APPAREL PRODUCTS SEARCH SYSTEM CONSIDERING INDIVIDUAL KANSEI EVALUATION

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Abstract: An apparel product search system was proposed, in which customers can refer to products through several stores. With the system, the user can search for apparel products by inputting category information and/or Kansei measure values. A unified format of category information of apparel products suited for the search was developed. The Kansei search was performed by using some measure values of Kansei words. The distance between the customer input of Kansei information and store side evaluation are calculated, then the closest products are shown. Semantic differential (SD) method and statistics analyses were used for selection of measure terms and evaluation of efficiency of the search. Generally, the Kansei evaluation of a product of the store side doesn't agree with customer evaluation. Some learning methods were investigated to improve the effectiveness of the search. In the learning, Kansei evaluations of individual customer and store side were made with some products beforehand. Statistical analysis was made with the results of the SD test to find effective methods. If learning is enough, the efficiency of search improved by using the linear multiple regression equation between store side and individual customer's evaluations.

Keywords: Apparel products, Search system, Individual correspondence, Semantic differential method, Multiple regression equation

1. INTRODUCTION

In apparel product retail business, people suffer from decreased sales by stagnation of demand and intensification of competition. For customers, there are some reasons. For example: "liking products that aren't found at a favorite store," or "I don't know the suitable store for the products I want," etc. In store side, they sometimes are unable to arrange stock products matched with customer needs, and do not have enough funds to put out an advertisement, etc. Therefore, an apparel products search system by which the customer can easily find objective products and which the shop bears only a small cost will be needed to rouse the demand.

As for apparel products, the product items can be enormous, depending on differences such as the kinds, colors, forms and the material. Differences of product evaluation between individual customers are also large according to their society reversion, self-representation greed, and physiological body characteristics. Accordingly, some proposals of products corresponding to individuals are required.

For apparel products, the differences between individuals in Kansei evaluation of clothes were studied [1-3] and some design consultation systems were proposed [4]. However, there are no studies on the search system for ready-made products.

For most of Internet on-line shopping, a few products of some brands or a specified shop are arranged like a catalogue, and do not use any search services. Though some key word search systems that are available for apparel category search extend over several shops, detailed searches aren't completed because the key words aren't standardized for the products. As a matter of course, it isn't possible to meet the demand of individual customer.

There are several studies on the search system for products and images[4-6]. They tried to obtain the relation between physical or geometrical quantities and average Kansei evaluations of the object. However, in the search, they didn't consider the differences in the evaluation between individuals.

In this paper, an apparel product search system is proposed, in which customer users can search apparel products through several stores. By the system, the user can search the products by inputting category information and/or Kansei measure values. A unified format of category information of apparel products suited for the search was developed. In the search, some methods to reflect the differences in the use of Kansei terms between individuals were also investigated.
2. OUTLINE OF ASSUMPTION SYSTEM

The search system assumes joint enforcement with some corporations and shopping malls. The system consists of a Web server, a database server and data warehouse put in the center, and some information terminals put at storefronts and street corners. Information terminals are connected to the center by exclusive lines. The users are members who registered beforehand and have an IC card. General users can also use the system with limited service. Each shop of the shopping mall inputs the data of selected products, and it is renewed automatically. Customers input the category and Kansei item of the product into a terminal machine put on a street corner or storefront. Then, they can refer to the product from the database of whole product input by the shopping mall and can obtain the product information and purchase method. By use of an IC Card, some service considering individual information of customer security is possible. If this system is put to practical use, from analysis of customer Kansei and the purchased products, shops can arrange products arrangement more appropriately.

The special features in this system and required techniques are as follows:
• Customers can search several stores’ products from the database at the same time. Making a standard format of clothing.

• Search for a specific product by a category search. Establishment of a technique categorizing apparel products.

• Suggestion of products by Kansei evaluation value. Development of Kansei search technique.

Table 1 Words used in SD test

<table>
<thead>
<tr>
<th>No.</th>
<th>M</th>
<th>F</th>
<th>M</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>cool, neat</td>
<td>not so</td>
<td>cute, pretty</td>
<td>not so</td>
</tr>
<tr>
<td>2</td>
<td>fashionable, stylish</td>
<td>not so</td>
<td>fashionable, stylish</td>
<td>not so</td>
</tr>
<tr>
<td>3</td>
<td>beautiful</td>
<td>not so</td>
<td>quiet</td>
<td>not so</td>
</tr>
<tr>
<td>4</td>
<td>childish</td>
<td>not so</td>
<td>adult</td>
<td>not so</td>
</tr>
<tr>
<td>5</td>
<td>showy</td>
<td>not so</td>
<td>casual, relaxed</td>
<td>not so</td>
</tr>
<tr>
<td>6</td>
<td>individual</td>
<td>not so</td>
<td>formal</td>
<td>not so</td>
</tr>
<tr>
<td>7</td>
<td>light</td>
<td>not so</td>
<td>urbaine</td>
<td>not so</td>
</tr>
<tr>
<td>8</td>
<td>urbane</td>
<td>not so</td>
<td>rustic</td>
<td>not so</td>
</tr>
<tr>
<td>9</td>
<td>elegant</td>
<td>not so</td>
<td>formal</td>
<td>not so</td>
</tr>
<tr>
<td>10</td>
<td>feminine</td>
<td>not so</td>
<td>mannish</td>
<td>not so</td>
</tr>
<tr>
<td>11</td>
<td>refine</td>
<td>not so</td>
<td>unique</td>
<td>not so</td>
</tr>
<tr>
<td>12</td>
<td>basic</td>
<td>not so</td>
<td>decorative</td>
<td>not so</td>
</tr>
<tr>
<td>13</td>
<td>simple</td>
<td>not so</td>
<td>gentle</td>
<td>not so</td>
</tr>
<tr>
<td>14</td>
<td>active</td>
<td>not so</td>
<td>high-grade</td>
<td>not so</td>
</tr>
<tr>
<td>15</td>
<td>cool</td>
<td>not so</td>
<td>feeling</td>
<td>not so</td>
</tr>
<tr>
<td>16</td>
<td>warm</td>
<td>not so</td>
<td>मानसिक</td>
<td>not so</td>
</tr>
<tr>
<td>17</td>
<td>tight</td>
<td>not so</td>
<td>loose</td>
<td>not so</td>
</tr>
<tr>
<td>18</td>
<td>hard</td>
<td>not so</td>
<td>soft</td>
<td>not so</td>
</tr>
<tr>
<td>19</td>
<td>smooth</td>
<td>not so</td>
<td>rough</td>
<td>not so</td>
</tr>
<tr>
<td>20</td>
<td>light</td>
<td>not so</td>
<td>dark</td>
<td>not so</td>
</tr>
<tr>
<td>21</td>
<td>I want to wear it</td>
<td>not so</td>
<td>(着たい)</td>
<td>not so</td>
</tr>
</tbody>
</table>

*M is for male and F for Female.

• Quick data updating in accordance with push type database. Development of data making system for product image, basic information and Kansei information.

• Using IC card with assured security. Development of suggestion and search service using individual customer information.

3. TECHNIQUES AND EXPERIMENTS

3.1. Making category data format of apparel products

Digital images for each products are used for the presentation in the search dialogue. These images are taken by digital camera with appropriate quality by each store. The database holds category and Kansei information of products. Standardized formats of category and attributes are required to execute the open type search in which individual shops input the information. Some advertising fliers, fashion magazines and mail order catalogues were investigated to collect the practical use of the category item of apparel products. Necessary product information for product selection was extracted and then rearranged. The clothes category information is additionally collected from various outfitting dictionaries, illustrated clothing-style books and others.

3.2. Selection of Kansei evaluation words

Kansei evaluations of clothes are performed using a measure of Kansei words. Customer inputs Kansei measure of a product wished in Kansei search after having selected a suitable category. Before the search, the user directly inputs several Kansei measure values or points to a coordinate on a map of appropriate Kansei measured space. On the other hand, Kansei evaluation values need to be set up for each product in the search system to show products matching with the Kansei evaluation values that the customer demands. This information must be established either by a suitable evaluation person or by forming from other information such as the image or the category. In practical use, persons of the shop side perform the input for this system. To show effective measures in the search and consider the convenience of the data input by the store side, selection of suitable terms is necessary. Adjective or adjective pairs extracted by the semantic differential (SD) method are used for the Kansei evaluation by words.
In order to select suitable words, several Kansei 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. Photographs of clothes without models are used and the images are put into a computer by an image scanner. Figures 1 and 2 show the images used for the experiment. WWW home page is made to show samples of a suit. The subjects can see it using a browser on their notebook computer. Evaluation results were printed on chart papers. Evaluation measures are 7 classes and 21 pairs for male and 23 pairs for females. They are description word pairs of opposite poles. 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. Table 1 shows the selected words.

3.3. Technique of product search

The search methods used are divided roughly into two methods. One is a category search. This is used to hone in on the products when a customer knows the category characteristics such as the material, color, size, figure design, brand and so on. The second is a search according to Kansei evaluation of the product that a customer seeks. If there are many products matching the category search, it determines the order of the presentation products by the Kansei evaluation.

The shop side Kansei evaluation values of each product are recorded in the database. In a simple method, when a customer inputs Kansei measure values of equal items, the search system sequentially shows the nearest distance between both evaluations. A search of similar products is also possible with the same method. This method supposes that the differences between the evaluations of each customer and store side are few. However, it is predicted that Kansei evaluations of each person are different even if the evaluating product is the same. Some investigations are needed in those points for apparel products.

Suppose that the customer knows the target product. The efficiency of a search method is evaluated by the improvement of the order of distance between Kansei evaluation values of a customer and the store side of the product. If all evaluations of a target product of the shop...
side are the same as the customer's, the order of the target becomes the first place because distance between both evaluation values of the product is zero. Using an arbitrary 2 people or average evaluation value of the SD test results, the order of the distance between evaluation values of all products are calculated and the efficiency of a search is evaluated. Furthermore, some techniques are investigated to improve the search efficiency. Effective search methods may shorten the distance between evaluation values of a target product and can raise the order. In order to investigate those problems, a search system for evaluation was developed and the result of SD test was also analyzed statistically.

4. RESULTS AND DISCUSSIONS

4.1. Making of apparel product standard format

Product information of approximately 5000 items is collected from advertisements, magazines, and catalogues including the spring and summer products. Collected terms are as follows: product name, kind, target age and sex (lady, gentleman, boy, girl and infant), season, use, manufacture and brand, sewing (constitution, processing, seam), pattern, color, material (cloth, fiber and finish), characteristic, size variation and the price.

Figure 3 shows a part of the result that was arranged from the extracted data. 16 distinct materials, approximately 50 color names and 70 product category names are used in the collected materials. A product name includes the target age and sex such as "boy's T-shirt" and adorned by the attribute that isn't standard in the category such as "V-neck T-shirt." The standard attributes can be used for the default value in the data input process. For example, the standard attributes of T-shirt are the cotton material, knitting, short sleeves, round neck, white, no pocket etc. These default attributes are checked against the descriptions of dictionaries, and suitable ones are employed according to actual use. The names of clothes aren't always standardized. There are differences between generations. For examples, jupon (zubon), trousers, pants (pantsu), slacks(surakkusu) coexist for clothes of the same kind. Using together with an illustration will be effective in a menu to deal with this problem. Because the necessary input item varies by kinds of product, it is also effective to make input menus of category data individually.

Figure 4 shows the input screen of the store side category data of a T-shirt that is produced experimentally. Details of the category structure, input system and search will be described in another paper.

4.2. Evaluation and a selection of Kansei search terms

A principal component analysis is performed for the result of SD test, and menu items of Kansei search are selected. The variables in the analysis are the SD measures. For the average data of males, the large variable of the first, the second and the third are (M11, M1, M9), (-M7, -M16, -14M) and (-M3, -M15, M6), respectively. The accumulation of contribution rate to the first, the second and the third are 40.16, 65.16, and 79.55%, respectively. For the average data of females, the large variable of the first, the second and the third are (F2, F1, F11), (F10, F17, F14) and (F17, F23, F11), respectively. The accumulation of contribution rate to the first, the second and the third are 35.21, 61.09, 73.09%, respectively.

If necessary, the Kansei words of the search menu can be decreased. Using the correlation matrix, terms that the coefficient of correlation is large are settled in a group with a variable contained in upper rank principal components as a basis, and menu items are reduced. They are 8 variables of F2, F5, F6, F8, F10, F11, F18 and F21 for female and 7 variables of M2, M3, M5, M12, M15, M16 and M20 for male. The common variables with male and female are (M2, F2), (M5, F6) and (M16, F18).

4.3. Method of product search

It is assumed that the shop side evaluation values of products are input in the database by the same measure that the customer uses at the input in the search. A customer selects arbitrary number of category of a product wished in a search (Figure 5). Then, one can set up the detailed attribute according to one's needs. The Kansei search starts by inputting the Kansei measures. The search objects are found by the conditions of selected categories. As a simple search technique, the Euclidean distance of the input values and store side evaluations of each of the products are calculated and then several products are shown from the nearest sequential distance (Figure 7). If a product for the purpose is found in shown products, the customer can see detailed information of the product, and go to the store or department in which he can see the actual
item and buy it. If any product liked isn't found, one can see the next product and do another search. Considering the specification an experimental version of search system is developed.

4.4. Evaluation of the search efficiency

By using an experimental system, the effectiveness of a search is investigated. The whole products used by the results of SD test are stored in the database and used in the search. An arbitrary subject person's values obtained by the SD test and the mean values are used as Kansei evaluation values of the store side. An operator is selected among the subject persons. The operator looks for a target product contained in the database. The target is shown beforehand. When the operator inputs the evaluations, the system indicates two items from the nearest object. The distances are the Euclidean distance between store side evaluation value of each product and user input values. When the indicated products aren't suitable, one changes evaluation values and searches another product once again. However in this method, it is difficult to reach the target product. Figure 8 (●) shows an example of the original orders of distance between the evaluations of the male mean and a male person. If both evaluations are equal, all orders become 1. Naturally, there are differences between evaluations. In this case, when two searched products are shown, the probability that the target appears in the first search is 23/50, and if four products are shown then 30/50. But there are many products that the order is very low. For those products, it is difficult to find the target in a method that the customer revised the values and searches it by trial and error. The diagonal element of the correlation matrix between evaluation variables of both was maximum 0.83, minimum 0.32 and average 0.67.

Therefore, there are some items with a low coefficient of correlation. Customers can't predict what is a high correlation variable.

To reach a target by repeating a search, a method that expands the distance of the presentation products from the nearest product corresponding to measure values input will be effective. Figure 9 shows the orders of distance between two female persons. If one of the persons evaluate the products at a shop side, the other person must repeat more searches because the average distance is large.

4.5. Improvement of the search efficiency by learning

As a method of improvement of the search efficiency, both customer and shop side can do a SD test on the
Figure 10: Example of effects of number of learned products and number of measurements on the average search order.

same sample beforehand. Using the result, the input values are converted into revised ones. The efficiency is investigated.

Linear multiple regression equation was used to revise the input values of a customer. The partial multiple regression coefficients between shop side and each customer’s evaluation value for equal products are calculated, and the input values of a customer are revised using them. The evaluation values are obtained by learning individually like the SD test. In figures 8 and 9, the revised values calculated from the SD test results are shown by (○). In the calculation of partial multiple regression coefficients, 50 evaluation values of all samples, and 21 and 8 measurement variables are used, respectively. As shown in the figures, the orders of most products improve in the case of both. But, in the practical system, the learning system can't use very many products and may not be able to increase evaluation items. Therefore, the effects of the number of evaluation values and the number of used products learned for the improvement of the search order are examined. Figure 10 shows the relationship between the average order of the target and the number of products used in learning, in which one female subject is assumed to be a customer and another one female to be a shop side. In this figure, (○) and (△) are the cases when all 21 measures and 8 selected measures are used, respectively. If many learning items are used, the effect of learning is recognized, but the effect becomes rather misguided when a few items are used. If enough numbers of measures are used, the effect becomes high, but isn't as high when only selected 8 measures are used.

The results obtained by combinations of other members are similar with this. It was found that if a customer does a learning operation like SD test and the search system revises the results using the partial regression coefficients, then the system can perform a search of high hit rates for individuals.

5. CONCLUSIONS

An advanced search system for apparel products was proposed. This system can search for products of several stores put together. Both category information search and Kansei measure values search are possible with the system. A unified format of category information of apparel products suited for the search was made. The Kansei search is done by measure values of some Kansei terms. Kansei information of products is input by the store side beforehand, and takes matching with the input information of a customer. An SD test and statistic analysis was done for a selection of measure terms and evaluation of search efficiency. Generally, the Kansei evaluation of the store side doesn't agree with that of a customer's, even though for the same product. Therefore, the possibility is low that a desired product will be shown. For improving the effectiveness, a method of getting Kansei evaluations of individual customer and store side by learning beforehand is devised. If enough learning results are obtained, the search is improved by getting the relation of Kansei evaluations between individuals and store side by multiple regression analysis and revising the input value by this.

In the future, using data of actual stores, the improvement and effectiveness of categorize and search methods will be investigated more and they will be inserted into a practical system.

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