The Study of the Cultural Values of Lighting Products Based on Intention Recognition and 3D Printing Technology

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Abstract. The interaction between culture and business, culture and economy, is increasingly close under the background of the integration of the knowledge economy and the world economy. Material comforts are no longer able to meet the demand of modern products. The pursuit of products receives more attention in personal emotion, psychology and other aspects. This requires the product design should meet the cultural values of the times, and correctly interpret the values. Therefore, this paper takes lighting products as an example, firstly makes the reverse model for the product, then improves the design on the basis of three-dimensional digital model, and finally produces samples with the application of rapid prototyping 3D printing technology. Moreover, this paper uses the Kansei Engineering Theory to collect users' emotional data on product awareness and experience by questionnaires. It uses Factor analysis method and considers of product design principles, constructs cultural values and the objectives and the values for lighting design elements. The paper determines the criteria associated with perceptual weighting coefficients on the basis of users' data, and accurately designs the lighting products based on the cultural values, then forms the method of product design that upgrades the cultural values.

Keywords: Cultural values · Intention recognition · 3D printing · Lighting design

1 Introduction

Nowadays, people's thoughts, aesthetic appreciation and even values are still influenced by traditional culture. Product design with traditional elements is favored and sought after by the people. The creation of products featured with Chinese traditional culture not only can cater for people's material and spiritual needs in the advancing society, but also can provide motive force of development for product design. However, we face to a difficulty now that is how to use Chinese traditional culture for innovation and application, thus building regional design that featured with Chinese characteristics and style. Therefore, the article is aimed at the design and development of OLED lighting products featured with Chinese elements to find a design method of

products that meets traditional cultural orientation and sentimental demands of the consumers by utilizing kansei engineering theory and 3D printing technology.

Brief of Kansei Engineering. Kansei engineering is the product design technology presented by a Japanese scholar in the 70 s. It converts sensibility of the customers to design elements of the products and discusses feelings and needs of the customers from a psychological and perceptual point. During design process of the products, the core of kansei design is the transformation of design elements from kansei images and feelings, via which the designer can grasp the features of the products and know their relationships with the sensory images of customers and thus to check the evaluation meets his intended idea.

Brief of Design-based Cultural Level. Based on the study of design culture stated by Leong, Yang Yufu and Zheng Meiyu, referring to the existing division of design-based cultural level, and combined with the comprehension of culture itself and its contents, the article divides the culture into three levels. For the study of modeling elements and cultural level, it concludes culture-based design elements for product modeling according to the nature of cultural level. E.g., Table 1:

Table 1. Culture-based design elements for product modeling

Level	Design elements of the products
Inner "intangible" level	Has special cultural meaning and application of cultural concept
Mid "behavioral" level	Function, usage and background story of the products
Outer "tabfible" level	Shape, color, structure and surface ornamentation of the products

2 Design Method and Process of Lighting Products with Cultural Value Elements in the Framework of Kansei Engineering

Firstly, sample products shall be collected, sorted, compared and analyzed to know current design status of lighting products with cultural value elements and the main design methods, then, the main reason that caused these methods shall be analyzed.

Secondly, ten samples with typical features shall be selected out as experimental objects via discussing. Then, questionnaire survey on kansei engineering-based design of cultural value elements shall be carried out via 3D printing technology to analyze the evaluation of all sorts of products and its forming reason.

Finally, a conclusion comes out by virtue of design methods in the framework of kansei engineering: It is better to extract the morphology of cultural value elements to be applied during morphology design and application process, and this morphology does not need to keep a high similarity with that of the original cultural value elements.

3 Statistics and Correlation Analysis of Cultural Lighting Products

In total, 40 pieces of lighting products are collected for research, in which 10 pieces are left for follow-up study upon discussion by the research group. As shown in Table 2, the collected samples are sorted as follows to gather statistics of application method of cultural value elements for each sample.

There are 15 tables in total. The article can not list all of them due to its space. Statistics is carried out for the application method of cultural elements relating to every lighting product.

After all samples in Table 3 are summarized, the usage frequency of each design element during the design process of lighting products with Chinese elements can be obtained, then the occurrence rate of each design element can be calculated. Please see Table 3. After analyzing the data gained from the above tables, we can make following conclusions.

1. Culture of outer "tabfible" level is used for all lighting products with Chinese elements when designing. Comparatively, cultural value elements of inner "intangible"and mid "behavioral" level are less used and are decreasing. It can be concluded that: Cultural elements of outer "tabfible" level are necessary to the design of lighting products with Chinese elements. Cultural elements of inner "intangible" and mid "behavioral" level are on the basis of cultural elements of outer "tabfible" level, that is to say, cultural elements of outer "tabfible" level are the carrier for that of the two other levels. Besides, we can see that the design for lighting products is mainly the design for cultural elements of outer "tabfible" level. Less design for cultural elements of inner "intangible" and mid "behavioral" level is carried out, especially for the cultural elements of mid "behavioral" level.
2. For each design element, cultural morphology, structural element and cultural concept element are the most used three cultural design elements. Hence, we can know that these three cultural elements are the easiest-to-use design elements which can present the cultural value orientation easily.

Based on the above analysis, we learn the main method, status and reasons for design of OLED lighting products via application of Chinese cultural elements.

4 Kansei Image Analysis Based on Product Shape Relating to the Cultural Value Elements of Sampled Lighting Products

By applying kansei engineering theory, shape element is quite important in the designing process of lighting products, and more cultural value elements are applied relatively, which has representative and significant meanings.

Table 2. Usage method table of cultural elements for sample 2 table lamp named running under the moonlight

Sample 1: Running under the moonlight ——OLED table lamp

Usage of culture									
(Outer "tabfible" level)					(Mid "behavioral" level)			(Inner "intangible" level)	
Shape	Color	Material	Structure	Surface ornamentation	Function	Usage	Background story	Has cultural meaning	Apply cultural concept
Application of ancient carriage's shape							Terracotta soldiers and horses of the Qin Dynasty	Conform to traditional aesthetic appreciation	

Application description of cultural elements: Via using the ancient carriage's shape, luminous source is combined with hood of the carriage.

Table 3. Summary table on application of cultural elements of lamp samples

		Outer "tabfible" level						Mid "behavioral" level				Inner "intangible" level		
		Shape	Color	Material	Structure	Surface ornamentation	Total of outer "tabfible" level	Function	Usage	Background story	Total of mid "behavioral" level	Has cultural meaning	Conform to cultural concept	Total of inner "intangible" level
Design of lighting products with Chines elements	Quantity (pcs)	10	1	1	4	2	10	2	2	1	3	2	4	7
	Percentage	100&	10 %	10 %	40 %	20 %	100 %	20 %	20 %	10 %	30 %	20 %	40 %	60 %

1. *Selection and determination of kansei quotations.* For a large number of kansei adjectives, expert opinion is adopted in the article. Combined with the features of lighting products and the contents as above-mentioned, ten pieces of dimensionality are put forward to improve lighting products' designing. After comprehensive consideration is implemented, 6 pairs of relative kansei adjectives are listed in Table 4.

2. *Establish SD semantic differential table and print material lighting products* via *3D technology.* If kansei quotations are combined with 10 groups of product samples, a semantic differential table of 7 steps can be established as Table 5.

3. *Statistical analysis.* After statistical analysis is carried out for the features of sampled lighting products in the above table and the corresponding kansei vocabularies, the design elements which can explain these kansei vocabularies properly can be analyzed. By using statistical method, Scoring of Features shown can be worked out in such manner. Meanwhile, by using statistical method, Scoring of Features shown in Table 6 can be worked out in such manner: 1 score shall be added for each feature of samples with high score, while 1 score shall be deducted for each feature of samples with low score.

4. *Analysis of result.* Through analyzing the above table, we can gain the research result on OLED lighting products with Chinese elements according to image cognition. It is concluded that the impacts on the sampled lighting products caused by the morphology of cultural value elements are:

Modernity: Those cultural value elements with biased abstract conceptualization and low similarity have high modernity. Innovativeness: Those lighting products with biased geometry, simple shape, biased abstract conceptualization and low similarity have high innovativeness. Interestingness: Lighting products with biased geometry and high similarity have high Interestingness. Convenience: Lighting products with biased organism, biased duplication and high similarity have high convenience, in which, those with biased duplication and high similarity with images and shapes have a greater impact on the convenience. Grade: The more biased geometry is used and the higher similarity is, the higher grade of the lighting product is, which cause a greater impact on the grade. Beauty: Lighting products with biased geometry, biased duplication and high similarity are more beautiful and have a greater effects.

The better the cultural value elements are applied to the OLED lighting products, the more cultural elements shall be abstracted rather than duplicate directly. Moreover, this does not need to keep a higher similarity with the original cultural value elements.

Table 4. Scoring table for the features of sampled lighting products

Perceptual demand	Property comparison of the product				Product shape and morphology of cultural value			
	Biased shape		Complexity of the shape		Application technique of cultural value intention		Morphology similarity relating to cultural value intention	
	Biased geometry	Biased organism	Complex shape	Simple shape	Biased abstract conceptualization	Biased duplication	High similarity	Low similarity
Modern - ancient	1	−1	0	0	3	−3	−2	2
Innovative - conservative	1	0	0	1	2	0	0	2
Interesting - monotonous	1	0	1	1	1	1	2	0
Easy to use - hard-to-use	0	2	2	1	0	2	3	0
Low-end - high-end	3	0	2	1	1	2	3	0
Beautiful - ugly	3	0	2	1	0	3	3	0

Table 5. Determination of Kansei quotations

Modern - ancient	conservative - innovative	monotonous - interesting
Hard-to-use - easy to use	low-end - high-end	ugly - beautiful

Table 6. Semantic differential table of 7 steps relating to sampled lighting products

Ancient	−3	−2	−1	0	1	2	3	Modern	Picture of samples

5   Conclusion

The practical application of the study with relation to the cultural values of lighting products based on intention recognition and 3D printing technology as that stated by this article when designing the OLED lighting products with Chinese elements is relatively a complete and feasible design procedure. All in all, we can solve three main problems as below.

1. Propose more comprehensive and reasonable cultural level classification for lighting products concerned with the study of cultural value elements.
2. Analyze modeling elements of the lighting elements and redefine cultural value-oriented modeling elements of the products when studying the OLED lighting products.
3. Investigate existing design of OLED lighting products and analyze a large amount of collected and summarized data via kansei engineering theory and 3D printing technology to gain a large amount of conclusions relating to cultural value-oriented design creativity of the lighting products, which simplify the design difficulty and dimensionality of the OLED lighting products.

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