

Title:

A Method of Gathering, Selecting and Hierarchizing Kansei Words for an Aesthetic Design using a Hierarchized Kansei Model

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Introduction:

Due to maturation of science and technology, it becomes increasingly difficult to differentiate products in terms of performance, functional feature or price. Therefore, companies are required to differentiate their products in terms of subjective and abstract qualities such as aesthetic and comfort that are evaluated by customer's feeling, which is called "Kansei" in Japanese. The quality evaluated by customer kansei is called "Kansei quality" [14].

In the field of emotional engineering or kansei engineering [6], [7], [8], the methods for measuring customer kansei or the impression of products have been developed and applied to many case studies [1], [3], [15]. In these researches, semantic differential method (SD method) [9] is widely used. SD method scores the impression which a customer receives from products using adjective pairs of opposite meanings named "Kansei words". In addition to measurement, methods for supporting aesthetic design by utilizing customer kansei have also been developed. These methods derive the aesthetic design which a customer prefers best by analyzing the relationships between the results of customer's kansei evaluation of existing products and their aesthetic elements. Tanaka et al. proposed the design support methods using interactive reduct evolutionary computation [11], Yanagisawa et al. proposed the design support methods using interactive genetic algorithm [13]. Yamada et al. proposed the method to design an eyeglass frame using rough set theory [10], [12]. Hsiao et al. proposed the design support method using fuzzy theory and multidimensional scaling (MDS) method and artificial neural network. In our previous research, we proposed an aesthetic design support method using a three-layer model, self organizing map (SOM) and artificial neural network (ANN) as analyzing method and genetic algorithm as a searching method [2]. A three-layer model consists of upper and middle level kansei words that come from mori's kansei evaluation model [5] plus aesthetic elements and shows the relationships between customer kansei and product aesthetics. The model is constructed by analyzing the questionnaire results using SOM and ANN. After constructing the model, a subject indicates his / her needs and GA explores the parameters of aesthetic elements that best fit the subject needs.

Selection of kansei words suitable for the targets continues to be an important problem for the kansei evaluation /design methods including our previous method. Inappropriate kansei words and too many / few kansei words decrease accuracy of kansei evaluation and too many kansei words also increase burden on subjects. Therefore, a designer needs to select kansei words based on his / her knowledge or experience in most methods including our one. Several methods of gathering and selecting kansei words have been developed [16].

In this paper, we develop a new method of gathering, selecting and hierarchizing kansei words based on text mining and questionnaire investigations. The features of the proposed method are selection and hierarchization of kansei words based on results of questionnaire investigations. This is

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because the target of the proposed method is our previous design method described above. Our previous method is based on hierarchical kansei model and requires two-level of kansei words, upper and middle kansei words to construct a three-layer model. The main target of the proposed method is our design method, but the proposed method also can be used for other design methods using a hierarchical kansei model or simply to construct a hierarchical kansei model.

Proposed method:

The proposed method consists of the following 6 steps.

Step1: Gathering of kansei words

Adjectives and adjective verbs are gathered from Web pages, magazines, leaflets etc. They are named candidate kansei words. To gather them, any text mining methods / software can be used.

Step2: Reduction of kansei words

Candidate kansei words gathered in step1 are narrowed down by questionnaire investigation. Subjects evaluate the words on a scale of 1 to 7 from the viewpoint how frequently subjects use the words in their daily life. This is because it is difficult for subjects to evaluate using not so familiar kansei words. The words that don't exceed a certain threshold value are eliminated. Threshold value needs to be configured by a designer.

Step3: Hierarchization of kansei words

Kansei words are classified into three-level (upper, middle and lower). Subjects evaluate kansei words using 4 semantic differential scales (Concrete - Abstract, Simple - Complex, Objective - Subjective, Difficult - Easy) proposed by Matsumoto et al. [4] and the results are analyzed by Multidimensional Scaling (MDS). Fig. 1 (a) illustrates the result. According to the studies of Ozawa et al., the kansei words belonging to the same level tend to be located close to each other on the space obtained by MDS. Therefore, a designer divides kansei words into 3 groups by considering the sense of each kansei word and their distance on the space. Fig. 1 (b) illustrates an example. In the case of this figure, kansei words are divided by 2 vertical dotted lines. The way to divide kansei words is one of our future issues.

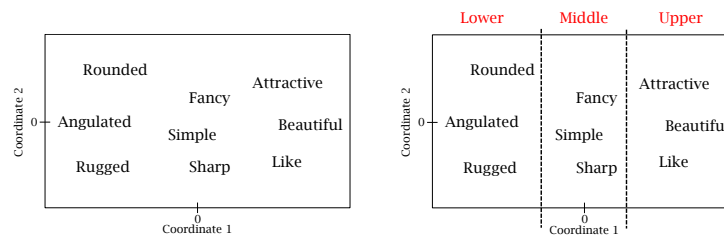


Fig. 1: (a) Result of MDS, (b) Division of kansei words.

Step4: Selection of upper level kansei words

A designer checks the kansei words classified as upper level kansei words and eliminate the words unsuitable for the design target. If the word has a negative sense, the word is replaced with the opposite word. If there is a pair of kansei words having opposite senses, the word having a negative sense is eliminated.

Step5: Selection of middle level kansei words

In our aesthetic design support method, middle level kansei words are used as the semantic differential scales when subjects evaluate upper level kansei words and existing products. To improve analytical accuracy and reduce burden on subjects, it is desirable to carefully select a limited number of kansei words.

Subjects evaluate upper level kansei words selected in Step4 using middle level kansei words classified in Step3 as semantic differential scales. The results are analyzed by principal component analysis and the score of j -th kansei word S_j is obtained by the below equation.

$$S_j = \sum_i^{n_\theta} q_i |a_{ij}| \quad (i = 1, 2 \dots M)$$

Where q_i is the contribution ration of i -th principal component, a_{ij} is the weight of j -th kansei word against i -th principal component, n_θ is the number of principal components when cumulative contribution ratio exceeds θ and M is the number of middle level kansei words.

Score S_j indicates the importance and familiarity of j -th kansei word when subjects evaluate upper level kansei words. Therefore, by only using the middle level kansei words with high score, accurate kansei evaluation with a limited number of middle level kansei words can be done. A designer needs to decide the number of middle level kansei words by considering score distribution.

Step6: Selection of lower level kansei words

Lower level kansei words are selected in the same way as Step5. In particular, subjects evaluate middle level kansei words selected in Step5 using lower level kansei words classified in Step3 as semantic differential scales, their scores are calculated and lower level kansei words with high score are selected. Since our previous design method only requires upper and middle level kansei words, this step can be skipped.

Aesthetic design support method using selected kansei words

Since the proposed method is specialized for our aesthetic design support method, we explain the method briefly and describe the connection between them in this section.

Fig. 2 shows a three-layer model and process flow of the method. A three-layer model consists of upper and middle level kansei words plus aesthetic elements and shows the relationships between customer kansei and product aesthetics. To construct a three-layer model, a subject needs to evaluate upper level kansei words and existing products using middle level kansei words as semantic differential scales. However, since a subject has already evaluated upper level kansei words in Step5 of the proposed method, the results can be reused to reduce burden on a subject. Therefore, a subject needs only to evaluate existing products at this time. The middle level kansei words selected by the proposed method are used in this evaluation. The evaluation results of upper level kansei words are analyzed by SOM while ones of existing products are analyzed by ANN. After constructing the model, a subject indicates his / her needs on the “Kansei map” obtained by SOM. Customer needs can be translated to the weight vector of middle level kansei words by using kansei map. GA explores the parameters of aesthetic elements that best fit the customer needs by using the network constructed by ANN that shows the relationships between middle level kansei words and parameters of aesthetic elements.

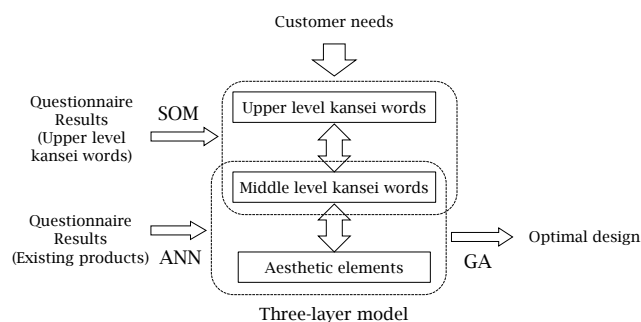


Fig. 2: Concept of three-layer model and process flow.

Case study:

To show the process flow of the proposed method, the proposed method is applied to office chair design.

Conclusion:

Kansei words are widely used as semantic differential scales in kansei evaluation. Inappropriate kansei words and too many / few kansei words decrease accuracy of kansei evaluation and increase burden on the subject. In this research, we develop a method of gathering, selecting and hierarchizing kansei words specialized for our previous aesthetic design support method based on the hierarchized kansei model. The proposed method consists of text mining and several questionnaire investigations conducted by subjects. Questionnaire investigations increase burden on subjects. However, since questionnaire results are reused in the aesthetic design process, burden on subjects can be kept to the minimum. In the case study, the proposed method was applied to office chair design and its effectiveness is confirmed.

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