Research on the Design of Electric Scooters Based on the Concept of Green Lifestyles

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Abstract—Based on the concept of green lifestyle, we propose to design an electric scooter that can adapt to modern traffic conditions, increase the willingness of the general public to travel green and solve the last mile problem. Focusing on the design of electric scooters under the concept of green lifestyle, research and analysis of the needs of electric scooter users by means of a questionnaire designed with the KANO model, and the design categories and elements of electric scooters were derived, combined with the BEV-E lifestyle model and IDR lifestyle design method to analyze and propose the design strategy of electric scooters, on the basis of which the optimal design practice of electric scooters was carried out. Finally, the electric scooter is constructed so that the electric scooter can meet people's green travel needs while planning and designing the lifestyle of the consumer as a whole, guiding people towards a green lifestyle and expanding the extension direction of the sustainable design concept.

Keywords- green lifestyle design; KANO model; BEV-E lifestyle model; IDR lifestyle design; electric scooters

1 INTRODUCTION

It has become the social responsibility of every designer to "create for a friendly environment and ecology". As a representative of "micro-travel", a new trend in the last mile, electric scooters are expected to become the new definition and direction of urban travel in the context of Internet +. This mode of travel is in line with the eco-city's emphasis on environmental protection, which not only reduces the environmental pollution caused by the past car-based travel mode, but also contributes greatly to the alleviation of traffic pressure, and undoubtedly provides a good model for China's future transport travel. But it also has many controversies, with indiscriminate parking, inconvenient charging and speeding making the public love and hate it. In this context, further research and design of electric scooters using green lifestyle design concepts is needed to better meet the needs of users.

2 BACKGROUND OF THE STUDY

As the government begins to promote green and low-carbon travel, the concept is gradually gaining popularity, and the public's need for diversity in travel is increasing, the lightweight and personalized electric scooter is becoming more and more popular with the public, especially with students, office workers and other large groups of young people. Its

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convenience stands out in modern transport: it has a definite advantage over cars, both in terms of space and energy efficiency. It is also faster for short and medium distances, such as the "last mile", and more portable than a bicycle, as it can cross narrower urban roads.

In the organic system of people - things (products) - environment, the relationship between people and products, i.e., people's lifestyles and product design are closely related. If you want to solve environmental problems with electric scooters, you have to go from the level of designing green products to the higher level of green lifestyles. Therefore, understanding people's lifestyles is the first task of design, and only in this way can we solve environmental and transport problems in a holistic way, and realize the change from green transport to green lifestyles.

Starting from a green lifestyle design will be a brand new design starting point for domestic electric scooters. Firstly, the green lifestyle requires that the design of electric scooters must fit in with people's desire for a green life, and secondly, it should also create a green lifestyle through product design, mainly by guiding or changing people's behavioral habits through the product design itself, in order to create a green lifestyle and living environment, which not only follows the current trend of development of the times, but also meets the requirements of sustainable human development.

3 RESEARCH METHODOLOGY

This study proposes an electric scooter design based on the concept of green lifestyle, which is analyzed through the BEV-E lifestyle model and the IDR lifestyle design method, so as to achieve an optimal design of electric scooters. Its specific research steps mainly include.

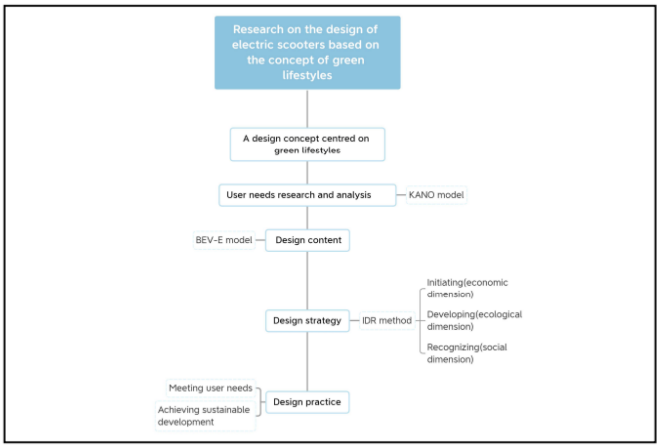

Figure 1. Design framework flow chart for green lifestyle design of electric scooters

First, Introduction of a design concept centred on a green lifestyle.

Second, Research and analysis of the needs of electric scooter users with the KANO model.

Third, A correlation analysis of the mapping of green lifestyle design onto electric scooters through the BEV-E model.

Fourth, Application of the IDR methodology to conceptualize a design strategy for electric scooters based on green living design in three stages and three dimensions.

Fifth, Analyze the innovation points from five aspects: function, material, form, detail and color, form the design practice and test whether it meets the user's needs and achieves sustainability.

Its research framework is shown in Figure 1.

3.1 Green lifestyle

Lifestyle research is one of the most important tools of user research. The concept of green living refers to choosing the way to live that best protects the environment and saves energy. The concept of life is closely linked to the thoughts of the people who live it. Electric scooters are energy-saving and environmentally friendly means of travel, and the choice of electric scooters as a means of travel reflects people's concept of green living and is a manifestation of their culture, values and attitude to life.

3.2 BEV-E Lifestyle Model

Behaviour, Environment and Value are three key elements that influence a user's lifestyle. Experience can be understood as the overall performance of a life experience or the feeling when performing a specific life task. Behaviour, environment, values and experience are also often found in different disciplines and in different scholars' interpretations of the lifestyle dimension, as four stable content attributes of lifestyle as a design object, which together form the lifestyle BEV-E model 1, as shown in Figure 2.

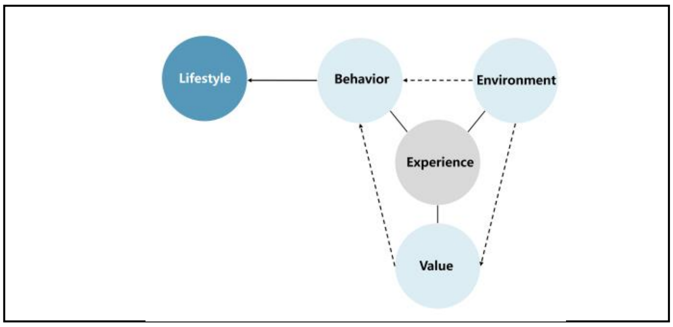

Figure 2. Lifestyle BEV-E model study components

3.3 IDR lifestyle design approach

The formation of a lifestyle is a difficult and slow process. The first step of change requires a good trigger to inspire and initiate change; the second step is to develop behavioral habits by creating an environment that supports change; and the final step is to develop a new value system as a result of growth, awareness and acceptance of the new life. This continuous process can be summarized as 'IDR', i.e., Initiating, Developing and Recognizing, and the elements of the IDR lifestyle design approach are shown in Figure 3.

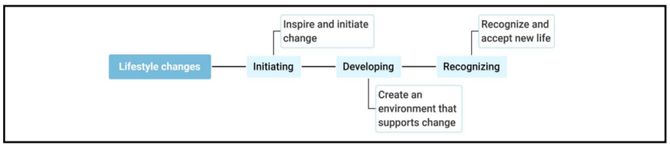

Figure 3. Elements of the IDR lifestyle design approach on the IDR approach

4 CONSTRUCTION OF AN ELECTRIC SCOOTER DESIGN STRATEGY UNDER THE CONCEPT OF GREEN LIFESTYLE

4.1 Research and analysis of the needs of electric scooter users

4.1.1 Introduction to the KANO model

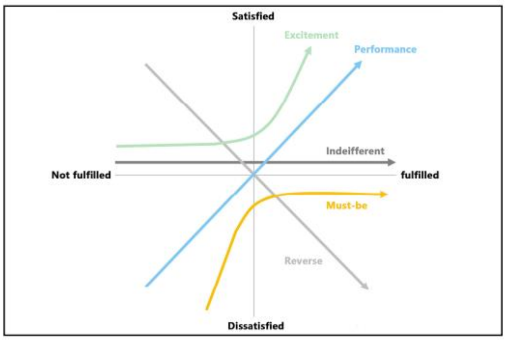

Figure 4. KANO model diagram

The KANO model is a user requirement analysis method proposed by Japanese professor Noriaki Kano in the 1980s, which classifies user requirement attributes into five categories: charm requirement, expectation requirement, essential requirement, non-differentiated requirement and reverse requirement, the KANO model diagram is shown in Figure 4.

4.1.2 Research Subjects

The research was conducted among 50 users (28 males and 22 females) with experience of using electric scooters between January 2022 and July 2022, aged 18-40 years old, in a combination of online and offline locations, with offline locations in Beijing, Guangzhou and Nanjing.

4.1.3 Research questionnaire

The research first collected the demand of various elements of electric scooters by means of fieldwork, websites, literature and magazines, and then summarized and sorted them according to their relevance by card classification method, and finally determined five design categories: shape, material, colour, function and usage, and designed a two-way questionnaire with KANO model, in which the questions were asked in two positive and negative directions, and the answers were divided into five levels to answer, as shown in Table 1.

TABLE 1 KANO Model Questionnaire Format

Question Satisfaction	Very much like	As it should be	No matter	Reluctantly accepted	Very much dislike
Foldable design elements in electric scooters	( )	( )	( )	( )	( )
No foldable design elements in electric scooters	( )	( )	( )	( )	( )

4.1.4 Needs analysis

In order to obtain the key issues of electric scooter design, according to the above derived electric scooter design categories and design elements, research on users with electric scooter experience through the KANO model, obtain the problems of existing electric scooters in the process of use, analyze user needs, combine the lifestyle BEV-E model and IDR lifestyle design method together to build an electric scooter design strategy The KANO model

The KANO model is designed to analyze the user's psychological situation in terms of satisfying and not satisfying a particular need, by setting the problem in two different directions. The KANO questionnaire is designed to investigate the user's satisfaction level and then the demand attributes are set into five categories according to the KANO model analysis table [5]. When a questionable need arises, it is generally because the survey user did not understand the question or the survey was collected incorrectly.

TABLE 2 KANO Model Analysis Table

User Needs		Negative (product does not have a certain need)				
		Very much like	**As it should be**	**No matter**	**Reluctantly accepted**	**Very much dislike**
Positive (product has a certain demand)	**Very much like**	Q	A	A	A	O
	As it should be	R	I	I	I	M
	No matter	R	I	I	I	M
	Reluctantly accepted	R	I	I	I	M

	Very much dislike	R	R	R	R	Q

The results of the questionnaire were analysed against the KANO model, and the attributes of each demand point were statistically summarised and collated. The Better-Worse coefficient is calculated as follows.

$$Better = \frac{O+A}{M+O+A+I} \quad (1)$$

$$Worse = \frac{O+M}{M+O+A+I} \times (-1) \quad (2)$$

The Better coefficient indicates the user's satisfaction when a demand is satisfied or not, while the Worse coefficient indicates the user's dissatisfaction when a demand is not satisfied, which allows the user's demand to be accurately defined through the calculation of the formula.

Combined with the previous survey analysis, the demand points of electric scooters were summarized and organized to obtain the Better-Worse value of each function, and then compared with the KANO model demand definition table, as shown in Table 4, to obtain the final attributes of each demand point, as shown in Table 3.

TABLE 3 Electric Scooters Better-Worse Values and Attributes Classification Table

Level 1 Function	Level 2 Function	A	O	M	I	R	Better	Worse
Modeling	**1.rounded**	8	17	18	1	1	0.56	-0.79
	2.rigid	5	16	19	2	3	0.50	-0.83
	3.simplicity	4	12	22	5	2	0.37	-0.79
	4.stream lined	5	12	19	6	3	0.40	-0.73
	5.steady	6	7	8	18	6	0.33	-0.38
Material	**6.recyclable**	7	7	18	12	1	0.31	-0.56
	7.lightweight aluminium	16	6	10	9	4	0.53	-0.48
	8.safety	3	3	38	1	0	0.13	-0.91
Color	**9.reasonable color scheme**	2	4	33	6	0	0.13	-0.82
	10.soft	7	7	12	13	6	0.35	-0.48
	11. Bright	3	4	23	8	7	0.18	-0.71
Function	**12.Foldable**	9	10	22	2	2	0.44	-0.74
	13. Removable battery	8	11	21	4	1	0.43	-0.72
	14.Highly accurate positioning	3	9	30	2	1	0.25	-0.88
	15.Data collection	10	13	10	6	6	0.58	-0.58
	16.Anti-theft	11	10	4	18	2	0.48	-0.32
	17.Load carrying	10	12	16	6	1	0.50	-0.63

	18.Shock absorption	12	15	14	4	0	0.60	-0.64
Usage	**19.Touch screen control**	14	10	11	5	5	0.60	-0.52
	20.Mobile control	1	2	36	1	5	0.07	-0.95

4.1.5 Research conclusion

The final attributes of each demand point were derived by comparing the KANO model demand definition table, as shown in Table 4.

TABLE 4 KANO Model Analysis Table

Better Value	Absolute Value of Worse Value	Degree of Demand
>0.5	>0.5	Desired demand (O)
<0.5	<0.5	Undifferentiated demand (I)
>0.5	<0.5	Attractive demand (A)
<0.5	>0.5	Essential demand (M)

Desired attributes are elements that increase user satisfaction when the product has them; conversely, user satisfaction decreases. 5 elements, 1, 2, 15, 17 and 18, are desired demand attributes. Therefore, these elements should be given priority in the design of electric scooters.

The charm attribute means that user satisfaction does not decrease when the product has the element; conversely, user satisfaction increases significantly. 7 elements belong to the charm demand attribute. Therefore, these 7 need to be given importance in the design of electric scooters.

Undifferentiated attributes mean that user satisfaction does not change when the product has or does not have the elements. 5, 10 and 16 are the three undifferentiated service demand attributes. Therefore, electric scooters can be designed in such a way as to provide fewer services in this category.

Essential attributes are those where user satisfaction does not increase when the product has the elements; conversely, user satisfaction decreases significantly. 3, 4, 6, 8, 9, 11, 12, 13 and 14 in total are essential service demand attributes. Therefore, these 9 items are necessary to be present in the design of electric scooters.

When planning the design elements of the electric scooter, the order of importance is: essential requirement M > desired requirement O > charm requirement A > non-differentiated requirement I. Based on the four levels of requirements, the design elements of the product are planned and analyzed, where non-differentiated requirements are not considered. To sum up, in this design, the essential requirements and desired requirements are mainly satisfied, and suitable charming requirements are incorporated to enhance the functionality and practicality of the product.

4.2 Electric scooter lifestyle BEV-E model analysis

First, directly changing lifestyles by inducing new behavioral habits. In inducing new behavioral habits and directly changing lifestyles, electric scooters are chosen among the many means of travel because they are not only convenient and environmentally friendly, but can also ease traffic congestion and improve travel efficiency. If you want to develop a new behavioral habit of using electric scooters, it takes a long time to settle down and repeatedly meet the majority of the travaller's behavioral needs, thus forming a directional habit of thought and generating a habitual choice, which in the long run will develop into a behavioral habit.

Second, indirectly changing lifestyles by changing the environment to influence behavioral habits. In the indirect change of lifestyle by changing the environment, the environment can be divided into natural environment and social environment, in which the natural environment that affects behavioral habits is mainly the terrain and climate factors; while the transportation environment and human environment are the social environment, under the influence of these two, people will correspondingly produce some habits such as living, thinking, eating, etc. These habits will inevitably affect the life These habits will inevitably affect the way of life, including the choice of means of travel and the way of travelling.

Third, influencing values to inspire users to discover new life goals and thus initiate lifestyle changes. In influencing values so that users are inspired to discover new life goals and thus initiate lifestyle changes, values are influencing life goals and choices while changing as individuals grow, and its content is mainly expressed in green consumption and green travel. Green consumption means consuming non-polluting products, and green travel means choosing the mode of travel that has the least impact on the environment in the process of moving around. The transition from 'man-centred' to 'nature-centred' values is reflected in the choice of the scooter as a green mobility tool.

4.3 Analysis of the IDR lifestyle design approach for electric scooters

IDR advocates the goal of leading an ideal (green) lifestyle, rather than satisfying a specific need in someone's life or a specific pain point in a product. From a sociological and developmental definition, sustainable development consists of three main dimensions: environmental, economic and social, which correspond exactly to the three stages of initiation, nurturing and confirmation of green lifestyle design, as follows.

4.3.1 Start-up phase (economic dimension)

In the green lifestyle design of electric scooters, the opportunity to initiate a change in the user's lifestyle may only be a short trip, but it is like a fluttering of wings in the butterfly effect, leading the user to unconsciously trigger changes in other elements of life such as behavior, social relationships and values. The value of the economic dimension of a product lies in the effective and rational use of resources and energy, and products that are more efficient in their use will inevitably take their place in the market for that product. Today's companies use the advantages of digital information to control quality management costs and choose a multi-perspective entry point for a sustainable route for long-term economic benefits.

Therefore, the design of electric scooters in the start-up phase in the economic dimension should follow: design for detachability and modularity. The use of lightweight materials, flexible use of energy resources and foldable products.

4.3.2 Nurture phase (ecological dimension)

The creation of a physical or social environment also plays a subtle role in the formation of green travel habits. In today's market, green as a non-physical property has become the new core competence of products.

Therefore, the design of electric scooters under the ecological dimension in the nurturing phase should follow: green material selection design and product recyclability design. The use of green processing processes for products, the reduction of toxic and harmful substances such as noise, waste water, waste gas and dust in the manufacturing process, the replacement of traditional resources by new energy-saving resources and the combination of the advantages of traditional processes with modern craft production.

4.3.3 Confirmation phase (social dimension)

In the process of changing lives, values are renewed into new ones, and on this basis help to conceive and guide the transition to a healthy lifestyle of the future. The "people-oriented" concept proposed by Guan Zhong is not only the basic spirit of traditional Chinese culture, but also the core of the scientific concept of development proposed by President Hu Jintao. As a product of contemporary society, electric scooters must implement this concept and focus on meeting the physiological and psychological needs of the user. In this day and age, the design of electric scooters should focus on simplicity, allowing users to use and get used to them more efficiently and smoothly, thus making it easier to guide a new way of daily travel.

The design of electric scooters should therefore follow: humanised design and minimalist design. Improve product quality, obey ergonomics, reduce unnecessary decoration reduce unnecessary decoration, improve product inclusiveness and satisfy psychological needs.

5 DESIGN PRACTICE

5.1 Design orientation

The S-PLASH electric scooter is designed for the general public, mainly for young users and for public transport, with the main aim of increasing the willingness of the general public to travel green, improving their mode of travel, opening up the "last mile" of urban transport and adapting it to modern traffic conditions, in order to achieve sustainable urban green transport. Explosion diagram, detail diagram and scene diagram of the product are shown in Figure 4

Figure 5. explosion diagram, detail diagram and scene diagram

5.2 Product modeling

The shape of the electric scooter follows contemporary design principles, reducing unnecessary decoration and saving costs without compromising on function and shape attributes; the body is rounded yet rigid, with an overall streamlined shape, dynamic and fashionable, with a unique style that meets the emotional needs of the younger generation in pursuit of trends and personalization.

The green lifestyle design of electric scooters based on the concept of sustainability follows the principles of sustainable design, starting with the study of green lifestyle design and reflected in the design: advocating green consumption, using green products, choosing green travel and establishing green concepts, all of which are green lifestyles, not only reducing pollution but also saving energy, fully taking into account the coordination between the three elements of people, things and the environment. The coordination between people, things and the environment.

At the same time, the design achieves a harmony between function and aesthetics by combining the strengths, weaknesses and development trends of previous electric scooter designs at home and abroad in a study that implements the concept of sustainability throughout the design process. The scooter's components are also closely linked to form a whole, avoiding the exposure of the internal structure, and its streamlined appearance reflects a sense of style and speed, thus representing a new trendy lifestyle. " solves the embarrassing problem of the "last mile" of "daily travel".

5.3 Product materials

Renewable or reusable materials are preferred. The handlebar armrests are made of PVC thermoplastic elastomer, which is shockproof, anti-chemical and sweat-absorbent; the body support is made of aluminium alloy, which is hard, light, corrosion-resistant and resistant to color and rust; and the types should be made of PU, which is not only flexible and tough, but also wear-resistant and ageing-resistant. These materials can not only be effectively integrated into the modern environment, but also make the user feel cared for and warm.

5.4 Product colors

In order to give the user a more intuitive and distinct sensory experience through the color design, the main colors of the S-PLASH electric scooter are blue, grey, orange and brown, in line with the complementary color palette: blue. It makes people feel trusting, safe, relaxed, calm, happy and friendly, while also providing a feeling of renewed energy.

Grey. Representing efficiency, rationality and simplicity, it is calming, extremely stable and modern.

Orange. Symbolizing health, playfulness, optimism and leisure, it gives a sense of vitality.

Brown. A very subtle neutral, on the warm side, revealing elegance, simplicity and a sense of sophistication.

5.5 Product function

Firstly, in order to meet users' green lifestyle services and health and safety needs, the electric scooter is both well damped and flexible, taking into account the complexity of urban roads, so the stable double front wheel construction enhances the stability and safety of travel.

Considering that users use the scooter mainly for shopping and travelling, the scooter has enough storage space and space for carrying people, with a simple storage basket in front of the body to meet the changing lifestyle and needs of users without being bulky. It can also be driven in three modes - electric, human and hybrid - according to people's needs, and has a folding function that takes up little space and is easy to carry.

Secondly, in order to meet the emotional interaction needs of the user, the electric scooter has good semantic functions and is easy to operate.

It is also a sliding computer that collects a large amount of data on the user's path during use, such as high frequency areas and intention areas when the user starts and stops, and thoughtfully pre-plans green travel routes before the user uses it through AI algorithms and 5G communications.

5.6 How the product is used

Users can unlock and use the S-PLASH with a single click through the mobile app or applet. It is worth mentioning that the removable external battery design has changed the previous cumbersome charging mode and solved the problem of low charging efficiency and easy battery theft. The battery is easy to charge because it is external and lightweight, and the capacity of the battery is greatly increased because of the ample space outside, making it more user-friendly compared to the traditional charging method.

6 CONCLUSION

An electric scooter based on green lifestyle design is a design study that takes into account the coordination of people - things - environment, and the "things" among them are both the product of green design and the guide for people's green behaviour and values. It is important that the design of the scooter guides the user towards a green lifestyle. This study starts from the concept of green lifestyle, through user needs research with the KANO model., combined with BEV-E lifestyle model and IDR lifestyle design method to analyze, and finally build an optimized design strategy for electric scooters, and apply it to design practice, proposing a new design solution for electric scooters in terms of shape, material, colour, function and usage.

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