A Study on the Service Design Strategies of Smart Beauty Mirror through Case Studies of Cosmetic Technologies

주 저 자 : 임지민 (Rhim, Jimin) KAIST Graduate School of Culture Technology
공동저자 : 다니엘 카라지(Karaji, Danial) KAIST Graduate School of Culture Technology
공동저자 : 이태하 (Yi, Taeha) KAIST Graduate School of Culture Technology
교신저자 : 이지현 (Lee, Ji-Hyun) KAIST Graduate School of Culture Technology
jihyunlee@kaist.ac.kr

접수일자 2017. 12. 02 / 심사완료일자 2017. 12. 12 / 게재확정일자 2017. 12. 26

Abstract

The purpose of this study is to propose design strategies for a Product - Service System Design that focuses on makeup technology of users who are interested in health and beauty lifestyle activities. A literature review and case studies of both research and commercial beauty services have been conducted. Findings indicate that with the advancement of technology and IoT (internet of things), beauty related products are being designed for personalized use at home. Respectively, we have suggested design modules and strategies of 'AI Smart Beauty Mirror'. A design flow for AI based beauty recommendation system using Case Based Reasoning (CBR) method that suggests optimized beauty solutions for individual characteristics and needs is suggested. The contribution of this research is that it defines design components of a product - service integration system called 'Smart Beauty Mirror'. Development of this PSSD has the potential to enhance user experience in health and beauty lifestyle activities in sustainable manners.

Keyword

Beauty technology, Service Design, User Experience, PSSD (Product-service system design), and AI

요약

본 연구의 목적은 건강과 아름다움에 관심이 많은 현대인의 메이크업 및 스타일링에 주목한 스마트 뷰티 제품-서비스 통합시스템 (Product Service System) 디자인 요소를 제안하고자 한다. 연구 방법은 관련 논문, 단행본 및 정기 간행물 등의 문헌 자료의 고찰을 통해 뷰티의 기술화에 대한 이론적 연구를 진행 하였다. 또한 국내・외 신문, 기사, 화장품 브랜드 웹사이트 등 상용화된 기술이 적용된 뷰티 제품과 서비스의 사례를 중심으로 고찰 및 분석했으며 분석 결과는 다음과 같다. 뷰티 서비스는 인터넷 및 기술과 연결된 제품의 형태로 집에서도 사용자가 직접 개인에게 맞춤화된 서비스를 체험할 수 있도록 디자인 되고 있다. 이러한 문헌 및 사례 분석을 토대로 &스마트 뷰티 미러&의 디자인 요소와 전략을 모색한 결과는 다음과 같다. AI 기법 중 사례 기반 추론 방법(Case Based Reasoning)을 통해 개개인이 지닌 신체적 특징과 선호하는 헤어 및 메이크업 기법에 대한 분석을 바탕으로, 색조, 질감 등 화장품이 지닌 세부 속성을 반영하여 추천하는 서비스 방법을 제안하였다. 본 연구의 의의는 &스마트 뷰티 미러&라는 제품-서비스 통합시스템의 디자인 구성 요소의 정의와 뷰티 서비스화 전략을 모색함으로써 개인의 라이프스타일의 중요한 일부분인 건강과 뷰티를 더욱 스마트하게 관리함을 통해 사용자 경험과 만족도를 증진 시키고자 함에 있다.

목차

1. Introduction

1-1. Research Background

Beauty and cosmetic is one of the worldwide industries that experiences rapid and non-stop growth which generates enormous revenues each year.[1] According to L'Oreal annual report, the cosmetics market reached 205 billion euro in 2016, which indicates an annual increase by 4 %.[2] The desire to pursue beauty in modern society is manifested in various ways such as fashion, hair-style, make-up, plastic surgery and so on. For the expression of beauty, applying make-up is the most common and wildly used practice. Applying makeup enables an individual to either emphasize or hide certain features to express the image they want to portrait. Furthermore, people invest tremendous amount of time and attention in applying makeup, because the ritual generates positive emotions such as confidence, excitement, and keenness to participate in social situations.[3]

Increasing number of people are investing in beauty activities. Contrary to the common belief that makeup is mostly used by women of a young age, male consumers in the beauty market are increasing in number.[4] Different from other commercial products, cosmetics are especially person-dependent. However, most researches are focused on analyzing sociocultural fashion trends and color preference analysis. Furthermore, research on makeup techniques is mostly a reflection of approaches that are popular among famous makeup artists or media outlets. These research methods are mainly focused on limited qualitative analysis of a beauty trends associated with certain time period, or the knowledge of a selected few experts, ignoring detailed analysis of individual characteristics.

On the other hand, the widespread of emerging technologies (e.g. tablets, smart-phones, WiFi, AR/VR, apps, and IoT) has transformed shopping experiences.[5] In-store interactions have become smart by collecting sensor data to provide optimal suggestions for customers considering their behaviors through virtual expressions.[6] However, the length of innovation in such interactions is limited at this point and consequently, it provides an opportunity for developing an AI-based system for promoting smart beauty, based on a large number of case studies regarding optimized makeup application through analysis of individual features and characteristics. Such system will enable personalized cosmetic services to provide enhanced techniques of beauty applications to meet user's needs.

1-2. Research Scope

This research is conducted to explore possibilities of a new product service system in the cosmetics domain. Case studies were conducted to analyze current trends of technology adapted beauty products and services, to understand users and their patterns. Furthermore, researchers have proposed service design modules for Smart Beauty Mirror and suggested research process flow for defining

1) Radzi, Nur Syuhada Mohd, and Mahfuza Musa, Beauty Ideals,Myths and Sexisms: A Feminist Stylistic Analysis of Female Representations inCosmetic Names, GEMA Online® Journal of Language Studies, 2017, Vol.17, No.1.

2) L'Oreal, Annual report, 2016.

3) McCabe, Maryann, Timothy de Waal Malefyt, and Antonella Fabri, Women, makeup, and authenticity: Negotiating embodiment and discourses of beauty, Journal of Consumer Culture, 2017.

4) Frank, Elena, Groomers and consumers: The meaning of male body depilation to a modern masculinity body project, Men and Masculinities, 2014, Vol.17, No.3, pp.278-298.

5) Nguyen, Tam V., and Luoqi Liu, Smart Mirror: Intelligent Makeup Recommendation and Synthesis, ACM MM, 2017.

6) Hwangbo, Hyunwoo, Yang Sok Kim, and Kyung Jin Cha, Use of the Smart Store for Persuasive Marketing and Immersive Customer Experiences: A Case Study of Korean Apparel Enterprise, Mobile Information Systems, 2017.

recommendation module of the Product-Service System.

2. Background

2-1. Beauty and Makeup Trends

Most of the domestic research on cosmetics has been conducted to measure color preference and perception of women. Researchers analyzed commercialized(13 products of 5 domestic beauty companies) products to define its color spectrum. The research found that the color spectrum for Korean cosmetic brands was different from that of international brands.[7] Another Research was carried out on 200 Korean college women to test their perception of 36 makeup color sets combinations. The study proved that the perception of a personal image is enhanced through a balanced combination of colors.[8] These research results indicate the importance of applying balanced colors, rather than blindly following the latest beauty trends.

Along with color combinations, facial shape analysis was conducted as well to better express makeup techniques. The research analyzed facial features of Korean women to define characteristics of facial profiles.[9] Another research applied architectural method on facial analysis and developed Face Architect base makeup application methods.[10] These researches attempted to analyze and include individual facial structures for more user-specific makeup applications.

It can be summarized that applying makeup is becoming more scientific and user-adaptive. However, there is not yet a smart and integrated beauty recommendation service that analyzes personal features in depth and provides instant user adaptive guidelines.

2-2. Service Design & User Experience

Service can be defined as the application of specialized skills through deeds, processes and performances to create values to the user.[11] Modern service industries have been adopted to integrate information technology and interactive computing systems.[12] With this shift in service characteristics, design of user experience has been emphasized. User experience is related to product, system or service which focuses on interaction between a user with something with an interface.[13] UX associates with a spectrum of meanings covering from traditional usability and pragmatic qualities to affective and hedonic aspects of technology use.[14][15] The CUE-Model

7) 정수진, 강경자, 메이크업 시 컬러코디네이션의 조화감에 대한 여대생의 지각 반응 연구, 한국색채학회논문집, 2006, Vol.20, No.2, pp.31-43.

8) 김영인 외 3인, 국내외 메이크업 브랜드 색조화장품의 색채 특성. 한국색채학회논문집, 2004, Vol.18, No.2, pp.91-101.

9) 백경진, 김영인, 한국 여성의 얼굴 이미지 유형별 형성 요소와 메이크업 디자인의 효과, 복식, 2014, Vol.64, No.4, pp.1-20.

10) 김민성 외 3인, 페이스 아키텍트 베이스 메이크업 기법에 대한 만족도 조사 - 대구 지역 백화점 이용 고객을 대상으로, 대한미용학회지, 2016, Vol.12, No.3, pp.267-276.

11) Vargo, Stephen L., and Robert F. Lusch, Evolving to a new dominant logic for marketing, Journal of marketing, 2004, Vol.68, No.1, pp.1-17.

12) Idoughi, Djilali, Ahmed Seffah, and Christophe Kolski, Adding user experience into the interactive service design loop: a persona-based approach, Behaviour & Information Technology, 2012, Vol.31, No.3, pp.287-303.

13) Law, Effie Lai-Chong, et al, Understanding, scoping and defining user experience: a survey approach, Proceedings of the SIGCHI conference on human factors in computing systems. 2009, pp.719-728.

14) Hassenzahl, Marc, and Noam Tractinsky. User experience-a research agenda, Behaviour & information technology, Vol.25, No.2, 2006, pp.91-97.

15) Hassenzahl, Marc, and Nina Sandweg, From mental effort to perceived usability: transforming experiences into summary assessments, CHI'04 extended abstracts on Human factors in computing systems, 2004, pp.1283-1286.

specifies three central components of user experience; the perception of instrumental qualities, the perception of non-instrumental qualities, and the user's emotional responses to system behavior.[16] To fulfill users' needs with satisfactory results, designers should consider varying aspects of user experience. To fulfill users' needs with satisfactory results, designers should consider varying aspects of user experience which can be carried out through extensive and wide range of methods. Following ([Table 1]) are the methodologies most appropriate for our scope of research.

[Table 1] User Experience Design Methodologies (35)

Method	Explanations
Competitive Audit	Knowing the competitors are and their potentials allows positioning your product or service in the market which offers competitive advantage.
Concept strategy	Following questions allow construction of a solid concept strategy: who are the ideal users (persona), what goal is the user trying to achieve with the product (interviews), and what primary tasks should user perform on a daily basis (customer journey map)
Personas	Personas are fictional characters that represents potential target users for a service, product, site or a brand. Personas are typically made at the definition phase of a project and aid to better realize the ultimate goal and vision of what the project needs to be.

3. Case Studies & Analysis

3-1. At Home Beauty Products and Services

A user does not have to necessarily visit experts for analysis and diagnosis of skin and hair conditions anymore. There are smart products and applications available for personal use at home. HiMirror([Img 1]) has been introduced in CES 2017. It is a mirror with a camera that analyzes and gives an assessment of skin condition (wrinkle, fine lines, dark circles, dark/red spots, and pores) and allows users to achieve their beauty goals effectively and efficiently. One can acquire professional results at home, which is both time and money efficient.

[Img 1] HiMirror, HiMirror[17]

3-2. Smart and Connected Beauty Products and Services

A conventional product has become smarter by combining mobile and sensor technologies within the beauty category. KÉRASTASE, a hair product company has collaborated with Withings, a smart health device company, to develop 'Hair Coach' The smart brush has built-in sensors to analyze hair condition and brushing patterns to measure the effectiveness of brushing habits, and provides personalized advice and product recommendations. The brush([Img 2]) is connected to a smartphone application for detailed analysis and information.

16) Thüring, Manfred, and Sascha Mahlke, Usability, aesthetics and emotions in human–technology interaction, International Journal of Psychology, 2007, Vol.42, No.4, pp.253-264.

17) https://www.himirror.com/us_en/home

[Img 2] Hair Coach, KÉRASTASE & Whithings[18)]

Neiman Marcus has installed 'Memory Mirro r'[19)], a digital mirror composed of video screen and a camera. A shopper can access a 360 degree view of how an outfit would look on him/her without actually trying on the clothes. it also allows clothing options comparison using captured images which also can be shared with friends for receiving feedbacks, enhancing social experiences through virtual reality.

An expert's beauty tips and guidance became available at home through 'memomi([Img 3])', a smart mirror placed at Le Métier de Beauté Neiman Marcus. The memory makeover captures the customer's in-store makeup session applied by a professional and sends an edited version of the video via email to the customer. Furthermore, a high-end lighting system has been developed to simulate different lighting variations to allow customers to see how they would look in different settings.

[Img 3] memome, Neiman Marcus[20)]

3-3. Technology Integrated Beauty Services

Due to widespread of smart-devices and enhanced AR/VR technologies, many web-based software and applications have been developed. Such applications track user's facial features and provide virtual images of how a user would look in a certain style. Such services optimize makeup experiences by providing personalized recommendation or guidance. Majority of such services have been developed by professional cosmetics companies with the addition of composing automatic online shopping lists for beauty products that the user has tried on. Furthermore, cosmetic application activities which have been perceived as personal has become social by sharing photos of virtually applied makeup looks for social experiences. ([Table2])

[Table 2] Virtual Try-on software or application

Service Name	Function and Descriptions
Visage MakeApp Makeup Wizard YubituSoft	App (Android/ios), virtual makeup try on, create own looks and save, share looks on SNS, Beauty product shopping list linked
MODIFACE	Web-based service, realistically render combination of entire beauty product line, personal beauty records
Wow How	App (Android/ios), analyze face shape, skin type and provide step-by-step tailored looks for the users with verbal and visual interfaces
L'Oreal Makeup Genius	App (ios), view latest looks and products, personalize and adjust intensity of virtual make up, take pictures to compare before and after looks
MatchCo	Web-based service, the camera scans skin and creates foundation specific to one's skin tone.
Meitu	App (Android), enable various make up products (lipstick, contouring, ey brow) virtual try ons and take selfies
Cosmethics	App (Android/ios), database of 100,000+ cosmetic products with product image and details, barcode scan to analyze one's cosmetic products, recommend personalized makeup for user

AI technology has been integrated into personal beauty industry as well. Amazon has

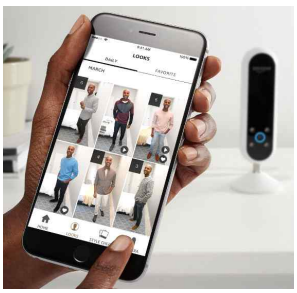
18) https://www.kerastase-usa.com/connected-brush

19) https://www.engadget.com/2015/01/13/neiman-marcus-memory-mirror/

20) http://www.retail-focus.co.uk/tech/2460-neiman-marcus-introduces-the-memory-makeover-mirror-at-le-metier-de-beaute-cosmetic-counters

released 'EchoLook ([Img 4])', a voice-controlled camera (depth-sensing and computer vision) that takes 360-degree snaps of outfit for a personal look book. It offers experts'advice through Style Check, a service that combines machine learning algorithms to suggest better outfit with numerical score comparison.

Another example of an application of AI in beauty field is the First International Beauty Contest judged by AI judges, called 'Beauty AI2.0'[21]. The contest was held from November 19, 2015, through January 15, 2016, in which all people around the world were welcomed to submit their selfies. By processing photos, a set of algorithms that evaluated criteria (wrinkles, face symmetry, skin color, gender, age group, and ethnicity) were analyzed through massive data. Nvidia and other partners have supported the development of the AI robot juries; RYNKL, MADIS, and Symmetry Master.



[Img 4] Echo Look, Amazon[22]

3-4. Summary of Case Studies

Researchers have chosen representative examples of advanced technology based beauty products and services. Summary of the cases, following insights were found which can be applied as guidelines for developing 'Smart Beauty Mirror', an integrative technology-based beauty service system. First, users are becoming more active participants in the creation of beauty trends. Instead of rigorously attempting to follow the latest trends, users seek to try various beauty styles to find their suitable personal look that are more appropriate for their facial features, characteristics, and the occasion. Second, professional beauty services are enabled at home through implementing or connecting digitalized devices with personalized AI recommendation systems. This provides individual user-centric and customizable beauty experiences in time and cost-efficient manners. Third, smart in-store technologies and services can be modified by integrating AI to their systems to provide optimized cosmetic analysis and guidelines for users at home and private settings for a thorough user experiences.

4. Service Design of "Smart Beauty Mirror"

The "AI smart beauty" can be delivered as Product Service System, an integrated product and service to create meaningful user experienc e.[23] Based on literature research and case studies of latest beauty trends and related technologies, our research group have defined modules for developing a "Smart Beauty Mirror. First module is 'Main Function' which describes the main features of the product service system. Second module is 'Related Technology' which lists technologies that could be applied to the smart beauty mirror. Third module is "Related Objects/ Products" which lists possible devices that could be connected to the smart mirror to enhance the service. Sub categories of each Service Design Module of "Smart Beauty Mirror" is listed in the [Table 3].

21) https://theblog.adobe.com/xd-essentials-how-to-develop-a-product-strategy/

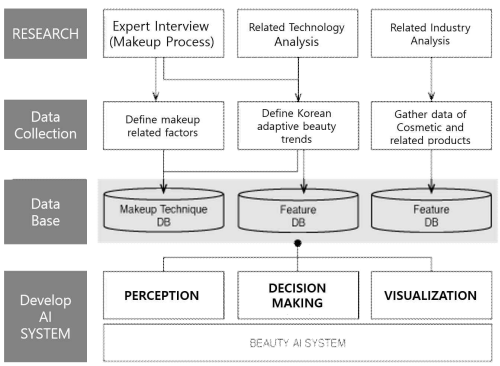
22) https://www.amazon.com/Amazon-Echo-Look-Camera-Style-Assistant/dp/B0186JAEWK

23) Meier, Horst, Raj Roy, and Günther Seliger, Industrial product-service systems—IPS 2, CIRP Annals-Manufacturing Technology, 2010, Vol.59, No.2, pp.607-627.

[Table 3] PSSD modules of "Smart Beauty Mirror"

PSSD Module	Subcategories
Main Functions	Real-time User Analysis and Feedback
	Real-time Expert recommendations
	Social Experience
Related Technology	WiFi, Sensors
	Virtual Reality / Augmented Reality
	Imaging Processing / Depth Analysis
	Interfaces (Voice, gesture, etc.)
	Artificial Intelligence
Related Objects/ Products	Smart Mirror
	Smartphone / Smart Devices
	Existing cosmetic products

Based on the aforementioned modules, the focus of our research team is to design a recommendation service. the adapted methodology will be Case Based Reasoning(CBR) method due to its integration of experts decision into the recommendation process. First, interviews and ethnography will be conducted with beauty experts to understand the professional decision making criteria for applying make up. Based on the results, catagories will be defined which will later creat the data base of our system. Case Based Reasoning (CBR) based AI system will be developed to provide recommendations based on user's individual characteristics and need for makeup application. [Img 5] describes the overall process of the research plan.



[Img 5] Research Process Flow Diagram

5. Conclusion

This paper suggests development plans for "Smart Beauty Mirror", a product-service system design which integrates AI recommendation services into a mirror used at home to provide individually adaptive and professional beauty service. Results of the case studies indicate that users are pursuing more personalized styles that enhances their unique characteristics rather than blindly following the current trends. Also, beauty products are becoming smarter and more integrated with technology. hence providing strong evidence that beauty recommendation products need to focus on enhancing personalized services.

The limitation of the study is that the research is yet in an exploratory phase in which suggests possible guidelines for solutions. Future research will follow step by step guidelines provided in this research for the development of the smart beauty service.

REFERENCE

1. Frank, Elena, Groomers and consumers: The meaning of male body depilation to a modern masculinity body project, Men and Masculinities, 2014, Vol.17, No.3.
2. Hassenzahl, Marc, and Noam Tractinsky. User experience-a research agenda, Behaviour & information technology, 2006, Vol.25, No.2.
3. Hwangbo, Hyunwoo, Yang Sok Kim, and Kyung Jin Cha, Use of the Smart Store for Persuasive Marketing and Immersive Customer Experiences: A Case Study of Korean Apparel Enterprise, Mobile Information Systems, 2017.
4. Idoughi, Djilali, Ahmed Seffah, and Christophe Kolski, Adding user experience

into the interactive service design loop: a persona-based approach, Behaviour & Information Technology, 2012, Vol.31, No.3.

5. McCabe, Maryann, Timothy de Waal Malefyt, and Antonella Fabri, Women, makeup, and authenticity: Negotiating embodiment and discourses of beauty, Journal of Consumer Culture, 2017.
6. Meier, Horst, Raj Roy, and Günther Seliger, Industrial product-service systems—IPS 2, CIRP Annals-Manufacturing Technology, 2010, Vol.59, No.2.
7. Radzi, Nur Syuhada Mohd, and Mahfuza Musa, Beauty Ideals,Myths and Sexisms: A Feminist Stylistic Analysis of Female Representations inCosmetic Names, GEMA Online® Journal of Language Studies, 2017, Vol.17, No.1.
8. Thüring, Manfred, and Sascha Mahlke, Usability, aesthetics and emotions in human-technology interaction, International Journal of Psychology, 2007, Vol.42, No.4.
9. Vargo, Stephen L., and Robert F. Lusch, Evolving to a new dominant logic for marketing, Journal of marketing, 2004, Vol.68, No.1.
10. 김민성, 한삼성, 김영희, 강지웅, 페이스 아키텍트 베이스 메이크업 기법에 대한 만족도 조사 - 대구 지역 백화점 이용 고객을 대상으로, 대한미용학회지, 2016, Vol.12, No.3.
11. 김영인, 주미영, 이현주, 김석정, 국내외 메이크업 브랜드 색조화장품의 색채 특성. 한국색채학회논문집, 2004, Vol.18, No.2.
12. 백경진, 김영인, 한국 여성의 얼굴 이미지 유형별 형성 요소와 메이크업 디자인의 효과, 복식, 2014, Vol.64, No.4.
13. 정수진, 강경자, 메이크업 시 컬러코디네이션의 조화감에 대한 여대생의 지각 반응 연구, 한국색채학회논문집, 2006, Vol.20, No.2.
14. Hassenzahl, Marc, and Nina Sandweg, From mental effort to perceived usability: transforming experiences into summary assessments, CHI'04 extended abstracts on Human factors in computing systems, 2004.
15. Law, Effie Lai-Chong, et al, Understanding, scoping and defining user experience: a survey approach, Proceedings of the SIGCHI conference on human factors in computing systems. 2009.
16. Nguyen, Tam V., and Luoqi Liu, Smart Mirror: Intelligent Makeup Recommendation and Synthesis, ACM MM, 2017.
17. L'Oreal. Annual report 2016.
18. https://www.himirror.com/us_en/home
21. https://www.kerastase-usa.com/connected-brush
22. https://www.engadget.com/2015/01/13/neiman-marcus-memory-mirror/
23. http://www.retail-focus.co.uk/tech/2460-neiman-marcus-introduces-the-memory-makeover-mirror-at-le-metier-de-beaute-cosmetic-counters
24. http://beauty.ai/
25. http://visagetechnologies.com/
26. https://in.oriflame.com/makeup/makeup-wizard-app
27. https://play.google.com/store/apps/details?id=com.yubitu.android.YouFace
28. https://ecommerce.modiface.com/
29. http://wowhowapp.com/
30. https://itunes.apple.com/us/app/makeup-genius/id871897775?mt=8
31. http://www.getmatch.co/
32. https://play.google.com/store/apps/details?id=com.meitu.makeup
33. http://www.cosmethics.com/
34. https://www.amazon.com/Amazon-Echo-Look-Camera-Style-Assistant/dp/B0186JAEWK
35. https://theblog.adobe.com/xd-essentials-how-to-develop-a-product-strategy/