



# Research on User Experience Evaluation Model of Smart Jewelry Based on Kansei Engineering

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**Abstract.** Kansei engineering is a theory that pays close attention to the emotional experience of users. This paper is based on Kansei engineering theory. The research group collected a certain number of emotional words related to the user experience of smart jewelry, and established a multilevel evaluation model of user experience based on analytic hierarchy process. Then the researchers get the weight of various indicators by calculating the judgment matrix. Thus the researchers can quantify the user experience status of the smart jewelry, and improve the design of the product.

**Keywords:** Smart jewelry · AHP · Kansei Engineering

## 1 Introduction

Jewellery refers to jewelry made of gold, silver, or natural materials (minerals, rocks, gem, etc.) and of certain value, such as rings, necklaces, earrings and pendants. When ancient ancestors began to adorn themselves, jewelry was born at that time. The earliest jewelry can trace its history to the Stone Age. With the rapid development of society, economy and culture, the kinds of jewelry become more and more. In recent years, along with the fast growth of Internet technology and digital information, wearable smart jewelry is beginning to enter people's field of vision. Digital information is the only way for jewelry industry to seek development, and it is also a magic weapon to win [1]. Smart jewelry, as same as traditional jewelry, is aesthetical and decorative. In addition to that, it also has the similar function of wearable devices. According to Maslow's hierarchy of needs, abundant material living conditions push the spiritual demand of consumers to a higher level, so people are no longer satisfied with homogeneous and stereotyped jewelry design. Pursuing individuality and showing oneself is becoming the theme of jewelry design at present. User experience design refers to improving the usability, accessibility and pleasure of the product during the process of interaction between the user and the product, so as to improve the usability of the product. It involves complex psychological activity mechanism of the users. Against this background, how can smart jewelry brings unique user experience to users has become the focus of smart jewelry designers.

## 2 Concepts and Research of Kansei Engineering

Sensibility is opposed to reason, and it is composed of people's cognition and five senses. John Locke said that: "I conceive that Ideas in the Understanding, are coeval with Sensation; which is such an Impression or Motion, made in some part of the Body, as makes it be taken notice of in the Understanding" [2]. Kansei, means sensibility in Japanese. The theory of Kansei Engineering was first born in Japan. In 1989, a famous Japanese scholar called Mitsuo Nagamachi published a book entitled "Kansei Engineering", and he defined Kansei engineering as "the technique of translating user's emotional needs to improve product design. When a user chooses a product, he is no longer just satisfied with its utility. The user makes a comprehensive consideration of the product through his own senses. These subjective feelings determine whether or not the product is ultimately purchased. Kansei engineering uses quantitative techniques to analyze and study users' perceptions, and it uses statistical methods to explore which product is better suited to the emotional needs of users. The product design method based on Kansei engineering consists of the following steps: Set goals-Collect emotional words- Evaluating emotional words-Quantify by means of engineering- Get the result. Although Kansei engineering is a relatively new theory, it has been widely used in the fields of automobile, electronic products, architecture and so on.

At present, the research on the application of Kansei engineering in the field of smart jewelry in China is still few. Using Kansei Engineering to establish an evaluation model for the user experience of smart jewelry can help designers and developers to find emotional and cognitive problems of users more efficiently and improve the design.

## 3 Establishment of User Experience Evaluation Model for Smart Jewelry

After interviewing the users who have used the smart jewelry, the research team of this article divided user experience of smart jewelry into the following three levels: Sensory experience, operation experience and value experience.

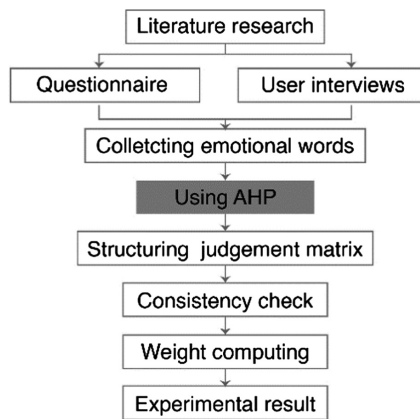
### 3.1 Experimental Method

The main experimental method used in this paper is Analytic hierarchy process (AHP). It is a decision method put forward by American operational researcher Thomas L. Saaty in the early 70 s of the 20th century, and it has particular application in group decision making [3]. Analytic hierarchy process treats a complex decision-making problem as a system, decomposing it into a hierarchy of goals, criteria, alternatives, and so on. By constructing a judgment matrix, we can calculate the weight of each element, the best scheme is the one with the largest weight. Analytic hierarchy process (AHP) has been widely used in economics, management, engineering and other fields.

In the field of design, analytic hierarchy process (AHP) is mainly applied in the evaluation of design plan and usability test. This method divides problems into several hierarchies and decomposes them layer by layer, and using quantitative methods to reduce the risk of subjective judgment of the evaluator. In this paper, combined with literature research and user interviews, analytic hierarchy process (AHP) is finally chosen as the research method of this paper.

### 3.2 Research Framework

The research framework is shown in Fig. 1



**Fig. 1.** Research framework

### 3.3 Collecting and Choosing Emotional Words

Emotional word is generally used to describe users' subjective impressions about products, and it is mainly used in the process of collecting emotion states. In this paper there are three ways to collect emotional words: (1) From relevant literature: Emotion related evaluation in usability test of Interactive products; Research and achievements related to emotional words in psychology literature. (2) User surveys and interviews: questionnaires or interviews conducted online or offline for consumers who have used smart jewelry. (3) Vocabulary expressions and emotional comments in product advertisements, websites and brochures.

Through these three approaches, researchers collected 92 emotional words and eventually chose 20 typical words, as shown in Table 1 below.

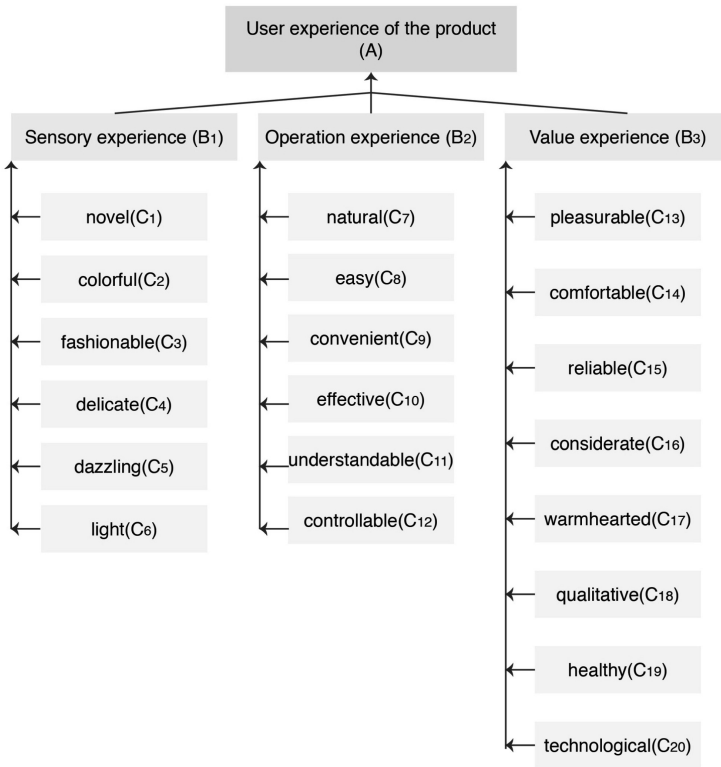
**Table 1.** Twenty emotional words selected in this paper.

No.	Emotional word	Explanation
1	Novel	The shape of the product is creative
2	Comfortable	The product is comfortable to wear
3	Colorful	Color matching of the product is beautiful
4	Natural	The product interacts in a natural way
5	Pleasurable	The product is pleasant to use
6	Easy	The operation of the product is very easy
7	Fashionable	The product conforms to the trend
8	Dazzling	The product is very compelling
9	Convenient	Operation of the product is not redundant
10	Reliable	The product is stable and trustworthy
11	Effective	All functions of the product are effective
12	Delicate	Appearance of the product is not rough
13	Light	Appearance of the product is refined
14	Understandable	Operation of the product is simple
15	Considerate	The product brings the user intimate feeling
16	Warmhearted	Product can bring emotional satisfaction
17	Qualitative	Product can reflect the quality of life
18	Controllable	Operation of the product is controllable
19	Healthy	Products can assist users to live a healthy life
20	Technological	The product has a sense of technology

### 3.4 Hierarchical Analysis

The team divided user experience of smart jewelry into several levels and then numbered them. User experience of a product ( $A$ ) as Target layer. Sensory experience ( $B_1$ ), operation experience ( $B_2$ ) and value experience ( $B_3$ ) as criterion layer. Sensory experience refers to the appearance of product appearance, color, material and texture. Operation experience refers to the experience during the interaction between users and products. Value experience refers to emotional and value resonance of the users. 20 emotional words selected are used as the alternatives ( $C_1 - C_{20}$ ). The hierarchy created is shown Table 2 below:

**Table 2.** Hierarchy



**3.5 Establishing Pairwise Judgement Matrices**

Researchers invited 24 designers, 12 college students whose major is design and users of smart jewelry to participate in AHP surveys, and then collected the data and built judgment matrices. This method lists all indicators, and form an  $N \times N$  matrix. In order to quantify the judgment, the researchers used the 1–9 scale proposed by Saaty and the details of 1–9 scale are shown in Table 3. Then, the researchers compared the factors to one another at one time. The evaluation of the factors shows the influence on the factors above them.

Values obtained from pairwise comparisons between different indicators are recorded as  $a_{ij}$ . If the ratio of element  $a_i$  to element  $a_j$  is  $a_{ij}$ , then the ratio of element  $a_j$  to element  $a_i$  is  $1/a_{ij}$ .

**Table 3.** Analytic hierarchy measurement scale

Reciprocal measure of intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Weak importance of one over another moderate importance	Experience and judgement slightly favor one activity over another
5	Moderate importance	Experience and judgement strongly favour one activity over another
7	Strong importance	An activity is strongly favored, and its dominance is demonstrated in practice
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation when compromise is needed
2, 4, 6, 8	Intermediate values between two adjacent judgements	When compromise is needed

### 3.6 Consistency Check

The research Group used mathematical methods to check the consistency of judgement Matrix in order to ensure that the judgment matrix can evaluate the importance of each index scientifically. The weighting factors of the different index can be computed by calculating vector resemblance-degree of index vector and normalization. The method of calculating the eigenvectors of a judgment matrix is:

$$\bar{W}_i = \sqrt[n]{M_i} \quad (M_i \text{ is the product of each row of the matrix}).$$

Then the eigenvectors are normalized to get the relative weight  $W_i$ . The computing method is as follows:

$$W_i = \frac{\bar{W}_i}{\sum_{i=0}^n \bar{W}_i}$$

In order to verify whether the matrix constructed is consistent, a consistency checking is needed. “The oldest and most commonly used measures are the consistency index (CI) and consistency ratio (CR)” [4]. Here we need to calculate the value of consistency ratio CR, and the calculating formula is defined as:

$$CR = CI/RI$$

If  $CR = 0$ , the matrix created is completely consistent, and if  $CR = 1$ , it means that the matrix is completely inconsistent. Base on Saaty’s theory, when CR is between 0.1 and 0.15, the consistency of the matrix is acceptable. When  $CR > 0.15$ , the evaluation

need to be repeated until CR is within the range mentioned above. In this experiment, the value of CR is  $0/0.490 < 1$ , meeting the consistency conditions.

### 3.7 Calculation of the Index Weight

Calculation process of weight is completed with aid of software Yaahp, and the result is shown as the follows:

**Table 4.** Weight of the index

User experience of the product (A)	Sensory experience ( $B_1$ )	0.312	Novel ( $C_1$ )	0.026
			Colorful ( $C_2$ )	0.039
			Fashionable ( $C_3$ )	0.057
			Delicate ( $C_4$ )	0.072
			Dazzling ( $C_5$ )	0.061
			Light ( $C_6$ )	0.057
	Operation experience ( $B_2$ )	0.211	Natural ( $C_7$ )	0.019
			Easy ( $C_8$ )	0.017
			Convenient ( $C_9$ )	0.033
			Effective ( $C_{10}$ )	0.041
			Understandable ( $C_{11}$ )	0.054
			Controllable ( $C_{12}$ )	0.047
	Value experience ( $B_3$ )	0.477	Pleasurable ( $C_{13}$ )	0.069
			Comfortable ( $C_{14}$ )	0.063
			Reliable ( $C_{15}$ )	0.047
			Considerate ( $C_{16}$ )	0.040
			Warmhearted ( $C_{17}$ )	0.057
			Qualitative ( $C_{18}$ )	0.076
			Healthy ( $C_{19}$ )	0.071
Technological ( $C_{20}$ )			0.054	

## 4 Result and Conclusion

In this experiment, the researchers combine Kansei engineering and AHP together, and established a evaluation model for the user experience of smart jewelry creatively. The main purpose of Kansei Engineering is to explore the relationship of sensibility and rationality of products. By quantifying user’s subjective feelings, designers can find the best combination in product design which can meet the specific sensitivity needs of users. When choosing a smart jewelry, the desire of purchasing is often influenced by

user's values, background and culture. Kansei engineering builds a bridge between users and products, and then the user can communicate with the product psychologically. The researchers of this paper take user experience of smart jewelry as the object, but the experimental method mentioned in this paper can also be applied to other fields of design, such as wearable devices design, design evaluation and usability test.

According to the details shown in Table 4, we can clearly see that the value of the weight reflects the influence degree of each perceptual evaluation index on total user experience of the product. Experimental results show that users of smart jewelry pay more attention to the value experience, especially whether the product can improve their life quality. The weight of  $C_{19}$ (healthy) and  $C_{13}$  (pleasurable) are respectively the second and third largest values. So designers of smart jewelry need to consider that whether the product can lead to a healthy life. In addition, the pleasure brought by the product is also necessary.

In the second place, users tend to pay attention to the sensory experience brought by products. Smart jewelry still has the traditional function of decoration, therefore, the appearance of smart jewelry cannot be ignored. The weight of  $C_4$  (delicate) and  $C_5$  (dazzling) show that consumers still prefer those smart jewelry with fine and shining looking as same as traditional jewelry.

By calculating the weight of  $B_2$ , it seems that the users pay less attention to operation experience. It may due to that users of smart jewelry are mostly young people who are no longer new to electronic products. Users tend to focus on understandability and controllability of smart jewelry.

Research and Evaluation of user experience from the perspective of Kansei Engineering can help R & D and designers understand the current situation and improvement direction of the product, so as to enhance the quality of the product.

Through this experiments we can see that it is feasible to create a smart jewelry user experience evaluation model based on Kansei engineering. By applying the theory of Kansei engineering in design process, we can quantify subjective feelings of the user, and give better realization of user's emotional demand. Thus the designers can combine sensibility and rationality together in a product. Due to time, energy, and feasibility of experiment, samples selected in this article are restricted and it may also caused some limitations.

## References

1. Shi, J., Ding, Y.: Construction of responsive jewelry brand in the Internet. *Ideas Des.* (3), 59–63 (2016)
2. Locke, J.: *An Essay Concerning Humane Understanding*, p. 44
3. Saaty, T.L., Peniwati, K.: *Group Decision Making: Drawing out and Reconciling Differences*. RWS Publications, Pittsburgh (2008). ISBN 978-1-888603-08-8
4. Brunelli, M., Critch, A., Fedrizzi, M.: A note on the proportionality between some consistency indices in the AHP. *Appl. Math. Comput.* **219**(14), 7901–7906 (2013)