Innovation Method of Health Products Design for Elderly Adults Based on Perceived Quality and User Experience

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Abstract. The traditional research method of the perceived quality is to find the main factors affecting the perceived quality through questionnaire survey and factor analysis, and establish a product perception quality evaluation dimension for UCD. Innovation design can improve the perceived quality has been proved. Therefore, it is necessary to combine innovation method and demand evaluation method to the perceived quality to explore the better design process, and make a bridge between perceived quality evaluation method and innovation design.

Results: In order to improve the perceived quality and user experience design of the health product for elderly, in this research, the perceived quality theory, innovation method and the demand analysis model are combined in the design process to improve the perceived quality. This method is proved to be feasible by the experiment. It will be used to design health products and services for the elderly, enhancing the user experience and alleviating the pressure of the aging society.

Keywords: Perceived quality · Innovation design method · Demand model
Elderly adults · User experience

1 Research Background

At present the Chinese elderly population continues to rise at the end of 2016. China's aging population has reached 230 million, accounting for 16.7% of the total population, in the 2020, the proportion of China's aging population will be expected to reach 17.8% of the total population. Pension has become a more common social problem. With the development of population aging, a new generation of elderly people have a significant different with the traditional ones. They make a great improvement in many conditions, such as the high income, education background and the concept of health. At the same time, they pay more attention to their health image and have more requirement of the quality of life, which also led to the development of aging health product.

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2 Theoretical Review

2.1 Perceived Quality

Product quality is divided into objective quality and perceived quality [1]. Objective quality refers to the real quality which is the suitable terms to describe the status of whole product with excellent quality and leading technology (Hjorth-Anderson, 1978). Perceived quality is usually defined as: 'evaluation on the Quality of the Products by the consumers' perception '(Steenkamp, 1990; Szybillo and Jacoby, 1979). The customer perceived quality, refers to the customer's subjective evaluation for a product or service [2].

It is found in one of our study that there are seventeen key factors in the perceived quality dimensions of health product for elderly adults, including personality factor, service factor, agreeableness factor, utility factor, material factor, basic function factor, entertainment factor, safety factor, shape aesthetic factor, health factor, convenience factor, brand factor, interface factor, communication factor, size factor, coordination factor, and price factor. Therefore, in the context of the silver economy [3], the innovation method based on the perceived quality and user experience for elderly is needed to help designers improve the design effect [4, 5]. With better user experience design for the elderly, the health living of the elderly will be improved.

2.2 Basic Innovation Tools of Triz Theory

The TRIZ theory was founded by Archie Schuler (G.S. Altshuller) in 1946, and Altshuller is also called the father of TRIZ [6]. In 1946, Altshuller began the research work on the theory of inventing problem solving. Altshuller found that product improvement, technological transformation and innovation in any field, like biological systems, all exist the rules of begin, grow, mature and die. If people master these rules, they can dynamically design the product and predict the future trend of the product. He set up a comprehensive theoretical system consisting of various methods and algorithms to solve technology and innovation, and set up TRIZ theory system [7] based on the principles and rules of multidisciplinary fields (Fig. 1).

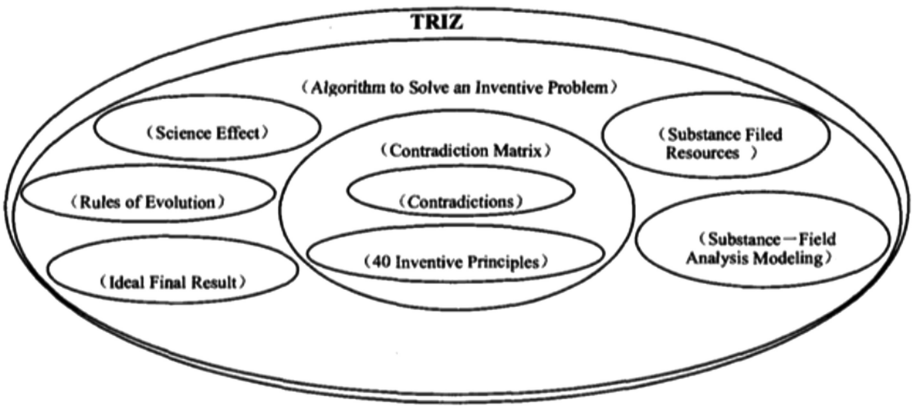

Fig. 1. Triz system architecture

2.3 Kano Model

The KANO model is a tool for classifying and prioritizing user needs invented by Professor Noriaki Kano of the Tokyo Polytechnic University. Based on the analysis of user needs and user satisfaction matrix, the nonlinear relationship between product performance and user satisfaction is reflected [8]. Five levels of customer requirements are defined by the KANO model: basic needs, expected needs, exciting needs, undifferentiated needs, and reverse needs [9], and the first three needs are mainly taken as effective data. The design direction can be effectively determined by identifying the different needs of the product system by the survey questionnaire. The Kano model is based on the UCD. Because of lacking of the development trend of technology, the opportunity for design innovation may be limited.

3 Research Methods

Taking the health products for elderly adults as an example, the research procedure is as follows: (1) Elderly users' feedback on the perceived quality of the product was collected with questionnaire survey, and the perceived quality factors were got by the factor analysis of the SPSS software. (2) The Triz innovation method was combined with the perceived quality factors in the innovative design process. 15 students with design background worked together to get more design concepts with Triz design tools. (3) In the later stage of design, the Kano model was combined into the design process which is a method to classify the user demands. The survey results were analyzed with the Kano model. The elderly users' demands were classified into four categories: demand with no differences, essential demand, expectation demand and exciting demand. This method overcomes the limitations of the user research for elderly and becomes a systematic innovation method for elderly adults.

4 Innovation Design Process of the Aging Health Product System

4.1 Innovation Method of Health Products Based on Triz Theory

The difficult of aging user insight is in the survey of user needs, because some users' thinking and habits are conservative,it is difficult to dig out innovative design insights from them. Therefore, traditional market research methods can not provide valuable insights for design innovation.

This research explores the concept of innovative design through product structure decomposition and nine graph model. Then, combined with the requirement identification and weight analysis of Kano model, users' needs sequencing is got and forward-looking design plan is designed (Fig. 2).

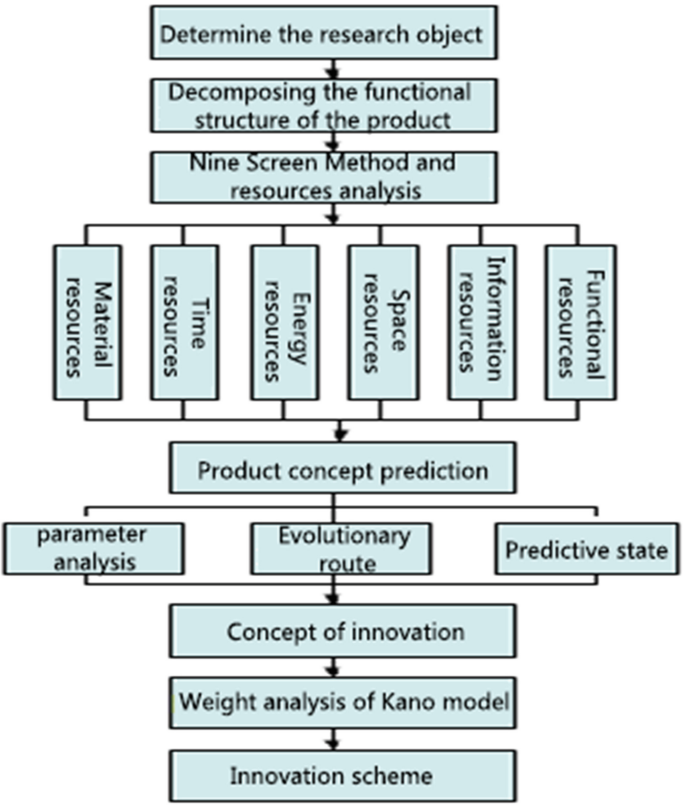

Fig. 2. Solution process of product innovation design

4.2 System Structure Decomposition and Resource Analysis

Build a product structure tree. The structure of the elderly fitness product includes backrest cushion, hand hold heart rate measurement, seat adjustment before and after adjustment, seat height adjustment, balance adjusting foot pad, front moving roller, antiskid foot pad, 8 stall resistance adjustment, fixing and adjusting handrails, and instrument panel.

4.3 Analysis of the Product Resources by the Nine Screen Method

The nine screen method is used to analyze the resources of the fitness bicycle. The current research system, the super system, the subsystem, the past and future of the system, the past and future of the super system, the past and the future of the subsystem are included in the corresponding nine screen lattices (Fig. 3).

According to the six types of resources, we analyze the resources of the nine screen grids, and get all the resources available for the elderly fitness product system, as shown in the following table (Table 1).

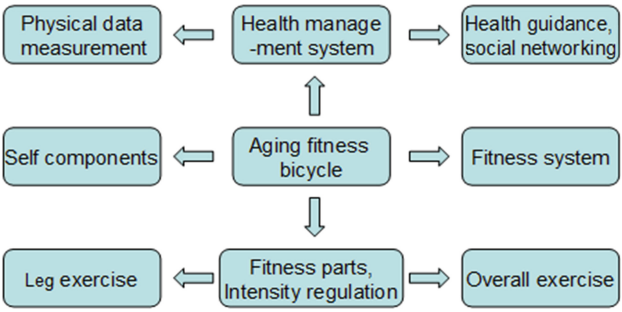

Fig. 3. Analyses of nine screen methods based on a fitness bicycle system

Table 1. Resource analysis1 (Triz theory)

Resource type	Definition	Health management software system	Health product system
Material resources	Any material in the system and in the super system	Main task support: body data measurement, body data recording cycle, body data visualization, etc.	The back cushion, the handrail with heart rate sensor, front and back adjustment, the adjustment of the seat height, the balance adjusting foot pad, the front moving roller, the antiskid foot pad, the resistance adjustment, the fixing and adjusting the handrail, the meter, the temperature adjustment, the electric power system, the network system and so on
Time resources	The time before, during and after the system runs; the pause, idle time, etc. between operations	Self-help learning health knowledge	When the fitness bicycle is idle, when it is used to exercised the leg and the upper arm, massage in the leisure time, the entertainment function is used
Energy resources	Any available field in a system or in a super system	Social support: offline social incentives, interactive help, relatives and friends supervision, etc.	Human, electric power, mechanical energy, heat energy, etc.

(*continued*)

Table 1. (*continued*)

Resource type	Definition	Health management software system	Health product system
Space resources	The system and the idle space available around it	Public facilities: community clinics, hospitals, drugstores, etc.	Frame space, seat space, home space
Information resources	Any knowledge, information, and skill accumulated in a system	Dialogue support: health education, health records, expert consultation and intervention, etc.	Fitness dynamics, time, pattern, heart rate, calorie, mobile phone interaction, network and so on
Functional resources	The use of the existing components of the system to produce new functions	System reliability support: expanding the connection with other intelligent products to form a health system	Protect the user's safety, Easy to use, Convenient adjustment

4.4 Requirement Analysis of User's Perceived Quality of Product System

According to the Triz evolution trend forecasting and the product evolution curve, combined with four stages (infancy, growth period, mature period and decline period) of the technology development of S curve ,more design concepts are got with the parameter judgment and evolution route analysis of the components of products (Tables 2 and 3).

Table 2. Concept prediction of the perceived quality requirements of the aging health product system

Research object	Structural components (dashboard)	Health system
Attribute	Perceived quality	Perceived quality
Parameter	Appearance, Recognition degree, Controllability	Interactivity convenience, Hardware platform sharing, Recognition and beauty, service
The corresponding phase in the S curve	Growth period	Development period
Evolutionary route	Transition to a flexible system or a mobile system	Developing to the function integrated direction
Existing state	Fixed interface and operating key, difficult to understand	Connecting a few smart hardware
Predictive state	Dynamic touch screen display, Customizable operation	Connect more intelligent hardware to form a comprehensive health management system, service

Table 3. Perceived quality and corresponding customer requirements of the aging health management system

Product parts	Customer needs to be investigated	Specific description
Dashboard	Fine appearance	Dynamic touch screen display
	Ease of operation	Customizable operation
Health system	Main task support	Shared hardware platform
	System reliability	Health management services
	Dialogue support	Entertaining
	Social support	Socializing

5 System Requirement Analysis with Kano Model

User requirements analysis based on Kano model. Based on the results of future prediction, a prospective, scientific and targeted customer questionnaire was built on the basis of two dimensional evaluation table of KANO model. The positive and negative problems are shown in Table 4.

Table 4. Kano questionnaire design

Serial number	Positive problems	Inverse problem
7	If there is a touch screen operation, what do you think?	If there is no touch screen operation, what do you think?

Make the Kano model questionnaire. The positive and negative questions in the upper table are filled into the corresponding spaces of the KANO model two-dimensional evaluation table. For example, select the questions corresponding to the "dashboard" in Table 4 as an example, and the form of the questionnaire is shown in Table 5.

Table 5. Examples of the application of the KANO model

Please tick "√" in the appropriate option						
	What do you think if there are no additional functional components on the fitness bicycle?					
What do you think if touch screen was added on the fitness bicycle?		Like	It must be like this	Remain neutral	Be able to endure	Dislike
	Like	Q	A	A	A	O
	It must be like this	R	I	I	I	M
	Remain neutral	R	I	I	I	M
	Be able to endure	R	I	I	I	M
	Dislike	R	R	R	R	Q

In the above two dimensional evaluation table, positive and negative questions are put forward. Among them, I = Not essential, M = basic requirements, R = negative opinion, O = expected demand, A = exciting demand. Then, according to the innovative design requirement screening principle, we eliminate Class I requirement items, retain Class A, Class O and Class M requirement items, and set various demand weights to 3, 2, 1, 0, −1 respectively. Kano weight priority calculation formula: API = 3 × A% + 2 × O% + M% − R%.

The main object is the user who is related to the subjects of this research. The questionnaire is distributed to 50 to 70 years old users. A total of 200 questionnaires were issued in this survey, and 180 valid questionnaires were recovered, and the effective recovery rate was 93.3%. Finally, based on the results of the survey, the analysis is carried out to get the Kano category of the requirement items, as shown in Table 6.

Table 6. Customer demand list

Customer demand	Exciting type	Expectation type	Basic type	Dispensable	Negative opinion	Category	API weight
F1	20%	66%	10%	2%	2%	M	2
F2	92%	2%	4%	2%	0%	O	2.84
F3	20%	54%	20%	2%	4%	M	1.84
F4	2%	86%	10%	0%	2%	I	1.86
F5	8%	14%	74%	2%	2%	M	1.24
F6	70%	4%	22%	0%	4%	A	2.36
F7	84%	8%	6%	2%	0%	A	2.74
F8	86%	8%	6%	0%	0%	O	2.8
F9	2%	2%	8%	0%	88%	R	2.74
F10	86%	4%	8%	0%	2%	A	2.72
F11	72%	2%	20%	0%	6%	A	2.34
F12	38%	0%	52%	0%	10%	I	1.56
F13	72%	8%	16%	0%	4%	A	2.44
F14	12%	80%	4%	0%	4%	M	1.96
F15	78%	2%	14%	0%	6%	A	2.46

F1 body data measurement and record
F2 The appearance of affinity with the modern sense
F3 easy to install and fix
F4 fitness function of upper arm
F5 customizable operation
F6 self generating function
F7 touch screen operation
F8 Small size
F9 foldable
F10 playing music
F11 has a tourist game
F12 has a massage function
F13 long distance health guidance of fitness instructor
F14 with placement of mobile phones
F15 social interaction sharing

6 Establishment and Solution of Product Concept

According to the results of the above table, the sorting of the exciting and expected needs of the elderly users is as follows: (Table 7)

Table 7. Needs Sorting

Sorting	Function	API	Sorting	Function	API
1	F2	2.84	9	F11	2.34
2	F8	2.80	10	F1	2.00
3	F7	2.74	11	F14	1.96
4	F9	2.74	12	F4	1.86
5	F10	2.72	13	F3	1.84
6	F15	2.46	14	F12	1.56
7	F13	2.44	15	F5	1.24
8	F6	2.36			

Setting the weights respectively 2.5, 2, and 1.5, three oriented functional requirements can be obtained. The designs of perceptual guidance are F2, F8, F7, F9. The experience oriented design are F15, F13, F6, F11, F1. The practical oriented design are F14, F4, F3, F12.

Based on the above statistical analysis, we can further explore the implicit needs of users, clarify the hierarchical relationship of user needs, and lay the foundation for further development of product design.

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References

1. Choi, E.J., Kim, S.H.: The study of the impact of perceived quality and value of social enterprises on customer satisfaction and re-purchase intention. Int. J. Smart Home **7**(1), 239–252 (2013)
2. Gale, T.B.:·Managing Customer Value: Creating Quality and Service that Customers Can See, 28–34. Free Press, New York (1994)
3. Siyu, S., Lin, L., Nan, S.: Design research of life assistive products for empty nest elderly in general design concept. Ind. Des. **5**, 63–65 (2017)
4. Wentao, S., Yali, W.: Product development trend and product' care design of the elderly. Packag. Eng. **10**, 120–123 (2017)
5. Yuanwu, S., Dai, L.: Design method of outdoor fitness equipment of elderly. Design **8**, 126–127 (2017)

6. Mayda, M., Börklü, H.R.: An integration of TRIZ and the systematic approach of Pahl and Beitz for innovative conceptual design process. J. Braz. Soc. Mechan. Sci. Eng. **36**(4), 859–870 (2014)
7. Huijuan, P., Siyang, L.: Research Summary on the theory system of TRIZ. Mach. Des. Manuf. **10**, 270–272 (2013)
8. Fanglan, Z., Chenqian, J.: Research on product innovation method based on user demand classification and importance evaluation. Packag. Eng. **16**, 87–92 (2017)
9. Jing, Y.: Product satisfaction analysis and design research based on KANO TRIZ Model. Mech. Des. Manuf. Eng. **6**, 84–88 (2017)