Research of Customer Product Form Preference based on Kansei Engineering

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Abstract: With the change of customers' aesthetic taste, product form design is becoming one of the most active research directions in product design theory. However, customers' perception preferences are processed by the cognition-feedback program which is complex, and also different customers' preferences vary. Taking the similar customers as the breakthrough point, this paper takes the form design of the toaster as an example. Through the induction and analysis of its form features, the relationship between the customer and the product form preference is studied by the inductive study of Kansei Engineering. Using the analytic hierarchy process, we build a model of influencing factors for the difference of the toaster form, quantify customer's perceptual cognition of product form features to solve the model. It is proved that the method is practical and effective to provide a valid method for finding and predicting personalized and differentiated product form preferences.

1. Introduction
Product form, the result of design materialization, is the form of design idea in product design activity and used to convey product information. The physical features of products and their different environments constitute the language of communication between designers and consumers and also change the information transmission[1]. With the rapid development of the economy and the improvement of the living standard, as for the toaster selection, people are no longer just satisfied with the functional requirements, but also satisfied emotionally. Therefore, the study of product form should no longer be limited to the coordination of function and form, but also pays more attention to focus on the relationship between the customers and the product form. The reduction of technology differentiation of similar products makes product form a key factor in marketing.

The customer's aesthetic preference for product form varies, so the demand for personalized products is becoming increasingly obvious. It is necessary to quantify the product form preference of target customers basing on the most widely used Kansei Engineering with the combination of deconstruction method, combined analysis method and analytic hierarchy process.

2. Related technologies
2.1 Kansei Engineering
The word "Kansei Engineering" was first proposed by Yamamoto Kenichi, the former president of Mazda automobile group in 1986, which means studying the perceptual association between human and objects from the perspective of engineering[2-3]. In the field of industrial design, it is often used to analyze the relationship between product form elements and customers' perceptual indexes. Kansei Engineering is able to implement as a method, a tool and a technique in a variety of fields, such as...
psychology, ergonomics, information systems, sociology and marketing. It is also a kind of sense generated by people’s perception and cognition for specific work pieces, environments, and circumstances\[4\].

The research based on Kansei Engineering builds the customer's cognitive model and analyzes the relationship between the product image and the features of product modeling generally from the perspective of the customer's psychological cognition. It is quite necessary to apply Kansei Engineering to product modeling design\[5\]-\[6\].

The method of Kansei Engineering is shown in Figure 1. The specific steps are as follows:

1. The preparation before accessing product form preference
   - Gather terms for questionnaire: Gather Kansei words about product. Next filtrate and summarize the words collected and then choose the most suitable terms for questionnaire.
   - Designate the form of evaluating: The general forms include Semantic Difference Method and Likert-type scale.
   - Designate product sample book presented to testees.

2. The implementation of the experiment to evaluate Kansei product
   In the experiment of evaluating Kansei product, testees are presented the selected samples of the products and are asked to complete the questionnaire.

3. The extracting of elements of product design
   It needs to use Morphological Analysis to doing extraction and deconstruction for elements of product design. Morphological Analysis was first put forward by an American astronomer Zwicky who lived in Switzerland in the 1940s. It’s a method of system innovation, which starts from system theory and looks for innovation scheme with the form of combination form, as described below\[3\]:
   - Decompose object into a number of basic elements which are mutually independent to identify dimensions.
   - List schemes of each element according to identified dimensions and the images of the sample.
   - Draw the morphological analysis matrix: “line” represents independent element, “row” represents specific statement of each independent element.
   - Encode the form elements of product samples.

4. Congruent relationship between performance of the products and design considerations
   Discuss congruent relationship between performance of the products and design considerations from the view of quantification\[7\]. Mature modeling approaches at present include Quantification Type I, Back-Propagation Artificial Neural Net-works, Conjoint Analysis and so on.

This paper researches the method able to predict consumer preference and makes innovative design of toaster, using for reference Kansei Engineering’s extraction and processing for product form design.
2.2 Product form preference of customers

The so-called preference refers to the individual's preference for things. Product form preference usually refers to customers' preferences for a particular product form. This kind of preference can be influenced by many factors such as product form, color, material and so on. It is also influenced by customers' cultural background and values[8].

Customer perceived information refers to the cognitive information composed by the customer's comprehensive impression of the product, that is, the comprehensive perception features compose of multiple image preferences. Through the research of customer product form preference[9-10], we can accurately grasp the customers' preferences and needs, then design the product form that satisfies the demands of the target customers. The result sets up the product shaping rule, which is oriented to customer preferences. The analysis results build a rule of product formation oriented for customer preference image.

3. Research framework of customer product form preference based Kansei Engineering

This paper mainly focuses on the relationship between customer preference and form elements of product form innovation design. From the point of view of similar customer group, Authors discuss the relationship between customer group and product form preference and predict the multitype toaster form preferences of the target customer. The preference model is used to extract form elements of the toaster and determine the influence of various elements on customer preferences. The forms of the toaster and the customer preference influence are analyzed, The product prediction based on the customer groups of similar grade is carried out after the analysis of the forms of the toaster and the customer preference influence.

This paper proposes research framework of customer product form preference based Kansei Engineering. Firstly, the prediction of product form preference based on customer features and the prediction based on customer preference selection are both studied. Furthermore, the form preferences of the toasters is researched: (1) extracting the features of the various toasters from collected pictures of product samples, (2) deconstructing them and construct the hierarchical deconstruction model of the toasters, (3) calculating the similarity of the product shape of the toasters. Finally, authors provide effective methods for finding and predicting the individualized and differentiated product form of the target customers.
The specific product form preference research framework is shown in Figure 2.

4. Measuring of toaster form preferences

4.1 Toaster form features extraction
In the toaster case, determination method of extraction, weighted in detail of the product form, and finally verified the results to determine the feasibility of the method.

4.1.1. sample collection
This Paper selects 15 representative toaster product forms from sample pictures of various types of toaster product collected from Internet. In order to avoid the interference of brand elements in the research of product form preference, all the brand logos of sample pictures are processed fuzzily, see Table 1.

| Number | Product Sample | Number | Product Sample | Number | Product Sample |
|--------|----------------|--------|----------------|--------|----------------|
| 1      | ![Toaster Product 1](image1.png) | 2      | ![Toaster Product 2](image2.png) | 3      | ![Toaster Product 3](image3.png) |
4.1.2. Deconstruction of toaster form features

Through interviews with the professional, the form features of toaster are deconstructed by morphological analysis, and the form features of all product samples are listed. See Table 2.

| Form features | Feature attribute value description          | Feature weight |
|---------------|---------------------------------------------|----------------|
| 1. Form       |                                             |                |
| A General form| ![Image](image1.png) ![Image](image2.png) ![Image](image3.png) ![Image](image4.png) ![Image](image5.png) | 0.2256         |
| B Support     | B1 hidden B2 compact B3 general B4 stable   | 0.0248         |
| C Button position | C1 Lower part of the front C1 Middle part of the front C3 sides of the front C4 sides of the product | 0.0794         |
| D Adjustment button type | D1 rotary type D2 Pitman style D3 Press type | 0.0311         |
| E Function button style | E1 circular E2 Ellipse E3 rectangle | 0.0351         |
| F Function button arrangement | F1 Vertical F2 Horizontal F3 Point aggregative | 0.0563         |
| 2. Button parts type | ![Image](image6.png) ![Image](image7.png) ![Image](image8.png) ![Image](image9.png) |                |
| G Color       | G1 Warm G2 Cool G3 Black                    | 0.2118         |
4.2 Calculating of toaster form similarity
When the similarity of the product form is lower than a certain threshold, it does not have the significance of evaluating the similarity of product form. For example, products are only a minor form of the same, then the similarity of product form their value does not have the significance of the comparison, it can be judged for their similar forms. Threshold setting should be based on the similarity of the classification of the case through iterative determination, and the similarity threshold of this toaster case is set to 0.8, as shown in figure 3.

5. Conclusion
Combining analytic hierarchy process and product form similarity method, the theory of applied Kansei Engineering extracts the product forms and constructs the hierarchical structure model of toaster's form differentiation. This paper proposes a method for calculating the similarity of product form to solve the problem of classifying product form used to be done by human resources. Besides, it introduces product form similarity as the consideration factor of customer preference selection similarity, builds the matrix diagram of product form feature and constructs the clustering graph of form similarity of toaster, which not only effectively reduces the effect of data sparsity on prediction results and makes consideration factors of similar customer judgment more comprehensive, but applies to quantitative analysis of the target customers preferences, helping guide the individualized design of the product form.

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References
[1] Gorno R and Colombo S 2015 Attributing Intended Character To Products Through Their Formal Features Politecnico di Milano 8 1.
[2] Yang C C 2011 A classification-based Kansei engineering system for modeling consumers’ affective responses and analyzing product form features Expert. Syst. Appl 38(1) 1382-11393.
[3] Schütte S T W, Eklund J, Axelsson J R C and Nagamachi M 2004 Concepts, methods and tools in Kansei engineering *Theor. Issues. Ergon. Sci* 5(3) 214-31.

[4] Alexandros S, Sotirios P and Dimitrios K 2011 Affective engineering: towards a consumer culture theory approach to Kansei Engineering Democritus University of Thrace 2.

[5] Shen K S 2016 The design evaluation in the process of product design and planning based on Kansei Engineering TOKO University 12.

[6] Hsiao S W and Wang H P 1998 Applying the semantic transformation method to product form design *Design. Stud* 19 309-30.

[7] Orsborn S, Cagan J and Boatwright P 2009 Quantifying aesthetic form preference in a utility function *J. Mech. Design* 131 0610011-110.

[8] Llinares C and Page A F 2011 Kano’s model in Kansei Engineering to evaluate subjective real estate consumer preferences *Int. J. Ind. Ergonom* 41 233-246.

[9] Burmester M, Mast M and K Jäger H Homans 2010 Valence method for formative evaluation of user experience Stuttgart Media University 8 36.

[10] Guo F, Ding Y, Wang T B, Liu W L, Jin H Z 2016 Applying event related potentials to evaluate user preferences toward smartphone form design *Int. J. Ind. Ergon* 54 57-64.