

# APPAREL PRODUCTS RETRIEVAL SYSTEM BASED ON PSYCHOLOGICAL FEATURE SPACE

Atsushi OHTAKE, Masayuki TAKATERA, Takao FURUKAWA and Yoshio SHIMIZU

*Faculty of Textile Science and Technology, Shinshu University, 3-15-1, tokida, Ueda-shi, Nagano-ken, 386-8567 Japan*

## Abstract

An apparel products retrieval system was proposed in which users can refer to products using *Kansei* evaluation values. The system adopts relevance feedback using history of the retrieval to learn the tendency of user evaluation. The system is based on a vector space retrieval model using products images expression as semantic scales. The system makes a query from user inputting information and retrieves closest products from the database. Revising algorithms of the difference method, linear multiple regression method and backpropagation neural network model are used for the learning. Some simulation was performed to investigate the effectiveness and criteria of the search. As a result of evaluation of the accuracy, it was found that the linear multiple regression and the neural network models are effective for the retrieval considering the individual *Kansei*.

**Keywords:** *Apparel products, retrieval system, Individual correspondence, Semantic differential method, Multiple regression equation, neural network*

## 1. Introduction

The circulation system is changing by information revolution rapidly. E-commerce sites accumulating a large quantity of product information appear today. The retrieval technique is required to find consumer desired objects from the product database.

As for apparel products, the naming and classification are made at production or circulation steps by the supplier. However, the standardized classification doesn't exist. Therefore, the selection of a keyword to look up a product is difficult. Moreover apparel includes many kinds and products number, and it is difficult to obtain product information by selecting hierarchical menu. In the current situation, many apparel products exist in the same category, so that the keyword type Web search system shows a large quantity of result in the search. On this account, the user needs great labor to get a desired result. Therefore it is difficult to look up apparel product by the search algorithm adapting the method to be used in text information retrieval. Apparel products contains various elements of designs, and the impression gives influence to consumer's selection and purchasing behavior greatly. However, users have only vague

retrieval basis. The *Kansei* retrieval model using impression of product can realize more user-friendly apparel retrieval.

There are several studies on the retrieval system for products and images. They tried to obtain the relation between physical or geometrical quantities and average evaluations of the object impression. However, they didn't consider the differences in the evaluation between individuals in the retrieval. In this study, some methods to reflect the differences in the use of *Kansei* terms between individuals were investigated.

## 2. *Kansei* retrieval system for apparel products

The query of *Kansei* retrieval model is made up from some numerical values of psychological evaluation such as impression for an objective product. It is easy to use for the user who doesn't have clear retrieval object. In the system, users input the evaluation values of desired product, and the system searches closest products from the database. The impression for a product is measured using semantic scale. Some adjective pairs being suitable to evaluate apparel products are selected for the semantics scale. If the number of psychological evaluation item is  $n$ , the evaluation of

a product is represented by an  $n$  dimension vector. The space composed by the vectors is called psychological feature space (PFS). The similarity is estimated as the difference between the input values and pre-evaluated values of products in PFS. As a simple retrieval technique, the Euclidean distance of the input values and evaluations of each of the products in the PFS are calculated and then several products are shown from the nearest.

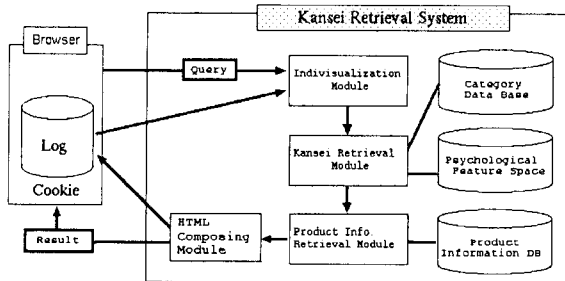


Figure 1: Apparel products retrieval system

## 2.2 Evaluations of retrieval precision and conformity rate

The propriety of the retrieval result is evaluated by expected search length. In general information retrieval system, precision and recall are used as evaluation of the retrieval precision. However, in case of vector type retrieval, the retrieval orders are settled to all objects in the PSF for a given query. In real retrieval trial, the expected search length shows whether the correct object becomes the several place of the result. Therefore, it is suitable for the retrieval. The expected search length  $\eta_r$  is given by Equation (2),

$$\eta_r = 1 - \frac{1}{M} \sum_{i=1}^M h(i) \quad \text{----- (2)}$$

$$h(i) = \begin{cases} 1 & \text{if } |Q_i - S_i| \leq |Q_r - S_r| \\ 0 & \text{Otherwise} \end{cases} \quad \text{----- (3)}$$

Where,  $Q$  is the query and  $S$  is the vector of PFS.

## 3. Simulation of retrieval

To show effective measures in the retrieval, selection of suitable terms is necessary. Adjective or adjective pairs extracted by the semantic differential (SD) method are used for the psychological evaluation by words. In order to select suitable

words, several words are tested using the SD method. The subjects were 37 males and 26 females; university-students in their early twenties.

For the gender differences, presentation samples according to male and female are made. The presentation samples for male and female subjects are 50 kinds. Sample images are selected from fashion magazines for male and female, respectively. Evaluation measures are 7 classes and 21 pairs for male and 23 pairs for females. The evaluating words are selected from 628 terms that adorn clothes and dress, which were extracted from approximately 5000 modifiers. Synonyms are eliminated and words that are easy to evaluate by sight are selected once again.

On the basis of this result, a retrieval model was built and inspection was carried out by a simulation. In the simulation, the PFS was built using the measurements of SD test for apparel product evaluated by a single subject person. In the SD test, 50 apparel product images, which can be used as the retrieval objects are used. Figures 1 and 2 show the samples for males and females respectively

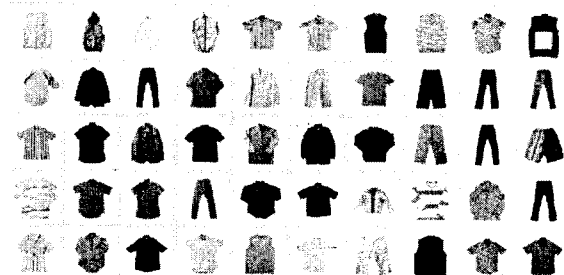


Figure 1: Samples for males.



Figure 2: Samples for females

In the retrieval simulation, the evaluation values in SD test of the other were used as Query. The order of the correct object among all of the results

obtained in a trial was used for the evaluation of the retrieval. The average search length was calculated from the normalized retrieval orders.

The result of simulation is shown in Figure 3 that is the expected search length about male subjects. In Figure 3, the expected retrieval order is 0.689 (standard deviation is 0.263). In the simulation of female subjects, the expected search length is 0.760 (standard deviation is 0.234).

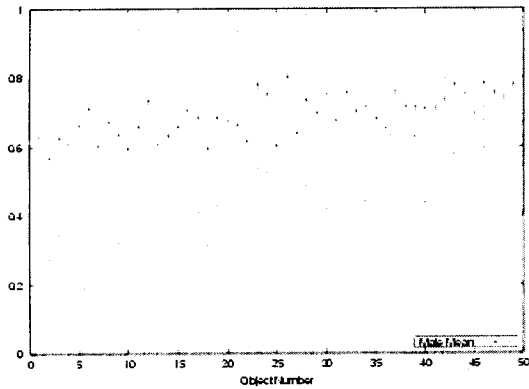


Figure 3: Expected search length of no revised retrieval for average of male subjects.

Table 1 Words used in SD test

| *No. |     |                      |                      |
|------|-----|----------------------|----------------------|
| M1   |     | cool, neat           | — not so             |
|      | F1  | cute, pretty         | — not so             |
| M2   | F2  | Fashionable, stylish | — Unsophisticated    |
|      | F3  | Beautiful            | — not so             |
| M3   | F4  | Childish             | — Adult              |
| M4   | F5  | Showy                | — Quiet              |
| M5   | F6  | casual, relaxed      | — Formal             |
| M6   | F7  | Individual           | — Popular            |
| M7   | F8  | Light                | — Heavy              |
| M8   | F9  | Urbane               | — Rustic             |
| M9   | F10 | Elegant              | — not so             |
|      | F11 | Feminine             | — Mannish            |
| M10  | F12 | Refine               | — not so             |
| M11  | F13 | good sense           | — not so             |
| M12  | F14 | basic                | — Unique             |
| M13  | F15 | Simple               | — Decorative         |
| M14  | F16 | Active               | — Gentle             |
| M15  | F17 | Cheap                | — high-grade feeling |
| M16  | F18 | Cool                 | — Warm               |
| M17  | F19 | Tight                | — Loose              |
| M18  | F20 | Hard                 | — Soft               |
| M19  | F21 | Smooth               | — rough              |
| M20  | F22 | Light                | — Dark               |
| M21  | F23 | I want to wear it    | — not so             |

\*M is for male and F for Female.

The retrieval result isn't much good. Therefore it is difficult to implement the no revised retrieval in a practical system. There are differences between individuals of the subject evaluation values used in the simulation, so the differences let the retrieval efficiency deteriorate. When average evaluation value of subjects are used for PFS, the expected search length becomes more short and the efficiency improves as shown in Figure 4. Therefore, it has big meaning in *Kansei* retrievals to consider differences of evaluation values between individuals.

### 5. Retrieval algorithms considering individual *Kansei*

For individualization of Products retrieval, conformity feedback using search histories was implemented to the retrieval model.

#### 5.2 MRE individualization module

Multiple Regression Equation individualization module does projection of an query to PFS which using retrieval history of users.

#### 5.3. Back Propagation Neural Network (BPNN) individualization module

BPNN individualization module is non-linear projection of the query to PFS.

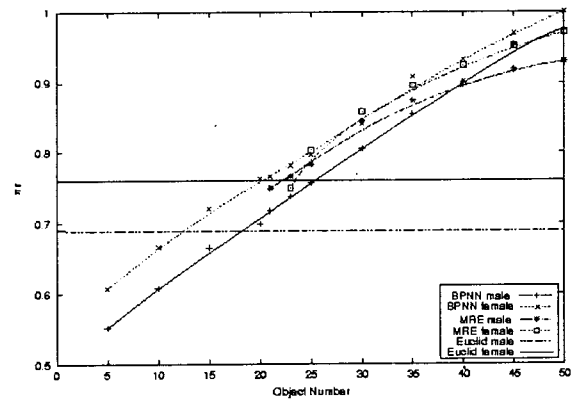


Figure 4: Expected search length of each individualization module.

In proportion as enough epoch, the expected search length is higher than previous simulation by MRE module and BPNN module. The expected search length of male subjects is 0.947(MRE) and 0.983(BPNN).

### 6. Construction of apparel product retrieval

system.

To construct the apparel product retrieval system, MRE individualization module was selected. BPNN module has a little higher expected search length than MRE module. However, the calculation cost of BPNN is too high for real time operation. Thus, the system equipped with the MRE module. By using MRE module, the system can retrieve apparel products considering the influence of differences between individuals.

In the simulate the *Kansei* retrieval model using 21 or 23 adjectives as queries. Using many *Kansei* evaluation words makes higher expected search length. That is hard to use many *Kansei* evaluating words in actual system. The system uses effective 8 words for expression of images that users search for.

The selected evaluating words were chosen by cluster analysis. The result of the simulation shown in is figure 5.

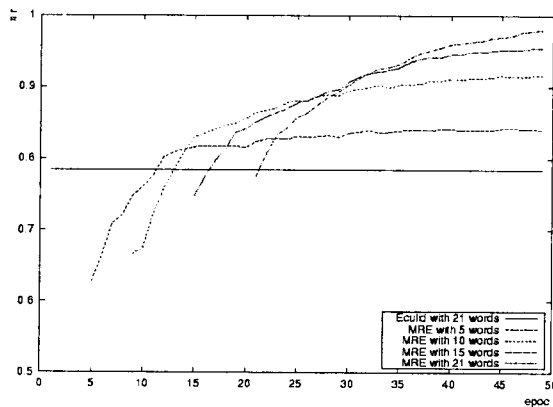


Figure 5: the expected search length when reduced adjectives are used.

The figure shows that the search is efficient even if adjectives are reduced around 8 words. The system was constructed as web-db system. Users can search apparel product through the Internet. The system interface shown in Figure 6 as the result of retrieval. In this system, the user, select the category of apparel products search for and next, input the SD value.

The system shows closed 6 items of retrieval to uses. Users of this system can change query by watching the result. The history of retrieval is saved in Browser as

Cookies. As the history collecting, retrieval results become a better for a user.

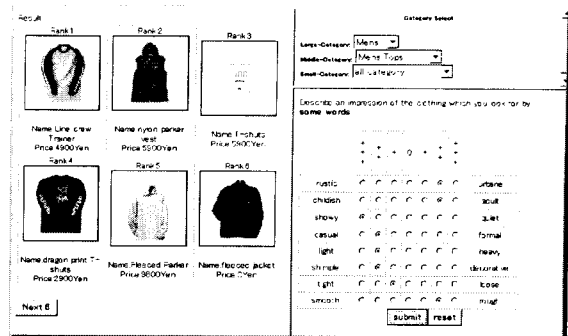


Figure 6: Apparel products retrieval system

## 7 Conclusion

When the expected search length higher, the retrieval system must consider the difference of users images. By the apparel products retrieval system based on psychological feature space, users will retrieve apparel products using image. The *Kansei* retrieval model will be effective retrieval system by implementation of the individualization module.

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