

Effect of facial makeup style recommendation on visual sensibility

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Abstract As ubiquitous commerce using IT convergence technologies is coming, it is important for the strategy of cosmetic sales to investigate the sensibility and the degree of preference in the environment for which the makeup style has changed focusing on being consumer centric. The users caused the diversification of the facial makeup styles, because they seek makeup and individuality to satisfy their needs. In this paper, we proposed the effect of the facial makeup style recommendation on visual sensibility. Development of the facial makeup style recommendation system used a user interface, sensibility analysis, weather forecast, and collaborative filtering for the facial makeup styles to satisfy the user's needs in the cosmetic industry. Collaborative filtering was adopted to recommend facial makeup style of interest for users based on the predictive relationship discovered between the current user and other previous users. We used makeup styles in the survey questionnaire. The pictures of makeup style details, such as foundation, color lens, eye shadow, blusher, eyelash, lipstick, hairstyle, hairpin, necklace, earring, and hair length were evaluated in terms of sensibility. The data were analyzed by SPSS using ANOVA and factor analysis to discover the most effective types of details from the consumer's sensibility viewpoint. Sensibility was composed of three concepts: contemporary, mature, and individual. The details of facial makeup styles were positioned in 3D-concept space to relate each type of detail to the makeup concept regarding a woman's cosmetics. Ultimately, this paper suggests empirical applications to verify the adequacy and the validity of this system.

Keywords Makeup styles · Collaborative filtering · Cosmetic · Sensibility

1 Introduction

Product consumption in consumers has been developed to preferential consumption, as a cultural aspect from material consumption. This further changes to emotional consumption

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as a hedonistic consumption. Thus, it is necessary to consider a sensibility approach to achieve human oriented product design based on personal sensibility desires. As the function, quality, and price in products do not fully satisfy the sensibility of consumers, a product development methodology that satisfies the sensibility and desires of consumers is developed. That is, a method that makes human life more convenient, comfortable, and pleasant by measuring the sensibility of human beings as quantitative and qualitative manners and analyzing and evaluating the sensibility scientifically. Thus, we can apply the results of these measurements and analysis to the design of products and environments has been presented [11]. In an aspect of sensibility engineering, makeup services can be understood as a form of mass culture that reflects the way of thinking and value of life in social members. There are some differences in skin conditions, including materials and skin colors, according to the difference in regions and human races that represent differences in makeup materials and expression methods [3, 7, 18, 24]. According to the development of IT convergence technologies, however, a trend that collapses the concepts of regions and borders and enables sharing the same culture is termed a vogue. A culture of makeup follows similar materials and techniques according to such a vogue. Makeup styles in an age of sensibility have been settled as a concept of coordination in fashion. This simply means a combined behavior that considers what type of makeup is to be matched to what types of clothes and hairs and represents an appropriate atmosphere of presentation for lifestyles according to changes in living environments [20, 22]. Thus, in this paper, a facial makeup style recommendation system is developed. The sensibility is collected and analyzed quantitatively and qualitatively through a survey to evaluate preferences to makeup styles. Based on the collected sensibility, an appropriate makeup styles are recommended using a collaborative filtering. In addition, the sensibility images for each detail are classified by measuring the sensibility of consumers by presenting stimulates for the details in the recommended makeup styles. In addition, relative scales in the effect of makeup style that are reached by such sensibility are investigated and its method is presented. Then, basic materials based on the sensibility are provided to easily develop makeup styles that satisfy the sensibility of consumers effectively.

The rest of this paper is organized as follows. Section 2 provides a brief cosmetic information systems. Section 3 describes in detail the facial makeup style recommendation system. In Section 4, the effect of facial makeup style on visual sensibility is presented. Conclusions are given in Section 5.

2 Cosmetic information systems

Basic elements for makeup design are color, texture, and type in which it is important to find colors that blend with consumers themselves. The conventional makeup systems have usually been managed to provide general beauty information on hair, fashion, and makeup. MISSHA Ltd.¹ provides content related to skin care, makeup, body care, diet, health, cosmetic surgery, fashion, and magazine. In particular, it provides much information on makeup for makeup artists, following vogues, and makeup focuses. In addition, in its simulation, the colors of eye shadow and lipstick are determined after selecting face types, skin colors, eye sizes, and lip shapes. Amore Pacific Co. Ltd.² focuses on business publicity and customer services, instead of selling products. In the makeup part, they introduce

¹ MISSHA Ltd., <http://www.missha.ae>

² Amore Pacific Co. Ltd., <http://www.amorepacific.com>



Fig. 1 Mary Kay's virtual makeover system

makeup basics, seasonal makeup, defect covering makeup, TPO makeup, and theme makeup. In the cyber makeup part, it is possible to select the colors of eye shadow, lipstick, and eyelash based on the customers' own styles. However, its drawback is that it is impossible to simulate such functions due to the lack of data.

An American cosmetic brand, Mary Kay,³ provides various services, such as company publicity, products (gift set, skin care, makeup, male care fragrance, order of application, and ingredients), e-beauty (makeover advice, tips, trends, and e-catalog), online shopping mall, magazine gallery, news clipping, and events. In particular, the Virtual Makeover provides a makeup that is blended with a customer via a specific makeup setting after registering customer pictures. Then, it enables finding appropriate foundations and lipsticks for their own skin tones and to help select appropriate blushers and eyeliners. In addition, it provides a realistic experience in makeup products visually, even the sensibility of a shimmer texture in eye shadows and shinning texture in lip glosses. Figure 1 shows Mary Kay's virtual makeover systems.

Fujitsu⁴ developed the virtual information and real-time makeup systems for some cosmetics in Shiseido stores established in the Mitsukoshi department store, Japan. The cosmetic information provides a search for the information on established brands through an appropriate terminal and guides the location of products to make a fast decision as customers step into a store. In addition, it enables sophisticated selection of various search items, including age, skin problems, and bestseller ranking and to print such information. In the virtual real-time makeup system, as an RFID tag is attached to products close to an RF

³ Mary Kay, <http://www.marykay.co.kr>

⁴ Fujitsu, <http://www.fujitsu.com>

reader, the customer's face is presented in a monitor where the color of the customer's lips is changed to the color of the cosmetic selected by the customer. Then, customers can test the color of the cosmetics that they do not usually use on themselves [3, 4, 14, 21].

The cases mentioned above have some drawbacks in company publicity, product information and Tip presentation, lack a screen interface configuration, and do not consider the sensibility according to personalization. Makeup products express various sensibilities, according to composition elements and details. It is necessary to conduct studies on the sensibility according to physical composition elements and makeup details in analyzing its sensibility to develop products based on the sensibility of consumers. Therefore, the sensibilities that are changed according to living environments are to be quantitatively and qualitatively analyzed. In addition, it is necessary to provide a sophisticated methodology and supporting multimedia tools for optimized makeup recommendation services that reflect personal differences and changes.

3 Facial makeup style recommendation system

3.1 Selection of makeup styles factor and sensibility

The makeup styles considered belong to categories: foundation, color lens, eye shadow, blusher, eyelash, lipstick, hairstyle, hairpin, necklace, earring, and hair length. The questions were randomly organized in the survey to minimize undesirable ordering effects. The extraction of configured makeup styles was performed as different styles by referencing current periodicals published by Shiseido Co. Ltd., LG Household & Healthcare Ltd.,⁵ and Amore Pacific Co. Ltd., makeup related articles, and previous studies. The sensibility adjectives are the input to the makeup style recommendation and directly influence the system output. Therefore, improving the validity of the sensibility vocabulary will improve system reliability. Although users have sensibilities about makeup styles, they have difficulty expressing these directly. Therefore, the system measures sensibility preferences indirectly using a sensibility expression vocabulary. In this paper, sensibility adjectives were obtained from a dictionary, magazines, and previous research [3–5, 9, 14, 21]. These words were organized into pairs of positive and negative meanings, and each was assigned a value on a five-point *Likert* scale. The pairs were then analyzed using a mean difference test. The 20 pairs of design sensibility adjectives is {young–adult, plain–characteristic, cute–courteous, neat–complex, luxury–worn, eastern–western, warm–cold, dark–bright, rural–urban, classic–modern, conservative–open, pure–sexy, female–male, old–new, static–active, curve–linear, soft–hard, dull–clear, mechanical–natural, ungraceful–graceful}. Subjects were asked to evaluate each design using the bipolar adjective pairs according to a five-point integer scale from –2 to +2. The questionnaire was designed to evaluate the sensibility by presenting the degree of preference in the sensibility adjective, while customers consider their makeup styles presented on a computer monitor. Presentation of the styles on a computer monitor may cause a limitation in this study due to lack of the homogeneity in colors [10, 15, 24].

3.2 Developing facial makeup style recommendation system

The facial makeup style recommendation system was developed, because the cosmetic industry did not have a system that could coordinate makeup style designers, resulting in

⁵ LG Household & Healthcare Ltd., <http://www.lgcare.com>

inefficient makeup development. Our facial makeup style recommendation system consists of server and client modules. The algorithms were implemented and simulated using MS Visual Studio C++ 2008, MS SQL Server 2005 [3, 7, 8, 25]. The server module performs sensibility analysis, collaborative filtering, image filtering, weather forecast, and recommendations, and then sends the result to the client module. User relevance feedback and pattern size on the recommendation is returned and saved by the server [23]. If the recommended facial makeup styles are inappropriate, a recommendation is given based on other users' preference using collaborative filtering. Collaborative filtering is used for personalized services, which provide recommendations based on ratings. Collaborative filtering recommends objects for a target user based on the opinions of other users by considering to what extent the target user and the other users have agreed on other objects in the past [5, 13, 16, 17]. This enables the technique to be used on any type of object. A large variety of services can be created, since the collaborative filtering considers only human judgments about the value of objects. These judgments are usually expressed as numerical ratings, expressing the preference for objects. Most collaborative filtering systems collect the user opinions as ratings on a numerical scale, leading to a sparse matrix rating. Collaborative filtering then uses this rating matrix to predict the rating [12, 15, 18, 26].

Figure 2 shows the facial makeup style recommendation system showing the most suitable makeup styles for a user's needs. The user enters his/her preferred sensibility in order and in its degree by moving the control bar. The user can select from four adjective pairs from a drop-down list. The makeup styles appear based on the recommendations from the input of sensibility factors, 'modern, sexy, luxury, young'. The preferred sensibility selected by the user and the level of sensibility are displayed in the process status at the bottom of the screen for confirmation. The previous research of [2, 3, 6, 7, 11] is described more detail. Figure 3 shows the result of facial makeup style combinations generated according to the sensibility adjectives entered into the facial makeup style recommendation system.

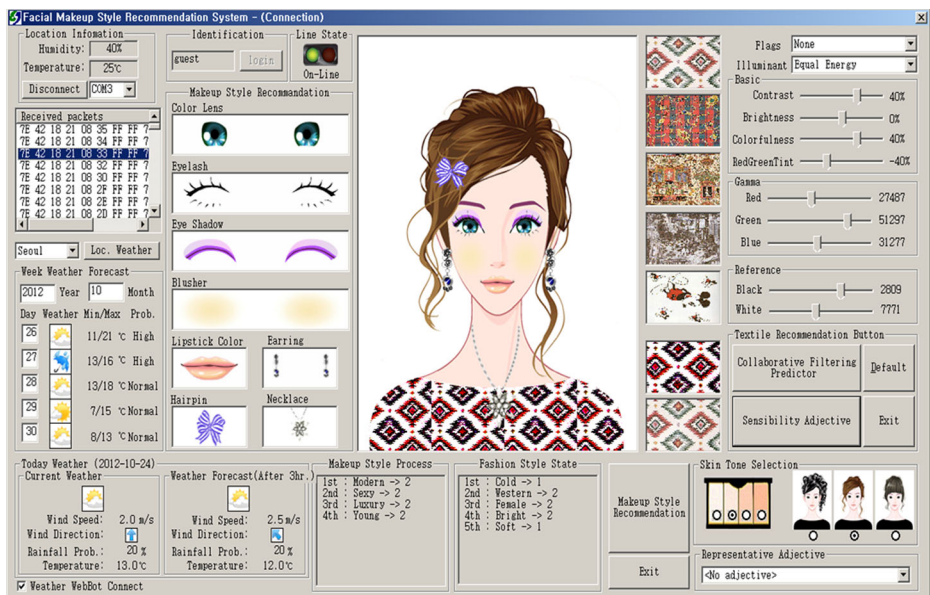


Fig. 2 Facial makeup style recommendation system



Fig. 3 Recommended facial makeup style results

The weather forecast was analyzed in terms of factors, such as, temperature, humidity, wind speed, wind direction, rainfall probability, and air temperature. The weather forecast uses a database of weather information extracted from RSS of the Korea Meteorological Administration [19] and collects information from various XML links off the main URL. XML is composed of a sequential and nested structure of elements in contrast to a non-sequential structure. An element is composed of a pair of matching start and end tags, and all the text that appears between them. The weather forecast module downloads each of these XML documents and uses a simple pattern to extract data about each factor. Information extraction is the task of locating specific pieces of information from a XML document, thereby obtaining useful structured data from unstructured text [1, 2].

4 Effects of facial makeup styles on sensibility

We used analytical data from the datasets of the questionnaires. The questionnaires on the World Wide Web were about 40 sensibility adjectives for facial makeup styles. The 5-point ratings for facial makeup styles have been explicitly entered by 978 users. The datasets consist of the user profile, evaluation rating values, sensibility adjective, and makeup information. We are currently performing analysis of a subset of datasets from the questionnaires [6, 8, 25]. The pictures of makeup style details, such as foundation, color lens, eye shadow, blusher, eyelash, lipstick, hairstyle, hairpin, necklace, earring, and hair length were evaluated in terms of sensibility. The data were analyzed by SPSS using ANOVA and factor analysis to discover the most important types of details for a consumer's visual sensibility.

Factor analysis for SD (Semantic Differential) was applied to measure the effect of makeup style on visual sensibility [3, 7, 8, 11]. It represents the characteristics of makeup style by this representative vocabulary. Figure 4 shows the mean SD profile for the evaluation of sensibility vocabulary pair for hairstyle and lipstick. We arranged, integrated and evaluated the sensibility shown for makeup concepts using the sensibility vocabulary. The three factors analysis for makeup concepts referred to the previous research of [10, 11, 18, 24]. The first factor grouped 'modern, cold, bright, new, western, sexy, and open' from the factor analysis for the SD profile of sensibility adjectives and termed this "contemporary". The second factor grouped 'courteous, adult, male, graceful, and active' and it was

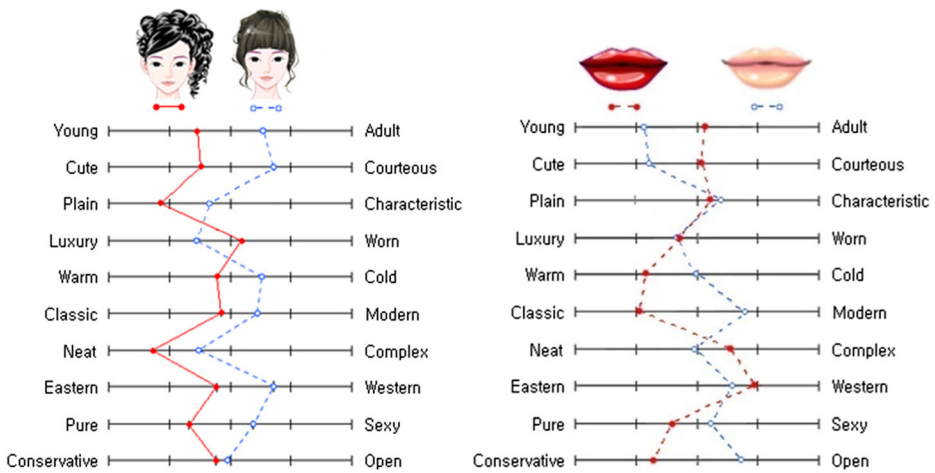


Fig. 4 SD profile of hairstyle and lipstick

termed “mature”. The third factor grouped ‘complex, characteristic, worn, urban, linear, natural, hard, and clear’ and it was termed “individual”. The details of makeup styles were positioned in 3D-concept space to relate each type of detail to a makeup concept.

The sensibility according to lipstick types in Fig. 5 can be separated into four parts. Lipsticks with high individual include low mature lipsticks, such as guava, and high contemporary lipsticks, such as crimson, rose blossom, and header pink. Lipsticks with low individual value include low contemporary lipsticks, such as old hollywood, cosmic

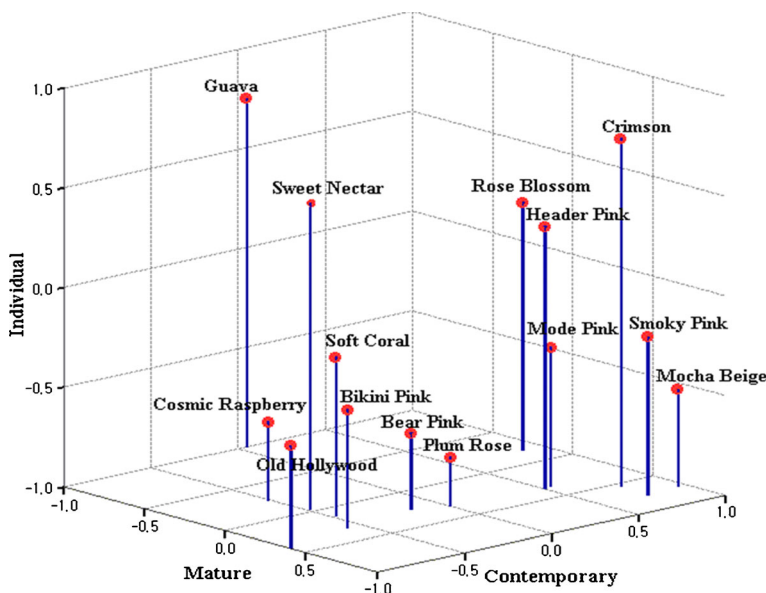


Fig. 5 Image scales by lipstick type

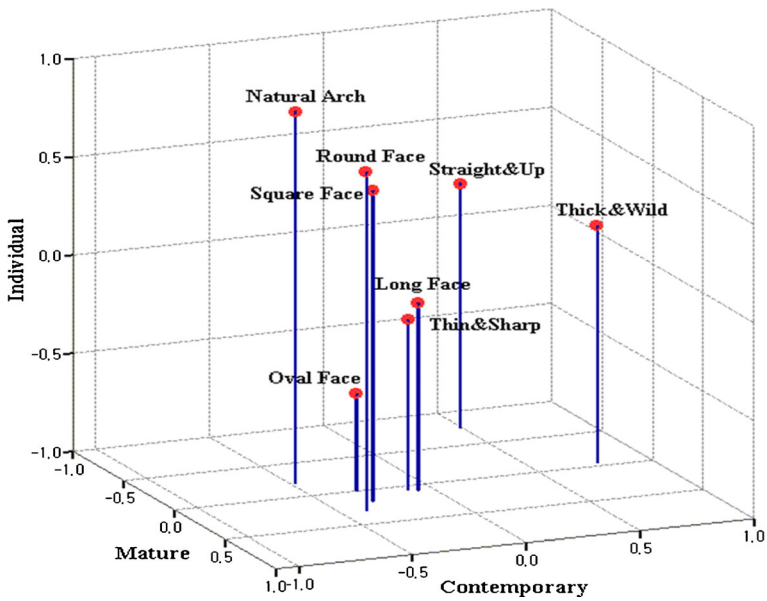


Fig. 6 Image scales by eyelash type

raspberry, soft coral, and bikini pink, and high contemporary lipsticks, such as mode pink, smoky pink, and mocha beige. Eyelash types can be classified into three parts, as shown in Fig. 6. The straight&up and thick&wild eyelash have high contemporary and individual

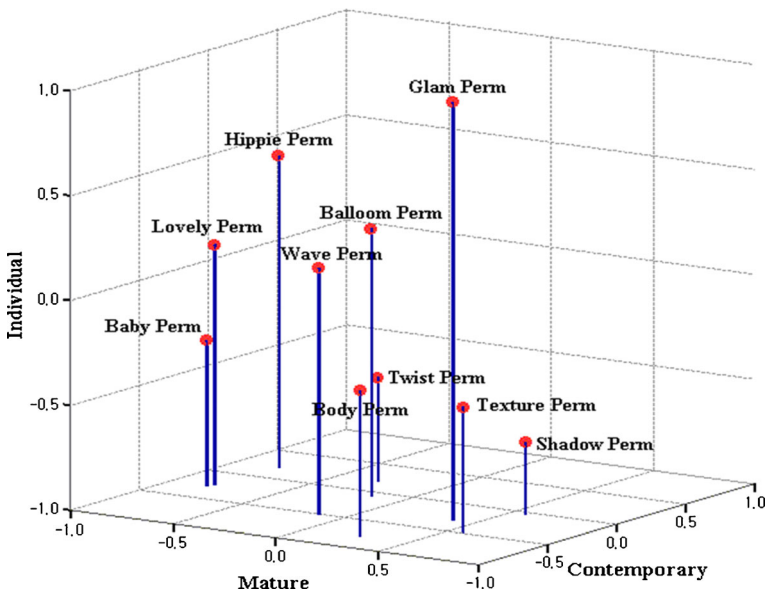


Fig. 7 Image scales by hairstyle type

Table 1 Sensibility factor score by hair length

Independent variable	Dependent variable—sensibility degree		
	Contemporary	Mature	Individual
Long length	−.25 C	.52 A	−.83 B
Medium length	.07 B	.14 B	−.88 B
Short length	1.54 A	−.89 C	.08 A
Sig.	*	**	*

* $p < 0.0001$, ** $p < 0.05$

values, but the natural arch, round face, and square face eyelash have low contemporary and high individual values. The oval face, thin&sharp, and long face eyelash have low contemporary and individual values. We can see that mature is not a sensibility adjective that makes a clear distinction for eyelash.

When hairstyle types are classified by the 3D sensibility axes, as shown in Fig. 7, they were evenly distributed in 3D space and could not be separated into clear groups. However, we could separate them into three categories: hippie perm and twist perm with high contemporary value, glam perm, wave perm, balloon perm, and lovely perm with low contemporary and high individual values, and shadow perm, body perm, texture perm, and baby perm with low individual value.

Short hair length had high contemporary and individual values, while the long length had a high mature value, as shown in Table 1. Vivid had the highest contemporary and individual values for sensibility according to eye shadow tone, while Very pale had low mature and individual values, as shown in Table 2. Dark showed the highest mature value. The reason for this is that most people are reminded of such sensibility adjectives as strong and clear by Vivid, while they are reminded of tender and soft by Very pale colors.

In this study, we did not analyze sensibility when combinations of details are presented as one piece of makeup styles [11]. Thus, it must be noted that analysis of the influence of the reciprocal action of detail combination on sensibility was excluded. However, from the findings of this study we could understand the important types of details and the concrete makeup styles that implement specific sensibility in women's cosmetics. The significance of this study lies in the fact that it developed a method to quantitatively determine the relative influence. We believe that the findings of this study can be used as basic data by cosmetics departments.

Table 2 Sensibility factor score by eye shadow tone

Independent variable	Dependent variable—sensibility degree		
	Contemporary	Mature	Individual
Vivid	.30 A	−.68 CD	.68 A
Bright	−.29 B	−.47 C	−.37 C
Very pale	−.33 B	−.85 D	−.18 C
Dull	−.15 B	.88 B	.35 B
Dark	−.34 B	1.38 A	.31 B
Sig.	*	**	*

* $p < 0.0001$, ** $p < 0.05$

5 Conclusions

Facial makeup styles in modern society plays a role in presenting both functional products and high value added products. Therefore, the importance of the sensibility related to makeup styles has gradually increased. We developed a facial makeup style recommendation system that recommends upper and lower garments for women according to the visual sensibility of consumers. We built a design sensibility database of sensibility adjectives for users. The respondents of the questionnaire were asked to evaluate the degree of sensibility for makeup styles using a scale of five with 20 pairs of sensibility adjectives presented on a computer monitor. The pictures of foundation, color lens, eye shadow, blusher, eyelash, lipstick, hairstyle, hairpin, necklace, earring, and hair length were evaluated in terms of sensibility and emotion. The data were analyzed by SPSS using ANOVA and factor analysis to determine the details that most effectively influenced a consumer's sensibility. Sensibility was composed of three concepts: contemporary, mature, and individual. Details of makeup styles were positioned in 3D-concept space to relate each type of detail to a makeup concept about women's fashion. Our facial makeup style recommendation system may allow cosmetic designers to work more effectively. Communication between designers and experts will occur easily without cosmetic concepts. The facial makeup styles design may meet the customer's need more precisely and easily with this system. This will result in quicker responses and stimulate the cosmetic industry nationwide.

In the future, customers will encounter this system in stores. It will help them obtain their needs by enabling them to see what they are ordering in advance on a computer screen. Finally, ubiquitous commerce using IT convergence with convenient on-line ordering and quick delivery will be available in the near future.

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