

**Title:****On Development of Methods for Expressing Customer Affective Response for Apparel Products****Authors:**

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Introduction:

Customer requirement is the first important thing to be considered for any product design. For the product such as the apparel, the customer requirement is not only the function and usability of the product but also the affective response or emotion when human interacting with the product. The quantification of the function and usability into product design is readily available. However, the quantification of a customer's affective response into a product is still a pending issue.

This paper presents a work that was aimed at developing a procedure to elicit a list of adjectives that represent the customer's affective requirement towards apparel in our case. Web mining technology was employed in developing this procedure, which adds value to effective and efficient acquisition of adjectives from a vast amount of information in the web media. Further, the procedure involves the apparel design expert with help of the expert opinion elicitation technique to add value to the validity of the obtained list of affective words. It is noted that the list can then be incorporated into an existing computer-aided design of apparel with consideration of the customer affective requirement on apparel, e.g., "I want to have a dress that can make me feel more elegant."

Related Work:

The first thing to design a product with consideration of customer's affective response is to represent the affective requirement of the customer on the product. This is feasible when a restricted application domain is considered, the apparel design in our case. To represent the customer's affective requirement on a product, the most common tool is perhaps Kansei Engineering [11]. Kansei Engineering is defined as "translating technology of a customer's feeling of the product to the design elements" according to [9]. It has been widely used in automotive industry, electric industry, apparel industry, cosmetic industry and so on [10]. For instance, Kansei words were used to evaluate consumer's emotional responses to e-Commerce websites for designing an affective quality website [1]. Another example is the work of [3] which proposed an approach to map a space of fabric image features to a human's feeling space. Similar studies can also be found in [15]. Also, Kansei words have been connected to children's clothing design in [7]. However, the Kansei words for apparel design in these works are shared with other domains, such as automatic industry. In fact, these works simply used the Kansei words in the database created by [9]. It is known that the semantics in both cognition and emotion is highly context-sensitive [17]. Emotion elicited from the sense of beauty on a car may be very different from emotion elicited from the sense of beauty on apparel.

Only a few studies have presented the Kansei words in the domain of apparel. For instance, researchers recognized 100 Kansei words for representing the customer's feeling in the apparel design through interviewing with the apparel designers [7]. In addition, 40 Kansei words were solicited in the work of [1] from the books, websites and journals of apparel domain. However, the process of collection of the Kansei words in that work is manual without rigorous statistical analysis in place, the process and thus low efficient and highly subjective. Therefore, to apparel, the customer requirement in terms of feeling or affective response needs to be captured.

The Procedure To Elicit Affective Words:

Affective words are mainly adjective and noun. Without loss of generality, only adaptive words are considered in this study. There are two main steps of collecting affective words: search and evaluation. A technique called web mining is employed to compile affective words [5]. The web mining technique is in essence to search the web to discover the knowledge for a particular domain of activity or event (apparel design in this case) by the computer rather than human (or manually) [5]. There are three categories of knowledge: the content, structure, and use/purpose/context [2].

Generally, data (both information and knowledge) [17] on the web is overloaded, unorganized, noisy, and massive. In order to mine useful contents, tools have to be employed for mining, such as NLP (Natural Language Processing) [14], IR (Information Retrieval) [8], and IE (Information Extraction) [4]. However, to use these tools is quite expensive and time-consuming. Thus, a particularly tailored, easy-access, and low-cost tool for mining of affective words in a domain may be necessary.

In this study, a procedure was proposed with the help of a proprietary tool [16], which has six steps. Details of these steps are discussed in the following.

Step 1: Identify the source of data (i.e. website) by the experimenter.

Step 2: Collect the articles from the source by the experimenter and reformat the articles ready for the extraction of adjectives. This step is achieved with an in-house developed tool called Clipboard Sniffer. The input to the tool is the content of a particular article, and the output is the content that is formatted into a plain text ready for the word screen process (the next step).

Step 3: Extract adjectives in each medium. This is achieved with an in-house developed tool called Adjective Extractor (accessed from <http://homepage.usask.ca/~yuz703/>). The input to this tool is a collection of articles that are in a plain-text format, and the output is the adjectives. The extraction process is terminated and turned to the next step if an increase of articles does not result in any increase of the number of adjectives.

Step 4: Find statistics for the adjectives with respect to the media. There are two statistics that can be found with an in house developed tool called TF-DF Generator which processes on a list of documents, say document 1, 2, and to n. The first statistics is the number of times a term appears in document *i*. This statistics is denoted as TF (term frequency) [13]. The second statistics is the number of documents in which a term appears. This statistics is denoted at DF (document frequency) [12]. In this research, we did not use TF, as we believed that the number of appearances of a particular term in one document does not add value to the popularity of this term. However, DF is, indeed, a measure of the popularity of a term, as each document is different and represents a unique context within for the term.

Step 5: Conduct a syntactical-based analysis of the collected adjectives with the goal to remove any abnormal adjective, leading to a set of syntactically clean adjectives. Adjectives with an extremely high or a low DF are regarded as abnormal adjectives, and they were removed from the list. For the adjectives with an extremely high DF, they have a high chance to be not specific to a specific domain, i.e. apparel domain in the study. For the adjectives with an extremely low DF, they are suspected, and therefore, they are removed.

Step 6: Conduct a semantic-based analysis of the set of adjectives obtained from Step 5 with the goal to reach a set of adjectives that describe the customer's affective requirement in a specific domain. A number of experts were called upon for conducting this task. They need to make two decisions. The first decision is on whether adjectives make sense in the domain. For each decision, a consensus needs to be formed. The technique of a so-called expert opinion elicitation or probability distribution aggregation [6] was applied. Experts are asked to rank a 5-Likert Scale based on the relevance of a particular word to a domain in the first, then, an aggregated rate for a word is formed.

Words with their rate being lower than a threshold are removed from the list of affective. For the convenience of later discussions, this list is called Affective Adjectives List (AAL for short). The second decision is on adjectives that have similar meaning, that is, to develop a sort of synonyms, called Word Synonyms List (WSL). For each adjective, say word i , the experts examine and vote all the other words in the AAL to their similar meaning to word i ; this will lead to a list of adjectives that have a similar meaning to word i , as WSL.

Illustration:

The application domain is apparel. Following is presented to acquire the adjectives that express the consumer affective requirement towards apparel based on the proposed procedure described in Section 2. That is, the six steps are run to generate an AAL and a WSL.

By following Step 1, we got 13 websites (see Table 1) as the source of eliciting affective words. By following Step 2, we got over 400 articles collected from the aforementioned websites. These articles can be found from the website <http://homepage.usask.ca/~yuz703/>. Note that the format of these articles is in a plain text format. By following Step 3, we got Figure 1. It is noted that in Figure 1, the increase in the number of articles does not increase the number of adjectives over about 400 articles collected. The process of the article collection is terminated at 446 articles collected. As a result, 1164 adjectives (accessed from <http://homepage.usask.ca/~yuz703/>) were obtained. By following Step 4 and 5, the threshold for low DF is 1, and there were 492 adjectives with DF=1. By removing the adjectives with DF=1, we got 672 adjectives (accessed from <http://homepage.usask.ca/~yuz703/>).

Name of Website	URL
Glamour	http://www.glamour.com
People Style Watch	http://www.people.com/people/
Teen Vogue	http://www.teenvogue.com/
Loop	http://www.theloop.ca/
Seventeen	http://www.seventeen.com/
Marie Claire	http://www.marieclaire.com/
Redbook	http://www.redbookmag.com/
Fashion	http://www.fashionmagazine.com/
Elle	http://www.ellecanada.com/
Loulou	http://en.louloumagazine.com/
Cliché	http://www.clichemag.com/
Australian Fashion Review Blog	http://www.fashionreview.com.au/
My Fashion Review Express Yourself	http://myfashionreview.co.uk/

Tab. 1: Sources of the website list.

The removal of adjectives which are not specific to the apparel domain is by means of the so-called high DF. In this case, the adjectives with high DF are determined by the following approach. First, we have a proprietary collection of adjectives that are with high DF, which is developed by a general study of adjectives [16]. In the collection, we had adjectives with their DF ranging from 1 to 34141. We inspected the adjectives with their DF greater than 10000 and discovered that they were general adjectives. The list of these general adjectives can be found from the <http://homepage.usask.ca/~yuz703/>. Let us call this list "general word reference (GWR)". Second, we compared our list (672 adjectives) with GWR list, and remove the adjectives in our list that appear in the GWR list with high DF as well, indicating that they are just general adjectives. Consequently, we removed 49 adjectives and we obtained the list of 623 adjectives that may make sense for apparel design (accessed from <http://homepage.usask.ca/~yuz703/>).

In running Step 6, for the first decision, we recruited 6 apparel experts in this study. We give them 623 adjectives with 5-level Likert Scale and ask them to rank. With their ranks, by applying aggregation process, we get the aggregated rate for each adjective (accessed from <http://homepage.usask.ca/~yuz703/>). The adjectives with their aggregated rate less than 4 are

removed. Consequently, we get 65 adjectives as AAL for apparel design. For the second decision, we build the WSL with 30 groups (see Table 2), which is obtained by the vote from experts.



Fig. 1: The relationship between the number of adjectives and number of articles.

Group	Adjectives	Group	Adjectives
1	Classic, artistic	16	Soft, pastel
2	Feminine	17	Quality, delicate, detailed, dressy
3	Edgy	18	Hot, sexy
4	Flattering, fancy, chic, stylish, pretty, beautiful, gorgeous, brilliant, stunning	19	Cute, lovely, adorable
5	Uniform, professional	20	Sophisticated, fuzzy
6	Relaxed, causal	21	Comfortable
7	Inspiring, asymmetrical, futuristic, unpredictable, personal, unique	22	Sporty, athletic
8	Vibrant, exciting	23	Practical
9	Dramatic	24	Slouchy
10	Minimal, understated, simple, light, min, basic	25	Youthful
11	Bohemian	26	Glamorous
12	Unconventional	27	Androgynous, neutral
13	Outside, playful	28	Exclusive
14	Romantic	29	Fashionable, trendy
15	Boyish	30	Traditional, conservative

Tab. 2: WSL for apparel design.

Conclusions:

In the paper, the current systems to represent human's affective requirement with adjective words in the apparel domain were analyzed through literature review. It has been found that they were shared with other domains such as car and led to a weak description in representation. Another finding was that they were usually manual processes. The manual manipulation to elicit words is complex, costly and inefficient. A new procedure for eliciting affective words was proposed by employing web-mining technology and experts' judgment in this paper. The case study was conducted to elicit affective words in the apparel domain for apparel product design. Through demonstration, we concluded that the procedure is effective for eliciting affective words with excellent description of human's affective requirements towards apparel. The procedure will help to build a bridge between human's affective response and apparel design parameters. It is promising to conduct human affective-based design for apparel product.

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