Analysis on Universality Evaluation Standard System of Product Design on Basis of Kansei Engineering and Virtual Reality

Wangqun Xiao[1,2], Jianxin Cheng[1(✉)], Xuejie Wang[2], Junnan Ye[1], and Le Xi[1]

[1] School of Art, Design and Media,
East China University of Science and Technology,
M.BOX 286, NO.130, Meilong Road, Xuhui District, Shanghai 200237, China
xiaoyao-l9l6@l63.com, cjx.master@gmail.com,
yejunnan97ll08@qq.com, xilutar@sina.com
[2] Academy of Art and Design, Anhui University of Technology,
NO.59, East Lake Road, Ma'anshan 243002, China
402860858@qq.com

Abstract. The universality evaluation standard system of product design on basis of Kansei Engineering and virtual reality constructed in this paper will effectively solve the current practical problems of product design evaluation to the greatest degree. The reasons why people are usually at a loss when conducting product design evaluation are that, on the one hand they do not know what kind of method or means is able to achieve the goal of scientific evaluation, and on the other hand whether there is or what kind of method and model among hundreds of product design evaluation methods and models can deal with the design evaluation problem of this product.This paper aims to carry out in-depth research from the following four aspects. (1) Systemically combing the product design evaluation research results which include Kansei engineering, virtual reality, and cross-over research results of product design evaluation. (2) Scientifically summarizing the construction elements of product design universality evaluation standard system. (3) Scientifically refining construction factor and correlation factor, and extracting universality standard construction factor through researches on comparison of construction factor and correlation factor. (4) Setting priority standard through researches on the reasonable and matched priority relation of various standard construction factors, and finally constructing a product design universality evaluation standard system on basis of Kansei Engineering and virtual reality.

Keywords: Kansei engineering · Virtual reality · Product design · Evaluation standard system

1 Introduction

Product design evaluation is the complex system including two aspects, "ration" and "emotion", and multiple factors. With the further pursuit of better life of human society and the continuous enhancement of realization of science and technology,

C. Stephanidis (Ed.): HCII 2015 Posters, Part I, CCIS 528, pp. 439–443, 2015.
DOI: 10.1007/978-3-319-21380-4_74

the traditional product design philosophy led by "functional practice" or "technology" has converted into the modern product design philosophy led by "user experience" or "emotion". Product design evaluation has become the new concern of the current product design research, and the scientific evaluation of subjective "emotional" factors in product design evaluation is the difficulty. It is the urgent practical needs to establish a scientific and high-efficient product design evaluation system as soon as possible, so as to improve product design innovation ability and scientific level, improve the success rate of enterprise product development and shorten the development cycle, etc.

2 Analysis of Research Status

Many scholars have carried out extensive researches on product design evaluation and have achieved encouraging results. A. Mousavi et al. [1] studied the complex problem of user preferences in the practice of product design and put forward a "customer optimization path and assessment model", i.e. CORE; X. Zeng et al. [2] proposed a fuzzy multiple criteria evaluation method of "fashionable design-oriented industrial products"; Chulwoo Kim et al. [3] proposed an efficient evaluation method of user impression by using the virtual prototype to analyze products; A. Rashid et al. [4] studied an intelligent design system evaluating the product aesthetics; Carmen Llinares et al. [5] studied to use Kano model to analyze the impact of different subjective attributes on consumer purchasing decisions based on Kansei engineering theory; Mark Evans et al. [6] studied the tactile feedback model evaluation in the practice of industrial design; Hyungjun Park et al. [7] studied the design evaluation of information devices based on tangible interactive Augmented Reality Technology; Francisco Rebelo et al. [8] studied the use of virtual reality to evaluate the user experience, etc.

For emphasizing the emotional experience interaction issues of users under the new concept of and current product design, various scholars have studied the quantitative evaluation of subjective factors on "emotion" based on Kansei engineering theory [5, 6], and the use of virtual reality technology to allow users to achieve "immersive emotional interactive experience" and realize intuitive and high-efficient evaluation [3, 7, 8], etc. However, the products will show great differences due to different individual types in the product design evaluation; meanwhile, product design evaluation is accompanied by the entire cycle of products from concept, design and verification to production. Evaluation indicator and assessment methods are different at all stages, so it brings about great inconvenience and difficulties for people conducting product design evaluation. There has not been the current research involved in the issue how to make every product get the most scientific and rational design evaluation at maximum efficiency. In addition, the data acquisition picture samples in Kansei engineering will affect the quality of samples because of not strong "sense of reality", and the data collecting actual samples will cause a lot of waste of manpower and material resources; if the visual experience component in the virtual reality is not processed scientifically, it will be difficult to ensure the scientificity of product design evaluation.

Therefore, scientifically extract the common factors from products, use the high-efficient technologies, scientific theories of the quantitative evaluation in Kansei engineering and the intuitive interactive evaluation in virtual reality, to effectively

integrate product design evaluation method and model, systematically build scientific and high-efficient product design universality evaluation standard system, and make a useful exploration on the researches on complex product design evaluation system.

3 Research Method

Research Method adopts the literature research method and the combination of induction and deduction method with experimental verification method. Through the collection of plenty of relevant research literature at home and abroad, understand the research perspective and research progress of each experts and scholars, grasp the development trend in this area overall and tease the relevant issues of product design evaluation system and the relevance issue of product design evaluation, Kansei engineering and virtual reality systematically and theoretically. Study the internal relation between constructing factors of product design universality evaluation standard system, use the relevant expertise and obtain product design universality evaluation standard system theory construction based on Kansei engineering theory and virtual reality technology through induction and deduction. Combined with eye tracking, EEG perception, EMG test, three-dimensional visual simulation and force feedback system experimental techniques, the author in this paper uses the combination of normative research and real evidence and selects a large number of typical cases to conduct empirical analysis, so as to verify the scientificity and high efficiency of product design universality evaluation standard system based on Kansei engineering theory and virtual reality.

4 Theory Construction of Product Design Universality Evaluation Standard System Based on Kansei Engineering Theory and Virtual Reality

4.1 Construction Element and Construction Factor of Product Design Universality Evaluation Standard System

Study construction elements of product design universality evaluation standard system centered by the product design, such as the evaluation object, the evaluation phase, evaluation indicator and evaluation method, etc., and then further deeply study the construction factors contained in various construction factors, such as performance, cost, materials, structure, shape, color and construction factors in evaluation indicator elements, product usability evaluation methods based on FAHP in evaluation method elements, product design evaluation method based on human physiological signals, product design quality gray system comprehensive evaluation and a rational multi-attribute multiplayer evaluation method in product design and other construction factors.

4.2 Relevance Factors Among Kansei Engineering Theory, Virtual Reality Technology and Product Design Evaluation

Through the theoretical researches on the application of Kansei engineering and virtual reality technologies in product design evaluation, extract the relevance factors between Kansei engineering theory and product design evaluation and the relevance factors between virtual reality technology and product design evaluation

4.3 Screening and Extracting Universality Standard Construction Factor

Conduct a comparative study of the relevance factor and the construction factor from the perspective of "quantifiable" and "emotional interactive experience", delete duplicate construction factor, condense construct and optimize the construction factor, scientifically extract the universality construction factor and establish the construction factor standard.

4.4 Theory Construction of Product Design Universality Evaluation Standard System Based on Kansei Engineering Theory and Virtual Reality

Study the hierarchical relationship and the cross relation between various construction elements; Based on the "scientificity" of Kansei engineering theory and "high efficiency" of virtual reality technology, focus on the research on the precedence relationship for reasonable match between the universality standard construction factor in construction elements and the universality standard construction factor in other construction elements, develop the precedence standards, so as to theoretically construct the product design universality evaluation standard system based on Kansei engineering theory and virtual reality technology.

5 Conclusions and Prospect

The author in this paper constructs the product design universality evaluation standard system based on Kansei engineering theory and virtual reality technology, which will effectively solve the realistic problem of current product design evaluation to the maximum: people are often at a loss during conducting the product design evaluation. On the one hand, people do not know what ways or means they can achieve the effect of the scientific evaluation; On the other hand, are there methods or models, etc. which can effectively solve design evaluation problem of the product among nearly one hundred product design evaluation methods or models. There are great differences in evaluation indicators of nearly one hundred product design evaluation methods or models, which are likely to cause thinking confusion of evaluation users and difficulty in evaluation work. Establish a set of generally applicable evaluation indicator standards and the corresponding evaluation solutions, and condense and unify the evaluation indicators, so as to make the product design evaluation become more standardized

and objective, which provides theoretical support for the government establishing the scientific and standardized product design evaluation standards or specifications from the national level.

The product design universality evaluation criteria system established based on the "scientificity" of Kansei engineering and "technical advancement" of virtual reality provides scientific basis and guidance for enterprise conducting product independent innovation design, which is of important strategic significance and practical significance to enhance the product design and innovation ability, scientific level and quantitative evaluation ability in our country, improve corporate product development efficiency and reduce corporate product development risks, etc. The project research results will provide theoretical support, quantitative evaluation method and technological means for product design theory research.

References

1. Mousavi, A., Adl, P., et al.: Customer optimization route and evaluation (CORE) for product design. Int. J. Comput. Integr. Manuf. **14**(2), 236–243 (2001)
2. Zeng, X., Zhu, Y., et al.: A fuzzy multi-criteria evaluation method for designing fashion oriented industrial products. Soft. Comput. **14**, 236–243 (2010)
3. Kim, Chulwoo, Lee, Cheol, et al.: Affective Evaluation of User Impressions Using Virtual Product Prototyping. Human Factors and Ergonomics in Manufacturing & Service Industries **21**(1), 1–13 (2011)
4. Rashid, A., Mac Donald, B.J., et al.: Evaluation of the aesthetics of products and integration of the findings in a proposed intelligent design system. J. Mater. Process. Technol. **153–154**, 380–385 (2004)
5. Llinares, Carmen, Page, Alvaro F.: Kano's model in Kansei Engineering to evaluate subjective real estate consumer preferences. Int. J. Ind. Ergon. **41**, 233–246 (2011)
6. Evans, Mark, Wallace, David, et al.: An evaluation of haptic feedback modelling during industrial design practice. Des. Stud. **26**, 487–508 (2005)
7. Park, Hyungjun, Moon, Hee-Cheol: Design evaluation of information appliances using augmented reality-based tangible interaction. Comput. Ind. **64**, 854–868 (2013)
8. Rebelo, Francisco, Noriega, Paulo, et al.: Using Virtual Reality to Assess User Experience. Hum. Factors **54**(6), 964–982 (2012)