A Method for Creating Package Images that Reflect Consumer Taste Impressions

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SUMMARY  
Product packaging is a significant factor in a buyer’s purchasing decision. We have developed a method for creating package images reflecting consumers’ taste impressions that balances the need to provide product information and the need to motivate purchasing. It uses a database showing the correspondence between adjectives and colors as extracted from consumer reviews. This correspondence is used to revise the colors in the original package image. Evaluation was done by having 40 participants drink target beverages and answer questions before and after drinking regarding their impressions of the taste and their desire to drink the beverage. The results revealed that displaying appropriately revised images reduced the gap between the expected taste when viewing the image and the actual taste. Displaying appropriately revised images should motivate purchasing decisions as well as increase product satisfaction.

key words: package image, taste, adjective, user review, color psychology

1. Introduction and Motivation

The various elements (packaging, displays, signage) comprising the so-called “silent salesman” greatly affect on-the-spot purchasing decisions [1]. They are particularly important because many shoppers, particularly when grocery shopping, do not want to spend much time deciding which particular products to purchase [2]. Even if a product has higher quality, the higher quality is of little benefit if it is not readily evident to the shopper [3]. It is thus important that the packages of products on store shelves give potential buyers immediate product information that motivates purchasing behavior and captures sales opportunities.

The market for cold beverages in Japan is experiencing both increasing production volumes and consumer purchases [4]. Therefore, many similar beverage products have been introduced. The manufacturers use the packaging not only to protect the product and identify the contents [5] but also to promote the product values [6].

These values include (a) information provision, (b) purchasing motivation, (c) product consumption, and (d) consumption experience [6]. The value of information provision is to increase the likelihood of purchasing by enabling a potential buyer to readily understand the product information; e.g., the image of an orange is typically shown on an orange juice package. The value of purchasing motivation is to increase the likelihood of purchasing by using packaging that gives an appealing impression; e.g., a package with an image of brightly colored flowers would give many potential buyers the impression of joy and beauty. The value of product consumption is to increase the likelihood of purchasing by showing how the product provides high usability during consumption; e.g., the bottle design is based on the shape of the hands. The value of consumption experience is to increase the likelihood of purchasing by showing that the product provides additional value during consumption; e.g., the bottle is uneven surface to express the ice and give potential buyers the impression of a very cold product. The first two values are created by the package design, and the second two are created by the package shape.

Beverage companies attempt to design their packages so that they motivate purchasing behavior and increase sales opportunities. To evaluate the effectiveness of their package designs, they conduct extensive testing and buyer surveys. Nevertheless, many negative reviews are posted on product review sites and shopping sites. Consumers typically complain that the impression of the taste given by the packaging differed from the impression of the actual taste or that the packaging caught their eye but the product did not taste good. They often say that will buy the same type of product from another company because they could not get a clear impression of the product taste from the package design and so on.

Such reviews are likely to reduce the purchasing motivation of other potential buyers and thus sales opportunities. Therefore, it is important for companies to design packages that provide extra values as well as convey the product information.

To help make purchasing more efficient for users and increase sales opportunities for companies, we are developing a method for creating package images that balances the first two values (information provision and purchasing motivation). We did not address the second two values because the cost of changing the package shape is higher than that of changing the package design [7].

As the first step, we focused on color selection because studies of color psychology have shown that images are generally the most significant aspect of product packaging [8]. They create various kinds of associations. We extracted colors that express taste impressions from consumer reviews and constructed a database of the correspondence between colors and typical adjectives representing various inner emotional states [9]. Using this database, we applied appropriate colors to packaging (except for the area providing information) to increase purchasing motivation. We
evaluated this method by performing an experiment with 40 participants to determine how the changes in the packaging changed taste impressions and how they changed the desire to drink a product.

2. Related Work

There has been a lot of research on package design such as evaluating the effectiveness of the design components and clarifying the relationships between colors and tastes. The research on the effectiveness of the design components focused on evaluating specific components such as object position, hue, and adjacent color in a limited number of products. For example, a study on using conceptual metaphors in package design focused on the company logo and showed that marketers can capitalize on consumers’ latent associations through package design [10]. A study on the effect of color in the packaging of a sweets product showed that hue is the most impact factor in color coordination [11]. A study on the use of a quantitative method for evaluating the effect of adjacent colors in packaging proposed a method for improving the design of mobile phones [12]. While these previous research efforts gave important insights into packaging design, they did not propose a method for creating or designing packaging.

The research on the relationships between colors and tastes focused on performing experiments or analyzing existing data for a limited range of products such as tea and coffee. For example, a study on analyzing the colors using in food packaging revealed that colors that are visually attractive and colors found in raw materials tended to be used [13]. A study on the impression made by a polyethylene terephthalate (PET) bottle containing green tea revealed that green is the most suitable packaging color for giving an accurate impression of the contents [14]. A study of the effects of the color of a beverage can revealed that the relationship between the impression of the beverage and the color differed between Japanese and Korean participants [15]. While these research efforts revealed that there is a relationship between the impression given by a package color and the taste, they did not propose a method for designing packages so that they give an accurate impression of the taste.

3. Proposed Method

3.1 Overview

Colors reflecting consumer taste impressions are extracted by examining consumer reviews. The taste impressions and feelings of the consumers are visualized by extracting the words describing them. There are two types of emotion: those that can be observed externally by others and described objectively, such as “surprised” and “fired up,” and those that represent an inner state based on emotion, such as “sweet (taste)” and “unexpected (encounter).” In general, the former type is described using verbs, and the latter type is described using adjectives [16].

Fig. 1 Flow of proposed method.

Colors are identified by extracting adjectives because our objective is to reflect consumer taste impressions, i.e., to reflect the inner emotions of consumers. As shown in Fig. 1, adjectives are extracted by analyzing the morphology of the input consumer reviews. Scores for colors are calculated on the basis of the total number of occurrences of each adjective and the relationships between adjectives and colors as expressed in a color database. Colors with higher scores are extracted for use in the target package image. A package image that reflects consumers’ taste impressions is created by replacing feature colors in the original image with the colors extracted from the consumer reviews.

3.2 Color Database

The color database was constructed using a color image scale [17] expressing the relationships between adjectives and colors. This scale defines 180 adjectives representing basic emotions and 130 colors that capture experiences psychologically. The color database has three attributes: color (RGB), adjective, and frequency of use. Each color has higher ranked adjectives expressing the features of the color, and the frequency of use is defined on a five-star scale—the greater the number of stars, the more strongly the color represents the image of the adjective [17].

We added 20 more adjectives that are related to taste and are sometimes used in consumer reviews, such as “sweet-sour” and “mild.” The colors for these adjectives were defined using the same color image scale [17]. Their frequency of use was defined as one star because they do not represent basic emotions. Each color corresponds to more than 1 but less than 25 adjectives. The 200 adjectives were extended to 3204 by using a thesaurus [18].

3.3 Calculating Scores for Colors

The morphological analysis extracts the adjectives from the input text, and a score is calculated for each one. The total number of occurrences of adjectives in the consumer reviews \( (a_1, a_2, a_3, \cdots, a_n) \) is defined as \((x_1, x_2, x_3, \cdots, x_n)\).
The colors in the color database correspond to various numbers of adjectives, so we normalized the frequency of use because the sums of the frequency of use are different. If a given color $C_j$ has defined adjectives $(d_{j1}, d_{j2}, d_{j3}, \cdots, d_{jp})$ and frequencies of use $(t_{j1}, t_{j2}, t_{j3}, \cdots, t_{jp})$, the weights for the adjectives $(z_{j1}, z_{j2}, z_{j3}, \cdots, z_{jp})$ are calculated using Eq. (1). Score $S_j$ for $C_j$ is calculated using the total number of occurrences of each adjective and the weight for each adjective, as shown in Eq. (2). The calculated $S_j$ are arranged in ascending order and the colors corresponding to the scores are defined as $(CE_1, CE_2, CE_3, \cdots, CE_q)$.

$$z_{jk} = t_{jk}/ \sum_{m=1}^{p} t_{jm}$$

$$S_j = \sum_{m=1}^{p} x_m \times z_{jm} \text{ if } a_i = d_{jk}$$

### 3.4 Selecting Colors to be Replaced

Many original package images have symbolic objects such as a red tomato and a green leaf. Shoppers would be confused if those colors were changed; e.g., the color of the tomato was changed to blue. To avoid this situation, the pixels corresponding to symbolic objects are excluded manually at this stage of our research.

(3) Repeat steps (2) to (4) until all pixels except for the pixels corresponding to symbolic objects have been scanned. Sort color scores in descending order on the basis of the number of occurrences $(n_1, n_2, n_3, \cdots, n_i)$ and the colors corresponding to the number of occurrences are define as $(CF_1, CF_2, CF_3, \cdots, CF_r)$.

The symbolic objects mentioned in step (5) are such things as product name. To reflect the impressions of consumers’ tastes visually and to motivate purchasing behavior, the colors that are proximate to the complementary color of $CF_1$ (the color with the most occurrences) are selected to be replaced because $CF_1$ provides important information. This selection is done considering not only the number of occurrences $n_i$ but also the hue differences between $CF_1$ and $CF_i$. The colors to be replaced are selected using the following procedure.

1. **Select one color from** $(CF_2, CF_3, \cdots, CF_r)$.
2. **Calculate the hue differences between** $CF_1$ and the color in step (1) $H^{DCF}_j$ using Eq. (3).
3. **Calculate the weight for the color in step (1)** $w_{CF_j}$ using Eq. (4).
4. **Repeat steps (1) to (3)** until all colors have been selected. Sort weights in descending order on the basis of weight and define as $(CV_2, CV_3, \cdots, CV_r)$.

$$H^{DCF}_j = \begin{cases} |H_{CF_1} - H_{CF_j}|, & (|H_{CF_1} - H_{CF_j}| \leq 180) \\ 360 - |H_{CF_1} - H_{CF_j}|, & (|H_{CF_1} - H_{CF_j}| > 180) \end{cases}$$

$$w_{CF_j} = H^{DCF}_j \times n_j$$

### 3.5 Selecting Replacement Colors

The replacement colors are selected on the basis of the color distance in the $L^*a^*b^*$ color space for adjacent colors of $CF_j$. The $L^*a^*b^*$ color space uniformly represents colors by using three coordinates: lightness variable $L^*$ and chromaticity indices $a^*$ and $b^*$. A color in the RGB space is transferred to a color in the $L^*a^*b^*$ color space after expressing the color in the XYZ color space for adjacent colors of $CF_j$.

The replacement colors are cyclically selected using the following procedure.

1. **Set to zero the number of occurrences for all colors in the color database.**
2. **Calculate the RGB value for a given pixel in each image.**
3. **Select the color in the color database that is the closest to the value calculated in step (2).**
4. **Add 1 to the number of occurrences for the selected color in step (3).**
5. **Repeat steps (2) to (4)** until all pixels except for the pixels corresponding to symbolic objects have been scanned. Sort color scores in descending order on the basis of the number of occurrences $(n_1, n_2, n_3, \cdots, n_i)$ and the colors corresponding to the number of occurrences are define as $(CF_1, CF_2, CF_3, \cdots, CF_r)$.

### Transformations

$$X = \begin{bmatrix} 0.4360 \\ 0.3851 \\ 0.1430 \end{bmatrix}, \quad Y = \begin{bmatrix} 0.2225 \\ 0.7169 \\ 0.0606 \end{bmatrix}, \quad Z = \begin{bmatrix} 0.0139 \\ 0.0971 \\ 0.7139 \end{bmatrix}$$

$$f(t) = \begin{cases} t^{1/3} & t > 0.008856 \\ [(29/3)^{2/3} + 16]/116 & \text{otherwise} \end{cases}$$

$$L^* = 116 * f(Y) - 16$$

$$a^* = 500 * [f(X/0.9642) - f(Y)]$$

$$b^* = 200 * [f(Y) - f(Z/0.8249)]$$

$$\Delta E^{*}_{ab} = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2}$$

The replacement colors are cyclically selected using the following procedure.
(1) Select one color per cycle from \((CV_2, CV_3, \cdots, CV_r)\) in ascending order.

(2) Find the adjacent colors of the color selected in step (1) in the original package image and extract the color that occurs most frequently.

(3) Calculate the distance in the \(L^*a^*b^*\) color space between the color in step (1) and each color of \((CE_1, CE_2, \cdots, CE_q)\).

(4) Select the color that has the longest distance (> 25) calculated in step (3) to maintain the original package design and to give buyers a visual impression of the taste [21]. This color is defined as the replacement color for the color selected in step (1).

(5) Repeat steps (1) to (4) until the threshold for the number of colors to be replaced is reached. Colors already defined as replacement colors in step (4) are excluded in step (5).

We defined the threshold in step (5) using Eq. (11) to standardize the degree of impressions per color. The \(q\) represents the number of colors extracted from consumer reviews, and \(r\) represents the number of colors extracted from the original image.

\[
p = \left\lfloor \frac{q}{r} \right\rfloor \tag{11}
\]

If the threshold for the number of colors to be replaced is two, \(CF_2\) is selected in step (4) of the first cycle as the color to be replaced, and \(CF_3\) is selected in step (4) of the second cycle.

3.6 Creating Revised Image

The revised image is created using the following procedure.

(1) Calculate the RGB value for a given pixel in each image.

(2) Select the color in the color database that is the closest to the value calculated in step (1). Go to step (3) if the color is one of the colors defined as a color to be replaced in Sect. 3.4; otherwise, go to step (4).

(3) Change the color of the pixel selected in step (1) to the replacement color defined in Sect. 3.5 for the color in step (2).

(4) Repeat steps (1) to (3) until the RGB values for all the given pixels have been calculated.

An example original image is shown in Fig. 2(a). The revised image created using only reviews from men is shown in Fig. 2(b), and that from women is shown in Fig. 2(c). These latter two images demonstrate the difference in taste impressions between men and women [22].

4. Evaluation

4.1 Objective and Preparation

To evaluate the effectiveness of this method, we performed an experiment with two objectives: how does revising the package image change the taste impression and how does it change the desire to drink. We selected six beverages (Table 1) on the basis of sales ranking [23]. Forty Japanese, 20 male and 20 female, participants were used for each beverage. They ranged in age from 20 to 29. None had previously drunk the beverage used in the test, and none were familiar with its original package. Some of them participated in more than one test.

The original package images were obtained using the same scanner. The size of each package image matched that of the actual package. For example, the image size of the package for beverage A was 500 \(\times\) 1016 pixels, and that for beverage C was 500 \(\times\) 1258 pixels.

To create revised images for each beverage, we checked consumer reviews on a food product introduction site [24] and administered a questionnaire to 61 people ranging in age from 20 to 50 (30 men and 31 women). We thereby obtained over 50 reviews for each beverage for each gender. Table 2 shows the features of the adjectives extracted from both types of reviews: the total number of extracted adjectives, the top 3 adjectives used, the total number of uses, and three example characteristic adjectives used only once for each beverage. We obtained original package images by using a scanner so as to create images taken in the same environment.

Table 3 shows the original images (\(o\)-images), images showing the pixels corresponding to symbolic objects (\(ex\)-images), the images revised on the basis of male reviews (\(rm\)-images), and the images revised on the basis of female reviews (\(rf\)-images). Two of the revised images were the same for male and female (\(r\)-images). The yellow area of the \(ex\)-images corresponds to the pixels excluded in step (5) in Sect. 3.4. Beverage E has no pixels corresponding to symbolic objects.

| Beverage | Type        | Volume (ml) |
|----------|-------------|-------------|
| A        | coffee      | 500         |
| B        | coffee      | 500         |
| C        | tea         | 250         |
| D        | tea         | 250         |
| E        | lactobacillus | 480        |
| F        | vegetable   | 250         |

Fig. 2 Original image and revised images.

Table 1 Beverages used in experiment.
Table 2  Features of adjectives extracted from reviews.

| Beverage | Total no. of extracted adjectives | Top 3 used | Other characteristic adjectives |
|----------|----------------------------------|------------|---------------------------------|
|          |                                  | Adjective  | Total no.                        |                        |
| A        | male                             | heavy      | 7                                | full-blown             |
|          |                                  | authentic  | 5                                | oversweet              |
|          |                                  | lush       | 3                                | rich                  |
|          | female                           | delicious  | 20                               | happy                  |
|          |                                  | heavy      | 19                               | refreshing             |
|          |                                  | nostalgic  | 10                               | persistent            |
| B        | male                             | heavy      | 7                                | sweet                 |
|          |                                  | delicious  | 4                                | rational              |
|          |                                  | mild       | 3                                | bitter                |
|          | female                           | heavy      | 8                                | bittersweet           |
|          |                                  | nostalgic  | 7                                | idyllic               |
|          |                                  | refreshing | 6                                | spicy                 |
| C        | male                             | heavy      | 14                               | humorous              |
|          |                                  | lush       | 8                                | gorgeous              |
|          |                                  | light      | 6                                | oversweet             |
|          | female                           | romantic   | 24                               | graceful              |
|          |                                  | heavy      | 18                               | simple                |
|          |                                  | delicious  | 13                               | natural               |
| D        | male                             | heavy      | 8                                | carefree              |
|          |                                  | rich       | 6                                | soft                 |
|          |                                  | bitter     | 5                                | mouth-filling         |
|          | female                           | delicious  | 20                               | traditional           |
|          |                                  | heavy      | 15                               | cheerful              |
|          |                                  | nostalgic  | 11                               | peaceful              |
| E        | male                             | heavy      | 7                                | cool                  |
|          |                                  | nostalgic  | 6                                | sweet-sour            |
|          |                                  | delicious  | 4                                | elegant              |
|          | female                           | fresh      | 10                               | strong                |
|          |                                  | rich       | 6                                | pure                 |
|          |                                  | modern     | 5                                | fresh                |
| F        | male                             | concentrated | 6                               | homely                |
|          |                                  | lush       | 4                                | refreshing            |
|          |                                  | rich       | 3                                | tough                |
|          | female                           | heavy      | 5                                | strong                |
|          |                                  | nostalgic  | 3                                | bold                 |
|          |                                  | rich       | 2                                | bitter               |

4.2 Procedure

The evaluation was performed in a bright room kept at 27°C in which the lamp color was natural white to recreate the environment of shops as much as possible. We used a 23-in monitor with a resolution of 1920 × 1080 to display the images to the participants. The color temperature was set to 5000 K using the on-screen display. The other monitor settings such as contrast and gamma were left at the default values. We visually compared the original packages with their scanned images to ensure that they matched.

The beverage containers were stored in the same refrigerator and were taken out and opened immediately before use. To eliminate the effect of the participants seeing the actual beverages, identical paper cups with a cover were used for all beverages. The beverage in a container was used for only one participant.

The 40 participants for each beverage were randomly assigned to one of four groups: ten men viewed the o-images, ten men viewed the rm-images, ten women viewed the o-images, and ten women viewed the rf-images. The procedure for each participant was as follows.

1. The participant viewed an image for the assigned group and answered six questions.
2. The participant drank a cup of water.
3. The participant drank a cup of the corresponding beverage while viewing the same image and answered the questions.
4. The participant drank a cup of water and took a break for a few minutes before viewing another image for the assigned group.

This procedure was repeated until all the images for their group had been viewed.

The first five questions were for the participant’s eval-
uation of the (expected/actual) taste (sweet, bitter, sour, strong, or heavy) [25] and the sixth one was for the participant’s desire to drink the beverage. The expected taste was based on the image before drinking the beverage, and the actual taste was based on actually drinking it. A seven-point scale (from 1 to 7) was used to answer all questions. For taste, 1–3 meant that the participant did not expect that taste or did not experience it, 4 meant neutral, and 5–7 meant that the participant did expect that taste or did experience it. The larger the number, the more they expected or experienced it. For desire to drink, 1–3 meant the participant did not want to buy it, 4 meant neutral, and 5–7 meant that they wanted to buy it.

4.3 Results for Taste

4.3.1 Impressions of Taste

To estimate the reduction in the gap between the impression of the taste when viewing the revised image and the impression of the actual taste, we calculated the differences between the average scores before drinking and the average scores after drinking. For example, Fig. 3 shows the average scores for each taste for beverage A for men. The participants who viewed the o-images and those who viewed the rm-images strongly expected/experienced two tastes; sweet and heavy (scores > 4). We found that in 12 of 50 cases (5 tastes for each beverage and gender), the impressions were different between before drinking and after drinking.

Table 3 shows that the differences between before and after drinking when at least one scores in four situations (viewed original or revised image/before or after drinking) was over 4. It shows that 27 of 50 cases fit this condition.

We found that the average difference between before and after drinking for viewing the revised image was less than that for viewing the original image (t(54) = 2.339, p < .05). These results show that viewing the revised images reduced the gap between the expected taste and the actual taste.

4.3.2 Desire to Drink

We hypothesized that viewing the revised image enhances the desire to drink when viewing the package image and that the revised image enhances the desire to drink after drinking because the expected taste nearly matched the actual taste.

To test the first hypothesis, we compared the desire to drink before drinking between viewing the original images and viewing the revised images. As shown in Table 4, the average score for the revised images was higher for seven of the ten product/gender groups. These results indicate that revising product images using our proposed method may increase sales opportunities.

For the three images with a higher average score for viewing the original image, the difference between CF1 (the color with the most occurrences) and the replacement color was less, and the color combination was discreet. It tries to balance giving an accurate impression of the taste with maintaining an easily-identifiable color combination when
selecting replacement colors.

To evaluate this characteristic, we compared the desire to drink when viewing the revised image between before and after drinking. Although the average scores were the same, viewing six of the ten revised images enhanced the desire to drink after drinking. This indicates that the revised images created increased consumer satisfaction after drinking.

The finding that three revised images produced a higher average score before drinking than after drinking is attributed to a high expectation resulting in lower satisfaction [26]. That is, the average after drinking was lower because the desire to drink was initially high. This indicates that the balance between expectation and satisfaction needs improvement.

4.4 Discussion

While the experimental results demonstrate the effectiveness of our proposed method, it did not work well for some beverages. We found that its effectiveness is lower when the original package consists of many colors or has a complex design. For example, the original package images for beverages A and F have many intertwined colors. The original package for beverage D has color gradation although the design is simple. Our method uses the adjacent color that occurs only most frequently with the colors to be replaced to select replacement colors. Checking all adjacent colors and considering the various color combinations would improve the performance of our method. We also found that effectiveness was lower when the area containing symbolic objects is large in the original package, such as the package for beverage F. A certain size area is needed to make the color reflecting consumer taste impressions stand out. Our next step is to consider ways of changing the design so as to cordon off the area where the colors extracted from consumer reviews are to be applied.

The impression about a beverage is affected by the product information obtained from labels and text in the package image. All the beverages used have labels expressing the contents. For example, beverage A has the word “mild” on the package, and beverage F has the phrase “getting nutrition.” Each potential consumer of beverage A would imagine different tastes of coffee with milk and different degrees of mild. They can discover the degree only by drinking the beverage. Although the effects of information gleaned from labels or texts were not completely excluded in this experiment, our method was equally effective for the beverages with texts expressing taste impressions and for the beverages without text, such as beverage B. Future work includes considering the effect of product information gleaned from labels and/or texts in the package image.

5. Possible Applications

5.1 Overview

Possible applications of our method include a real-time recommendation system. Recommendation systems on e-commerce sites are based on text such as information on products purchased or viewed by users and reviews. The product images are the same in both cases because companies capture images of product packages only once. It is difficult to change the package image in a real space, but it can be easily done in the virtual world. A package image created using our method could be displayed without ostentatious advertisements during a buyer’s beverage search. It could help the user assess the expected taste and thereby select one that fits the buyer’s present feelings; e.g., “I want to drink something sweet because I’m tired, so I’ll chose one with a package with warm colors.”

5.2 Example for Vending Machines

Drink vending machines with digital signage are being introduced [27]. The image of each beverage is displayed on a screen, and a buyer selects a product by touching the screen. Such machines could have a camera positioned on top that captures a facial image of a person standing in front of the machine. Software in the machine or on the Internet could use the image to estimate the person’s age, gender, and state and then recommend products matching the person’s profile.

Such an application is illustrated in Fig. 4. The system crawls user reviews, personal properties and product properties from food product introduction sites and shopping sites and uses the collected information to create a product database, a preference database, and a color database. The preference database contains the relationships between tastes and personal properties that are created by analyzing the tastes, feelings, and properties such as age and gender. The product database includes information about each product and its original package image. The color database contains the relationships between adjectives and colors as described in Sect. 3.2.

When a person stands in front of the machine, his or her taste preferences are estimated from the preference database on the basis of the captured facial image from which are estimated the person’s age, gender and state (excited, tired, etc.). Images are then created for each product reflecting...
the estimated taste preferences, and the product images are displayed. Implementation of such a system requires development of an algorithm for analyzing the relationships between taste preferences and personal properties (including feelings). Such a system could effectively recommend products without pushy advertisements and expand the buyers’ choices.

6. Conclusion

We have developed a method for creating package images that reflect buyers’ taste impressions. It balances the value of information provision and the value of purchasing motivation. We constructed a database of the correspondence between adjectives and colors and developed a method for extracting colors from reviews and applying the colors to the original package image. We evaluated this method experimentally by having 40 participants drink target beverages before and after drinking.

We found that (1) displaying appropriately revised images can reduce the gap between the expected taste when viewing the package image and the actual taste, (2) the revised images can increase sales opportunities, and (3) the revised images can increase buyer satisfaction.

To create an effective package image reflecting consumers’ taste impressions, it is necessary not only to improve the algorithm for selecting replacement colors that maintain a good balance between taste impression and an easily-identifiable color combination but also to improve the color combination to better match the expected taste with the actual taste.

Fig. 4 Overview of application to digital signage vending machine.

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