

Demand-driven development design for outdoor fitness facilities

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Abstract. As the improvement of person's health consciousness, exercise time corresponding increase. Most people are inclined to use the outdoor fitness facilities, the majority of new demands to outdoor fitness facilities emerge. Analysis of the current user experience of outdoor fitness facilities and the potential demand based on the Kano model is the basis for the development of new fitness facilities, this paper focuses on determining new demands and the key demands by mean of essential factors, expectation factor and charming factor. Starting from the demands of users of different levels, this paper puts forward three fitness facilities design conceptions, that is the human-computer interaction conception, interpersonal function conception and special fitness facilities conception, and take the solar interactive fitness facilities, parenting fitness facilities, elderly 's fitness facilities for practice, which provide foundation for demand-driven development of outdoor fitness facilities.

Key words. Kano model, interaction, demand-driven development, outdoor fitness facilities.

1. Introduction

With the promulgation and implementation of the "National Fitness Program (2011-2015)" and the "National Fitness Program (2016-2020)", person's health consciousness unprecedented high, exercise time corresponding increase. Most people are inclined to use the outdoor fitness facilities that get the favor of fitness people due to its convenience, openness and diversification. Consequently. Its manufacturing industry has been developed rapidly. Nevertheless, due to systematic and comprehensive normative standards vacancies ,There are many deficiencies in the fitness facilities in function, shape, man-machine factors, entertainment and other aspects(Matztler K, et al.1998) (1) We found in the satisfaction survey that the change of fitness crowd, the way of fitness and physical fitness led that the existing

¹Acknowledgement - This paper is supported by Hebei Province Science and Technology Plan Foundation with project number: 15275702 d

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fitness facilities function has been unable to meet the new requirements of the fitness crowd. Therefore, the Kano model will be applied to demand-driven development of outdoor fitness facilities design. The purpose is through the Kano model to excavate the new appeals of the fitness crowd for outdoor fitness facilities, and to analyze the important demands of the fitness crowd satisfaction, and then to determine the design ideas. This will provide the foundation for the development of outdoor fitness facilities.

2. Overview

Professor Noriaki Kano of Tokyo Polytechnic University founded Kano model in 1984. Now Kano model has been widely used and promoted in the field of product design. The purpose is to understand and distinguish the demands of users of different levels, so as to identify the important factors which make customer satisfy, and find the breakthrough point of improving customer satisfaction in product development. In the light of the relationship between product's objective performance and user subjective perception, Kano model divides the factors which influence user satisfaction into three types: charm factor, expected factor, essential factor (Sireli Y, et al. 2007) (2). Charm, also known as "exciting demand", means that customers do not expect too much demand. Charm factor can greatly enhance customer satisfaction. Nevertheless when the product does not have charm factors, the user satisfaction will not be reduced. When the customer for some products or services did not express a clear demand, enterprises provide customers with some totally unexpected product attributes or service behavior, so that customers have a surprise and will show very satisfied, so as to improve customer loyalty. This kind of demand often represents the potential demand of customers. Moreover the enterprise's approach is to find and explore such demand, leading competitors. The expected factor is the most important factor affecting customer satisfaction. When the product provides this functionality, the user satisfaction will increase; when the product does not provide this function, the user satisfaction will be reduced. The essential factor is the functional requirements that the product will provide, and when the product offers the functionality, the customer satisfaction will not be raised. When the product does not provide this requirement, the user satisfaction will be greatly reduced (Tontini G, et al, 2007) (3).

There are many theories that use the Kano model to obtain the user's demand method and have been applied in many fields. Some research progress has been made in product development. In 2015, Dong Chao demonstrated the feasibility and effectiveness of developing infant and young children's products based on the Kano demand model. In 2016, Bao Yuting started from the development and design of cultural souvenirs, using Kano model of product satisfaction evaluation system, based on the Kano model of Hangzhou cultural souvenir design and research methods (Gao.XY, et al, 2017) (??)4).

3. METHODOLOGY

3.1. *Researching crowd demands for outdoor fitness facilities*

The research object of this paper includes the fitness population of the representative community in Lianchi District, Jingxiu District, Mancheng District, Qingyuan District and Hi-tech Development Zone of Baoding. The main investigate purpose is to analysis the satisfaction and new demands of fitness facilities. Exercise satisfaction with community fitness equipment refers to the choice of residents in the community fitness exercise on the fitness equipment items head, exercise effects and equipment design and other conditions of the overall evaluation. These data can provide a reliable basis for the development of new fitness facilities. According to table 1, the user's demands and experience were researching with interviews, questionnaires and so on, we investigate mainly from outdoor fitness facilities for the crowd, fitness time, fitness function, fitness effect, fitness methods, safety, comfort, modeling and other aspects. We survey and evaluate the fitness facilities for fitness people, and fill the Kano evaluation form with the answers of the positive and negative questions about the quality of the demands of the fitness crowd. This will determine the demands of the fitness crowd (Gao.XY, et al, 2017) (4).

Table 1. Kano evaluation form

Sequences	From	Frames	Resolution
Ballroom	MERL	250	640×480
Vassar	MERL	250	640×480
Exit	MERL	250	640×480
Race1	KDDI	300	640×480
Ballet	Microsoft	100	1024×768
Breakdancers	Microsoft	100	1024×768
Doorflowers	HHI	150	1024×768
Jungle	HHI	250	1024×768

3.2. *Kano model analysis*

research findings show that fitness crowds have several requirements for outdoor fitness facilities. We do further research from two aspects which can meet this demand or not and offer five options: "like", "take for granted", "do not matter", "barely accept", "do not like" (Gao.XY, et al, 2017) (4). The selection results are analyzed by the Kano model, as shown in figure1.

The satisfaction of the demand is the horizontal axis, the user satisfaction is the vertical axis, and all the requirements are analyzed. The letters in the figure1 are abbreviations, and their meanings are listed in table II below

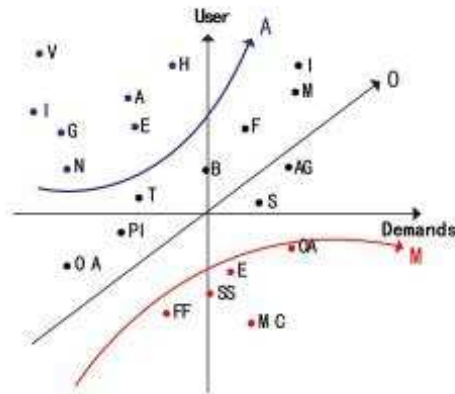


Fig. 1. The Kano Model analysis diagram of outdoor fitness facilities

Table 2. Abbreviations

Abbreviations	Representative meaning (demand)
V	Virtual coach
I	Information sharing
G	Remote guidance
N	Intelligent networking
OA	Operation adjustable
A	Movement analysis
E	Energy recovery
T	Time display
PI	Put items
H	Heart rate monitoring
B	Beautiful shape
F	information feedback
I	Interaction
M	Music playing
S	Suitable

Through analysis, it is found that the essential factors of outdoor fitness facilities are concentrated on the basic functions and safety. At present, the outdoor fitness facilities in the market are various and fully functional. From the analysis of the single fitness facilities, it can meet the demands of adult fitness and has better safety, but it cannot meet the demands of children, the elderly and the disabled. Some

children will use adult fitness equipment. But often there is a safety accident because the size and intensity are inappropriate. The expected factor is the decisive factor in the development of outdoor fitness facilities and reflects the user's expectation of new products. It is mainly embodied in two aspects: meeting the demands of different crowds of people's health requirements and emotional requirements. Functional charm factors are some of the features that make users more unexpected. It is found that these functions are focused on the interaction between products and people, such as virtual coaches offered by fitness facilities, intelligent networking, energy recovery, movement analysis, and friends circle communication.

3.3. Outdoor fitness crowd appeal analysis

By means of the Kano model, we can analysis that the fitness crowd's experience and the potential demand for the outdoor fitness facilities. We conducted further interviews with certain important appeals, then identify opportunities for outdoor fitness facilities, as shown in Figure 2.

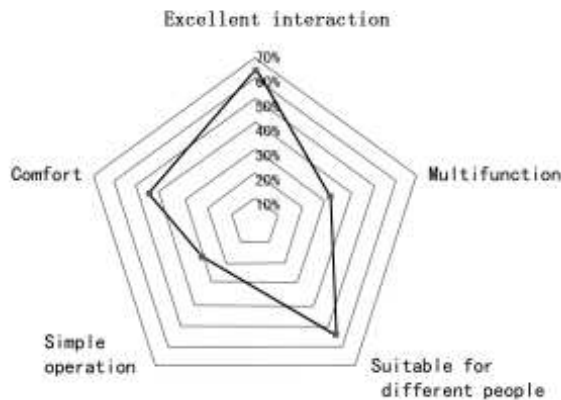


Fig. 2. Demands analysis of outdoor fitness crowd

Through depth interviews, it was found that the vast majority of users expected to design fitness facilities according to different crowds' physical characteristics and fitness requirements. Children and the elderly expect to have dedicated fitness facilities. Most of the outdoor fitness facilities in the market are for healthy adults.

But fitness facilities for children, the elderly and the disabled are rare. In reality, the use of fitness facilities is very chaotic. Security, pertinence and fitness effect are unsatisfactory (HOVEN V D E, et al. 2013) (6). The survey found that people's demand for outdoor fitness facilities changed from pure fitness function to emotional experience and spiritual comfort.

4. RESULT ANALYSIS AND DISCUSSION

4.1. The solar human-machine interactive fitness facilities

The solar human-machine interactive fitness facilities are capable to interact and communicate with the fitness crowd in the field of the voice guidance, music player, information feedback, etc. When the fitness person is prepared to fitness, the infrared inductor installed in the interaction system will feel the people and send the signal to control unit. At the same time, the control unit determines that there are people around the fitness device, opening the music player, hinting the exerciser after proper operation how to play the same rhythmic music as the fitness actions and causing the information such as exercise time feed back to the exerciser in time. When the fitness person finishes and leave, the infrared inductor will feel the person's departure, sending a signal to control unit again, at the same time it will judge that there is no person and quit music player to save energy (James H, et al. 2005) (6).

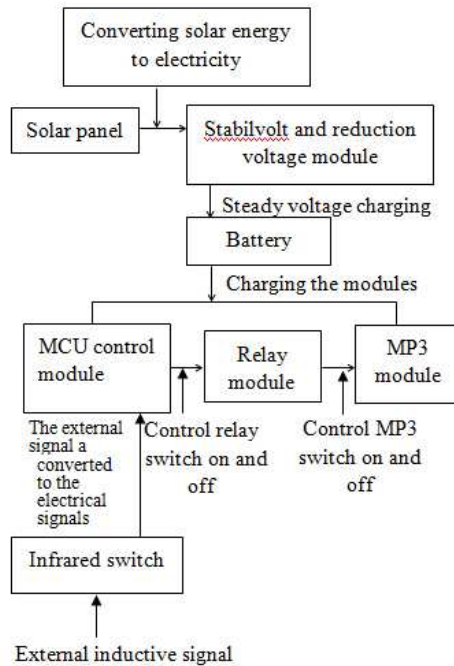


Fig. 3. The human-machine interaction module

1 the fitness module ; 2 the installation body; 301 level table;3 man-machine interactive module installation position; 4 solar power module

To fit the existing fitness facilities and decrease the cost of new product development, the interactive model is installed on a solo subject, and the existing facility will be installed between the two sides of the subject (Sutthachaidee W, et al.2015). The structure design of the solar human-machine interactive fitness facility is shown

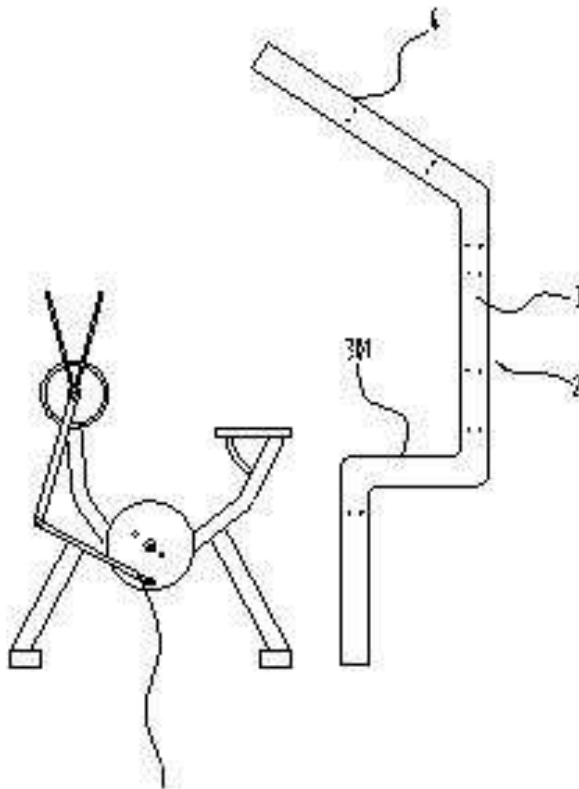


Fig. 4. The structure diagram of solar interaction fitness facility

in Figure4 take a fitness bike as an example. This designing using the stationary fitness bike as a case, its fitness module guarantees the interactive position. Let the assembly unit of the human-computer interactive module such as inductor, music player and so on install on the position 3, assuring its sensitivity and the effect of voice playing. Figure 5 is another rendering of solar human-machine interactive fitness facilities, which takes Sit-Rally equipment as a case.

1 the fitness module ; 2 the installation body; 3 man-machine interactive module installation position; 4 solar power module

4.2. The paternity stretching apparatus

With the development of society, there are more and more fitness facilities, which become more and more novel in style. But most exercise equipment can only be exercised by one person(LYNDELL B,et al.2012(8. Therefore, in some families with children, they will not be able to combine fitness and children care, which brings great inconvenience to the fitness. The parents-child fitness facility allows adults to interact with children while taking exercise. This paternity stretching apparatus locate the families and children, the child is between 1 and 5 years old ,and the age



Fig. 5. The rendering of solar human-machine interactive fitness facilities

orientation of the adult is $24^{\circ}\sim 50^{\circ}$. Interactivity is the biggest feature of the fitness equipment (Offi F, 2013(9). As shown in Figure 6, when the parent extension exerciser moves, the adult sits on the adult seat 6. There is a second support 5 and pedal rod 7 in front of 6. The adult seat 6 is connected with the first cam 3 by a connecting rod 4. there is a oscillating rod 9 between connecting rod 4 and second holder 5. When the adult makes a "push" action, the swing rod 9, the connecting rod 4 and the first cam 3 can work with linkage. The child sits on the child's seat 2. There is a rotation part 8 at the bottom of child seat 2, which connects with first cam 3 with Higher Pairs.

Measures taken to improve the stability of the device:

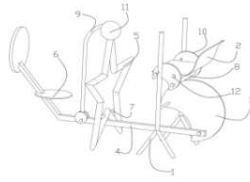
There is a second cam 10 on each side of the child seat. The second cam 10 is respectively connected with the first bracket 1 and the rotating part. This improves the stability of the child's seat;

In order to improve the stability of connection between the children's seat 2 and second cam 10, we can put more cross bars 12 on the second cam 10, and the children's seat 2 can be fixed on the cross bar 12.

1- first holder, 2- child seat, 3- first cam, 4- connecting rod, 5- second holder, 6- adult seat, 7- pedal lever, 8- rotation part, 9- oscillating rod, 10- second cam, 11- ball, 12- rail

4.3. Tai Chi Fitness Facility for Elderly

Most of the fitness equipment used by the elderly is a simple operation type, which pay little attention on the physiological, psychological and special emotions



1- first holder, 2- child seat, 3- first cam, 4- connecting rod, 5- second holder, 6- adult seat, 7- pedal lever, 8- rotation part, 9- oscillating rod, 10- second cam, 11- ball, 12- rail

Fig. 6. paternity stretching apparatus

of the elderly (Van Dyk T. et al 2012) (10). Found in the survey, the elderly begin to miss the unique simplicity and innocence of national culture. Existing fitness equipment is affected by standardization and internationalization, which lack ethnic culture. Fitness equipment for the elderly can incorporate the concept of Tai Chi, as an important exercise for the elderly; Tai Chi has many advantages, such as strengthening heart and lung function, and treating digestive tract diseases.



Fig. 7. Tai Chi Fitness Facility for elderly

we sum up the main points of action in the "white crane spreads its wings" in Taiji. Moreover, after comprehensive consideration of the elements of scientific fitness, we explore this "Tai Chi" outdoor fitness equipment for elderly. The action flow in the course of exercise is shown in the figure 8. The movement comes from the "white crane spreads its wings". The action has alternating speed and is firm and flexible. The elderly can exercise elbow joint and knee joint. Meanwhile they can exercise the coordination of the body, and enjoy and understand the broad and profound Chinese Taiji Culture.

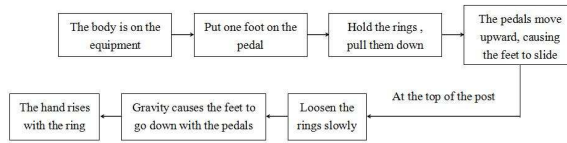


Fig. 8. Fitness action flow

5. CONCLUSIONS

The application of the Kano model effectively exploits the potential demands of the fitness crowd and broadens the range of fitness facilities design. Based on the Kano model theory, this paper point out that the interaction and special fitness facilities are the central requirements of the users. So design practice was carried out, including solar interactive fitness facilities, paternity fitness facilities, and fitness facilities for elderly. The solar human-machine interactive fitness facilities had made a prototype and finished the further verification for their solar skills and interactive function. The paternity fitness facilities mainly studied their fitness function and the method of application, which needed to further study the trouble of load measure and so on. The subject of the specialized fitness facilities discussed the fitness facilities design for elderly incorporating the concept of Tai Chi as an example. Although the study that had been mentioned above has a value of theory support for the study of fitness facilities, its content is not comprehensive, only providing thinking of research and development. The actual R&D process still demands to conduct specific studies of several details.

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Received November 16, 2017

