of charm demand index, XM indicates the frequency of basic demand index, XO indicates the frequency of one-dimensional demand index, and XI indicates the frequency of irrelevant demand index.

According to the research results in Table 3, SPSS analysis was used to construct a scatter map with satisfaction and dissatisfaction coefficient as vertical and abscissa, respectively, with the mean of Si and Di as the critical line, and

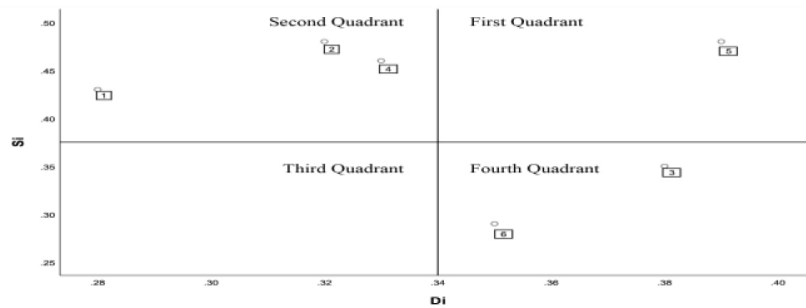


Figure 3: User design four-quadrant diagram.

divided into four quadrants of the Kano model, see Figure 3. The first quadrant belongs to the desired demand, can improve user satisfaction (Haili; Xiaobo, 2015); the second quadrant is exciting demand, can enhance the product charm (Yuwen et al., 2017); the third quadrant is irrelevant demand; the fourth quadrant belongs to the basic requirement (Zongming; Qianwen, 2020). Among them, once the user needs of the first and second quadrants are met, the product user satisfaction can be improved with (Yanli, et al, 2022). Therefore, the four user needs of modular rental / battery replacement service, setting groove for mobile phone, adding wireless / wired charging, and visual difference with other electric bicycles are taken as important user needs for takeout delivery of electric bicycles.

RESEARCH ON THE DESIGN OF DELIVERY DELIVERY ELECTRIC BICYCLE BASED ON TRIZ THEORY

TRIZ Theory is an innovative approach founded in 1946 with a group of researchers led by G.S. Altshuller and others in the former Soviet Union. This theory is a theoretical method system that can guide the development of practical new products, and provides innovation theory and innovation tools (Yunfeng, Guiying, 2018) for designers from all walks of life.

Query and analysis and verification of technical contradiction matrix based on the four important requirements of “modular rental / battery change service, set groove placement mobile phone, add set wireless / wired charging, and visual difference with other electric bicycles” determined by kano model: among them:

1. The requirement function of “setting groove for placing mobile phone” corresponds to the technical contradiction matrix is “12 shape”, the parameter leading to deterioration is “the volume of 12 static objects”, and the corresponding invention principle is “7,2,35” in the matrix;

2. “Demand function of adding setting wireless / wired charging” corresponds to the parameters needed to be changed in the technical contradiction matrix is “complexity of 36 device”, the parameter resulting in deterioration is “29 manufacturing accuracy”, and the corresponding invention principle is “26,24,32” in the matrix;

Table 4. Application frequency of invention principle.

Principles of Invention	7 The Principle of Nesting	32 Principles of Color Change	12 Equipotential Principle	36 Principle of Phase Change	1 The Principle of Division
The Number of Occurrences	1	2	1	1	2	1

4. The requirement function of “Modular leasing / battery changing service” corresponds to the parameters needed to change in the technical contradiction matrix is “33 operability”, the parameter leading to deterioration is “34 repairability”, and the corresponding invention principle is “12,36,1,32” in the matrix;

5. The requirement function of “visual difference with other electric bicycles” corresponds to the parameters needed to change in the technical contradiction matrix is “32 fabricability”, and the parameter resulting in deterioration is “the difficulty of 37 monitoring and testing”. The corresponding invention principle is “6,28,11 and 1” in the matrix;

According to Table 4, the two invention principles of “32 color change principle” and “1 segmentation principle” appear frequently, so the two invention principles as the main design principles.

CONCLUSION

In this study, the interview and questionnaire to understand users and their delivery service system, analyze the nonlinear relationship between the product function and user satisfaction and screening, produce the four quadrant scatter diagram, so that the charm demand and expectation demand, contradiction matrix analysis using TRIZ theory technology, and provide the innovative design and development of delivery electric bicycle industry. The disadvantage is that this paper integrates the advantages of KANO model and TRIZ theory (Wu, Xiaofeng. 2021), got the key requirements, but the design practice needs to be further extended and developed, and KANO questionnaire is usually longer, questionnaire questions from both sides and ask, may cause to the user to repeat, if the user does not answer seriously, it will cause the decline of data quality. It may affect the real needs of users to some extent and has certain limitations.

In the era of the rapid growth of China’s digital economy, Problems and safety risks in our food delivery industry always exist, In this study, the combination of KANO model with TRIZ theory, Investigate and study the user behavior and needs of the whole process of user delivery delivery, Through the KANO model born to study user behavior and needs, Get key user requirements “Modular rental / battery change service, slot placement cell phone, add wireless / wired charging, visually different from other electric bikes”, Combining the TRIZ theory again for the contradiction matrix analysis, The design directions and principles that can be applied to practice, The research basis and direction are provided for the future related studies. In this study,

the KANO model innovatively found the real demand of Chinese and foreign sellers in the service system, which provides an effective experimental basis and solution for the future design practice and output.

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