# Smart Skincare System: Remote Skincare Advice System Using Life Logs

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## ABSTRACT

Many women find it difficult to maintain beautiful skin as skincare approaches require a great deal of effort, time, and special knowledge. Women often ask experts in cosmetic stores for skincare advice. However, this approach has limitations in terms of time, place, and privacy. To solve these problems, we propose a remote skincare advice system using life logs. This system helps users automatically log information related to their skin condition and share these data with skincare experts in order to obtain appropriate advice. First, we performed a feasibility study to select proper life log data for our system, and then we built prototype systems. Finally, we verified the effectiveness of our system through two studies.

## Categories and Subject Descriptors

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## General Terms

Human Factors

## Keywords

Skincare, advice, life log

## 1. INTRODUCTION

Many women hope to be beautiful forever. They also want to keep their skin beautiful. However, a lot of women find it difficult to maintain beautiful skin. According to a questionnaire-based survey on skincare in Japan[1], 90% of the female subjects had some skin problems, and 80% of them were interested in skincare. However, only 60% of those interested in skincare actually cared for their skin since many did not have knowledge regarding appropriate skincare methods.

The difficulty in skincare results from the complexity of the causes of skin problems: UV rays, humidity, sex hormone balance, dietary habits, amount of sleep, and the stress of daily life. Therefore, some women ask experts in cosmetic stores for skincare advice (We call this approach "face-to-face skincare

advice"). However, this approach has limitations in terms of time, place, and privacy. Moreover, according to research by FANCL Corporation (a giant cosmetic company in Japan)[2], many women[3] hesitate to use face-to-face skincare advice.

To solve these problems, we propose a remote skincare advice system using life logs called the "Smart Skincare System (SSS)". Using SSS, women can easily log information related to their skin condition, share these data with experts through the Web, and obtain appropriate skincare advice from the experts anytime at home.

## 2. Feasibility study

Our system requires skincare experts to give users advice based only on digital data transmitted from the users. To select proper data, we undertook a feasibility study with a skincare expert working for Shiseido (a giant cosmetic company in Japan). We observed her face-to-face skincare advice for a user, and then interviewed her.

The procedure for her face-to-face skincare advice was as follows:

- Taking the user's makeup off
- Evaluating the user's skin condition using a microscope camera
- Checking the user's skin moisture and sebum levels
- Giving advice about skincare methods and cosmetics suited to the user's skin condition

The expert asked the user following questions during the face-to-face advice:

- Job (e.g., environment and problems)
- Physical condition (e.g., sex hormone balance)
- Sleep (e.g., sleeping hours and quality of sleep)
- Dietary habits
- Skincare methods at home

After observing the face-to-face skincare advice, we interviewed the expert about the meaning of each step and question. Our

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[1] http://www.herstory.co.jp/jisya/200412/20041208skin_trouble.html

[2] http://www.fancl.co.jp/corporate/news/data/2009.10.30bihadakantei.pdf (in Japanese)

[3] 45% of women in their 20s have never used face-to-face skincare advice service, and 60% of them hesitate to use it.

results showed that the most important information for the skincare expert was as follows:

- Appearance of the face
- Appearance of skin texture
- Skincare cosmetics used at home
- Work and life environments

First, the expert could find potential skin problems from the appearance of the face, such as dullness, wrinkles, and sags. Second, the expert could find even small irregularities in the skins by observing skin texture[4], and could forecast future skin problems based on skin texture. Thus, the appearance of the face and skin texture is the most important information for skincare advice.

Third, the expert needed information regarding the user's skincare cosmetics used at home (e.g., price and effectiveness). Based on these data, she could introduce new skincare methods and cosmetics suited to the user. For example, she could recommend new cosmetics with proper constituents (e.g., organic) at similar prices.

Fourth, the expert wanted to know about the user's work and home environments (e.g., UV radiation and humidity) as these often affect skin condition. For example, when a user always works outside, the expert recommends strong sunscreen and mild skincare cosmetics because the user's skin is under the influence of large amounts of UV radiation. Meanwhile, when a user works in an air-conditioned room, the expert introduces skincare methods to combat dryness as the user's skin may be affected by the dry air.

According to these results, we decided to log five sets of data in the Smart Skincare System:

- Pictures of the face
- Close-up pictures of the skin
- Usage of skincare cosmetics
- Amount of UV radiation
- Amount of Humidity

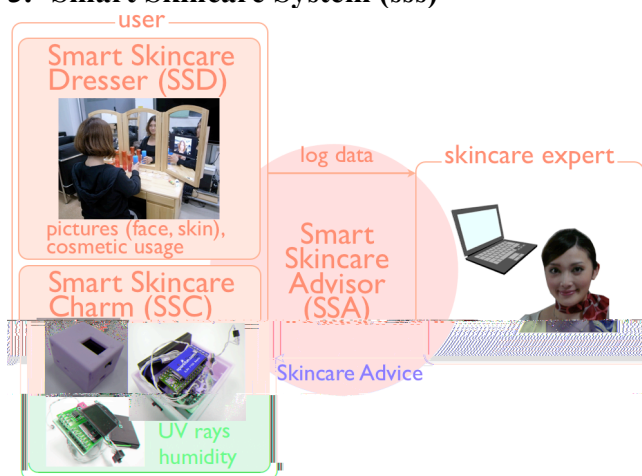## 3. Smart Skincare System (sss)



Fig. 1 The Smart Skincare System concept

The Smart Skincare System consists of the following three components:

- Smart Skincare Dresser
- Smart Skincare Charm
- Smart Skincare Advisor

Smart Skincare Dresser is a device that helps users take pictures of their faces and skin, and easily record their cosmetic use. Smart Skincare Charm is a mobile device that logs the amount of UV radiation and humidity. Smart Skincare Advisor is a Web-based application in which users can easily share data (collected from Smart Skincare Dresser and Smart Skincare Charm) with skincare experts, and obtain advice related to appropriate skincare methods.

We designed Smart Skincare Dresser to collect data to be logged in a stable environment (pictures and cosmetics use) and Smart Skincare Charm to collect data regarding the effects of the work and home environment (UV radiation and humidity). Using Smart Skincare System, users can obtain proper advice from skincare experts based on log data related to skin condition. Therefore, even women who dislike face-to-face skincare advice may easily adopt the advice of skincare experts.

## 4. Smart Skincare Dresser (SSD)

The basic concept of Smart Skincare Dresser is the collection of the minimum data required to obtain skincare advice (i.e., pictures of the face and skin texture, and use of skincare cosmetics) without the need for complicated operations. Therefore, we designed special hardware that is suitable for use during skincare routines since most women may not want to use computers in such circumstances. Consequently, we attached all devices to a daily dresser since many women usually use dressers while caring for their skin. An illustration of the Smart Skincare Dresser is shown in Figure 2.
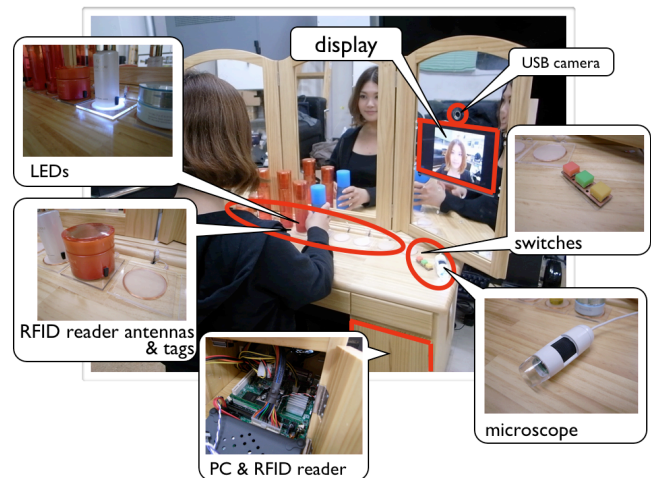


Fig. 2 The Smart Skincare Dresser

The Smart Skincare Dresser basically consists of a USB microscope, a USB camera, an LCD monitor, cosmetics stands with white LEDs and RFID antennas, push buttons for operating the system, a computer and other components (an RFID reader and an I/O board) attached inside a drawer. The LCD monitor and USB camera were embedded in the mirror to preserve the

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[4]Generally, we can observe a lot of triangle and diamond shapes created by deep and crossing lines in healthy skin. On the other hand, we find shallow lines flowing in one direction in unhealthy skin.

appearance of the dresser. We attached nine cosmetics stands on the top board of the dresser[5]. Each cosmetic stand consists of an RFID antenna and a white LED attached to an acrylic plate (7cm x 7cm[6]).

The RFID antennas were connected to an RFID reader attached inside the dresser. This RFID function helps users to automatically log the use of their cosmetics (attached with RFID tags); that is, the system can detect which cosmetics are used by identifying the RFID tags. The system also can inform users about which cosmetics should be used next by lighting the corresponding LED.

Users can take pictures of their face and skin using three buttons attached to the top panel of the dresser. These buttons can be used for (1) capturing skin images using a microscope, (2) capturing face images using the USB camera, and (3) canceling operations. Next, we will briefly explain the procedure for taking pictures. First, when a user pushes the capture button, the captured picture is shown on the LCD. Next, he/she can save the picture by pushing the same button once more. Conversely, the operation can be cancelled by pushing the cancel button. Thus, the Smart Skincare Dresser enables users to easily log data related to their skin condition without the need for complicated operations.
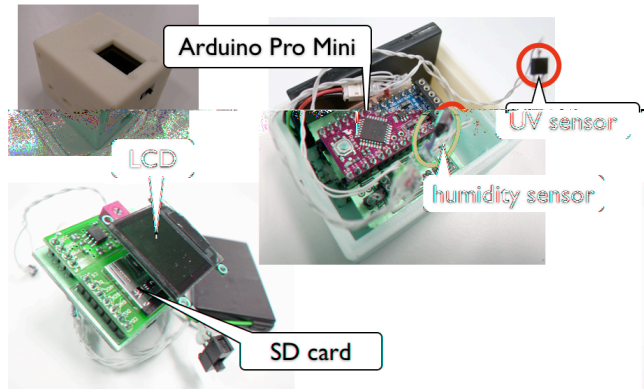
## 5. Smart Skincare charm (SSC)



Fig. 3 The Smart Skincare Charm

The basic concepts of the Smart Skincare Charm are as follows:

Logging UV rays and humidity

Offering real-time feedback

Suitable for mobile use

First, the SSC can log information related to two major factors that affect skin condition: the amount of UV radiation and humidity. As is well known, UV radiation and dry air are harmful to the skin. However, most women are rather unconcerned about these factors since there are no methods to easily control these effects. To solve these problems, we have developed a logging function that can measure the amount of UV radiation and humidity in the surrounding environment and record the data on a memory card. Figure 3 shows the prototype of SSC.

Second, SSC offers real-time feedback for users. For example, when the amount of UV radiation increases (or the humidity decreases) rapidly, the system warns users using a built-in display.

Third, SSC is designed for mobile use. Although the Meteorological Agency provides basic data related to the amount of UV radiation and humidity in the environment, actual data may differ depending on the user's immediate surroundings. For example, proper skincare methods may differ between outdoor workers and office workers. For this reason, SSC is designed as a compact device suitable for mobile use.

The SSC consists of a UV sensor (G5842, Hamamatsu Photonics K.K.) and a humidity sensor (SHT75, Sensirion AG), an OLED display ($\mu$OLED-96-PROP, 4D Systems), a memory card (Transflash microSD card), a lithium-polymer battery, and a microcontroller (Arduino Pro Mini) to control the above devices. Moreover, we attached a USB connector to transmit data to a host PC and charge the battery. The size of the entire device is approximately 5cm x 3cm x 3cm.

The system flow is as follows. When a user carries the SSC, it automatically detects the amount of UV radiation and humidity and saves them to the micro SD card every 20 minutes[7]. UV radiation is automatically converted to UV Index values[8]. When the UV Index and humidity[9] values change, the SSC may warn the user via the display. For example, the display shows "UV is strong! Apply sunscreen again!" when the UV Index is over 3.

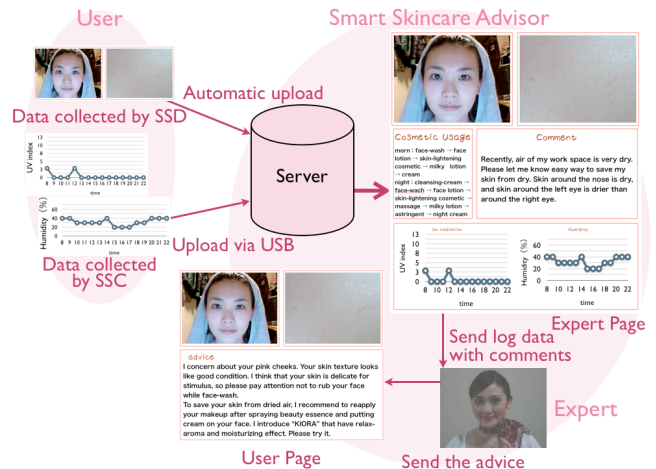## 6. Smart Skincare Advisor (SSA)



Fig. 4 System architecture of the Smart Skincare Advisor

The Smart Skincare Advisor helps users upload data collected by the SSD and SSC. Even when users can record data easily using the SSD and SSC, they may still have difficulty in sending these data to skincare experts. Using the SSA, users can quickly upload data with a minimum of fuss: the system automatically uploads data collected by the SSD (pictures and cosmetics use) to a server,

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[5]Since skincare cosmetics are mainly divided into six types (face lotion, milky lotion, special lotion, massage cream, astringent, and night cream). We developed nine stands in case multiple cosmetics are used.

[6]The plate size was determined based on the size of commonly used cosmetics.

[7]Generally, when a user stays under UV radiation more than 20 minutes, his/her skin may be affected by the UV radiation.

[8]The UV Index is proposed by the National Weather Service and EPA. The UV Index divides the strength of UV radiation into 11 categories from 1 (low) to 11+ (extremely high).

[9]Generally, the best humidity for maintaining skin condition is from 60 to 65%, and a user's skin may be affected when he/she spends long periods in a room where the humidity is under 50%.

and a user can upload data from the SSC (UV radiation and humidity) by connecting the device to the SSD via the USB port. Moreover, the user can upload comments while previewing these data using a keyboard. Skincare experts then confirm these data on the server using a common web browser. Finally, the experts upload appropriate advice based on these data. We developed the SSA based mainly on Ruby On Rails.

# 7. evaluation

We performed two the following two studies to evaluate the systems:

- Short-term evaluation using the prototype systems
- Long-term evaluation of the concept

First, we performed short-term evaluation using the prototype SSD and SSC systems. We verified (1) the usefulness of log data from these systems for skincare advice, and (2) the ease-of-use of the devices.

Second, we evaluated the concept of our research; that is, whether experts can offer proper advice based only on life logs and how the advice benefits the users. We performed this evaluation using the Wizard of Oz method, because of the difficulty in installing the current prototype systems into actual homes.

## 7.1 Short-term evaluation of the SSD

The objectives of this evaluation were as follow:

- Evaluating the ease-of-use of the SSD
- Evaluating the usefulness of the skincare advice based on log data collected by the SSD

We selected two female subjects (Subject A: a 22-year-old undergraduate student, and Subject B: a 24-year-old graduate student) from among the members of our laboratory and a skincare expert (a 23-year-old, female professional skincare consultant).

The evaluation procedure was as follows. First, each participant put her daily skincare cosmetics on the cosmetics stands of the SSD, and took pictures of her skin and face using the push buttons. As she applied skincare products in the usual manner, the system automatically logged the cosmetics use [10]. The subjects then transmitted these data, with comments, to the expert. Next, the expert wrote advice in a free format based on the data and transmitted it to each subject. After each subject read the advice, they were asked for their impressions of and opinions on the system and the advice. We also asked the expert for her impressions of providing advice using only limited data.

## 7.2 Results

The expert wrote her advice within about 2000 characters in Japanese [11]. The expert gave advice under 4 main aspects: "evaluation of skin texture", "evaluation of facial appearance", "description of skin condition", and "recommended skincare". Moreover, her advice included comments on the causes of the skin problems and practical skincare solutions. Next, we show the advice for each subject.

## 7.3 Subject A

Figures 5 and 6 show images of subject A (face and skin texture, respectively) taken by the SSD. Subject A commented that she had dry and partial oily skin.

Based on these data, the expert indicated that the lines in her skin texture were quite shallow and dark circles existed under her eyes. The expert explained that her multi-layered skin [12] was probably the cause of her skin problems (dry and partial oiliness). The expert recommended a particular face lotion that was effective in improving multi-layered skin and a night cream for preventing dryness.

## 7.4 Subject B

Figures 7 and 8 show images of subject B (face and skin texture, respectively). Subject B commented that she had dry skin and was worried about pimples.

Based on these data, the expert indicated that the lines in her skin textures flowed in one direction. Moreover, the expert found red cheeks, dark circles under eyes, and dullness around the mouth and chin. The expert said that slow skin metabolism was the cause of her skin problem (dry). The expert recommended new cosmetics (a new face lotion, a milky lotion, and a night cream) to reduce her skin problems and several foods that could improve her skin metabolism.

## 7.5 Findings

First, we summarize the impressions of the participants:

- *I could easily understand the advice. I thought it was helpful for my daily skincare.*
- *I could take pictures quite easily with the SSD. However, I had a little difficulty in controlling the focus of the microscope.*
- *I felt it difficult to take "pleasing" pictures of my face because I could not see my face on the display while I was looking at the camera.*

The difficulty in controlling the focus of the microscope was probably due to the fact that the subjects were not accustomed to operating the equipment. Actually, according to the subsequent long-term evaluation, users came to be able to control the focus easily within one month. The difficulty in capturing a "pleasing" picture of one's face was caused by the parallax problem. Although we attached the camera just above the display, the subjects felt the parallax when they brought their faces close to the camera. Consequently, the subjects could not make "stage faces". However, the expert indicated that the natural facial expressions were useful for skincare advice because skincare experts could observe wrinkles and sags more accurately from the natural facial expressions rather than from artificial ones. Thus, although the subjects felt the pictures were unattractive, these pictures were quite useful for skincare advice.

Next, we give the impressions of the expert:

- *I thought the pictures were clear and easily viewable. I could give proper advice based on the pictures.*
- *I could give proper advice for new customers based on the data collected by the SSD.*

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[10]We have attached RFID tags to cosmetics bottles and registered the product names in our system in advance.

[11]Equivalent to about 1000 words in English.

[12]A type of unhealthy skin that has incomplete keratinized layers formed by restoring dry skin

- *I need log data from the surrounding environment (e.g., UV radiation and humidity data) for regular customers.*

As a result, the expert was able to give appropriate advice using only data collected by the SSD.

## 7.6 Short-term evaluation of SSC

We next evaluated the ease-of-use of the SSC and the value of the data collected by the SSC

We selected a subject (Subject C: a 24-year-old, female office worker) and a skincare expert (the same person as used in the short-term evaluation of the SSD).

The evaluation procedure was as follows. First, the participant put the SSC in her handbag, and carried it with her all day long (from 10.00 a.m. to 8.00 p.m.). We then took the SSC back from her, and we transmitted data from the SSC to a PC via the USB port, and asked her for her impression of the device. After that, we showed the data to the expert and asked her for her impressions of and opinions regarding the data.

The impressions of the participant were as follow:

- *I got a little worried about the size (too big to fit in my bag) in the beginning, but it did not bother me at the end.*

- *I did not experience any problems as I had just to carry it around with me.*

According to these impressions, the participant seems to have used the SSC without any problems.

The impressions of the expert are as follow:

- *The collected data is useful to understand the participant's environment.*

- *I need continuous data for UV radiation and humidity, not detailed data, to give proper advice.*

- *The most important data for giving proper advice are the pictures of the face and skin, but the UV radiation and humidity data are important to understanding the cause of persistent skin problems.*

- *The continuous data is useful for giving proper advice for users whose skin conditions are definitely bad.*

According to these impressions, the continuous log data collected by the SSC appears to have been useful for the expert.

## 7.7 Long-term evaluation of this concept

To confirm the effectiveness of the concept of our research, we performed the four-week evaluation with two subjects (Subject D: a 30-year-old, married female office worker, and Subject E: a 27-year-old, unmarried male office worker) and a skincare expert (the same person as used in the short-term evaluation). The subjects and the expert did not know each other before the evaluation, and never met during the evaluation. The subjects and expert did not receive anything as compensation. In this evaluation, we focused on the following two aspects:

- The long-term usefulness of the remote skincare advice

- Observation of changes in subject behavior and skin condition

First, we evaluated the long-term usefulness of the remote skincare advice without any face-to-face communication. We previously confirmed that the subjects felt the remote skincare advice was useful at first impression from the results of the short-term evaluation. However, the usefulness of the advice may vary

over a long period, since the expert may have difficulty in providing continuous skincare advice based only on log data (pictures of the face and skin, cosmetic usages, amount of UV radiation and humidity, and simple comments from users) without face-to-face communication. Therefore, we sought to verify the long-term effectiveness of the remote skincare advice for subjects.

Second, we observed changes in subject behavior and skin condition to verify whether these changes were due to long-term remote skincare advice using life logs.

### 7.7.1 Part 1: Entrance Questionnaire

Subjects completed a questionnaire to collect basic demographic and skincare information i.e., their daily cosmetics (categories, names, and order to use), and impressions of face-to-face skincare advice. It was conducted at each subject's home, one participant at a time. This part familiarized us with the subjects' backgrounds, and helped us understand their everyday behavior toward skincare.

### 7.7.2 Part 2:Data Collection and Skincare Advice

Subjects logged data (close-up pictures of the skin, pictures of the face, amount of UV radiation, amount of humidity, and comments on skin problems and the work and home environment) every day, and sent these data all together to the expert once a week. The expert then wrote advice in a free format based on these data and sent the advice to the subjects within 24 hours.

The subjects took pictures of their faces and skin texture after washing their faces every night. Moreover, the subjects logged UV radiation and humidity manually using stand-alone sensors when they went outside/inside.

We performed this part with the Wizard of Oz method because it was difficult to install the current prototype systems into actual homes[13].

### 7.7.3 Part 3: Interviews

During the interview, subjects are asked for following three questions:

1. About the changes in their behavior during the evaluation

2. About impressions on the expert's advice

3. About impressions on the remote skincare advice.

And the expert is asked for the impressions and opinions about the remote skincare advice.

## 7.8 Results from the female subject

First, we summarize the results obtained from the female subject (Subject D).

### 7.8.1 Part 1

She received face-to-face skincare advice at regular intervals (once every four months), and used the skincare cosmetics recommended during the face-to-face advice. However, she could not manage to maintain proper use. And her complaint about the face-to-face skincare advice was that she could not ask advice when her skin became rough since she was busy at work in such situations.

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[13]    The subjects used USB cameras and USB microscopes connected with their PC to take pictures of their faces and skins. They also used existing measuring instruments of UV radiation and humidity.

### 7.8.2 Part 2

Throughout the evaluation period, the amount of UV radiation was almost zero and the amount of humidity was about 30% on average, because she worked inside every day. The expert evaluated the skin condition based on the pictures of her face and skin, then gave advice on the reason for her skin problems and proper skincare methods and cosmetics that may improve her skin condition.
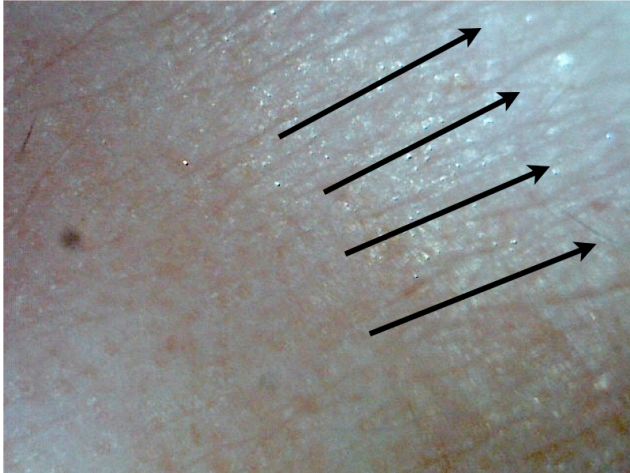


Fig. 9 Changes of Subject D's Skin texture

### Week 1

Figure 9 shows the skin texture of the subject during Week 1. She commented that she had a problem with partially dry skin during this week. She also mentioned that she got sunburned since she had worked outside for 2 weeks before the evaluation.

The expert pointed out that the lines in her skin flowed in one direction, dull skin around her mouth and sags around her chin. And she recommended skin-lightening cosmetics[14] to improve her skin condition and introduced proper use of cosmetics, and a web site that presented a facial massage technique via video to improve her skin.

### Week 2

Figure 10 shows the skin texture of the subject during Week 2. She also had a problem with dryness in Week 2. Further, the subject mentioned that she changed skincare cosmetics to those recommended and began using a bit of cotton wool on the third day.

The expert pointed out the expansion of the pores based on the skin pictures. To solve the problems of dry and enlarged pores, the expert advised her to continue to use the skincare techniques introduced in Week 1.

### Week 3

The subject was worried that her dry skin and little white pimples had not improved. She was also worried that her husband worked too hard.
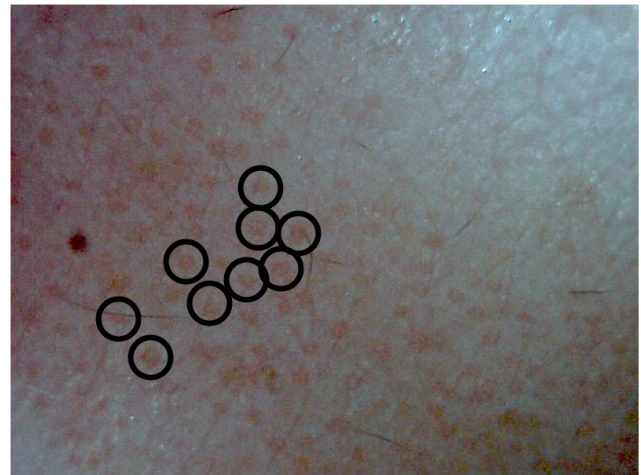


Fig. 10 Skin texture of the female subject during Week 2

The expert presumed that her pimples and dry skin were caused by PMS (Premenstrual Syndrome)[15] and persisted in spite of the change in cosmetics. According to the expert, during PMS the skin becomes dry easily, and the dry air of her working space was damaging her skin. The expert recommended her not to irritate the pimples because irritating them only worsens their condition. The expert also recommended that she use a humidifier to prevent her skin from becoming dry. The expert also introduced new skincare cosmetics with a relaxing aroma to ease her PMS-related stress.



Fig. 11 Skin texture of the female subject during Week 4

### Week 4

Figure 11 shows the skin texture of the subject during Week 4. The subject did not comment on any skin problems, and mentioned her menstrual period began on the third day. She also mentioned that she installed a humidifier in her office on the last day.

The expert mentioned that she could find triangle and diamond shapes in her skin, indicating that her skin condition was improved compared to that at the beginning of this evaluation. The expert did not make any mention her facial appearance. The expert indicated that the reasons for this improvement were her menstrual period and proper skincare. The expert recommended her to keep

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[14]A special cosmetic effective in whitening skin

[15]PMS: the uncomfortable physical and mental state for one or two weeks before the menstrual period begins.

using the current skincare techniques and to use milder cosmetics during her next PMS period.

### 7.8.3 Part 3

#### Changes in behavior

She mentioned that she began to look at herself in the mirror more often, and to apply skincare carefully. In addition to these, she mentioned that she noticed skin problems that she had not seen before. Moreover, she gradually stopped sleeping before taking off her makeup no matter how tired she was.

#### Impressions on the expert's advice

She mentioned that most pieces of advice were convincing: they were easy to understand because of the expert's use of similes and metaphors. And she got a lot of new information about skincare. Moreover, she mentioned that the remote advice was more believable than face-to-face advice because she did not feel the expert was forcing her to buy new cosmetics.

#### Impressions on the remote skincare advice

She mentioned that the remote skincare advice is useful because she could look at the advice over again since it is saved on the computer and she could get the expert's advice any time she wanted.

### 7.8.4 Consideration of the female subject

In Week 1, the lines in her skin texture were quite shallow and flowed in one direction. Although these problems were little improved in Week 2, her pores were enlarged. By the fourth week, although the lines in her skin were still shallow, we could find triangle and diamond shapes in her skin, indicating her skin condition had improved.

Based on these comments about changes in her behavior during the evaluation, it appears that she became more interested in her skin condition and proper skincare methods. Moreover, she began to act on the expert's advice: she bought the new skincare cosmetics and started to apply cosmetics using a bit of cotton wool.

Besides these, based on her comments about the expert's advice, it appears that the advice was useful for her.

## 7.9 Results and consideration of the male subject

### 7.9.1 Part 1

He had not applied skincare cosmetics before. Moreover, he had never been interested in skincare. Of course, he had never used face-to-face skincare advice, because he felt embarrassed about asking skincare advice at cosmetic stores.

### 7.9.2 Part 2

Throughout the evaluation period, the amount of UV radiation was almost zero and the amount of humidity was about 30% on average, because he worked inside every day.

Figure 12 shows changes observed in the subject's face observed over the evaluation period.

In Week 1, the expert recommended him to use a night cream for his skin problem around his nose; that is, his skin peeled due to dryness. In the Week 2, he had not yet started to use night creams and, of course, his dry skin had not improved. The expert introduced a specific night cream, and explained its effect and use. In Week 3, he finally started to use the night cream. As a result, his dry skin improved significantly in Week 4, with the skin

around his nose no longer peeling, and his facial appearance was totally improved.
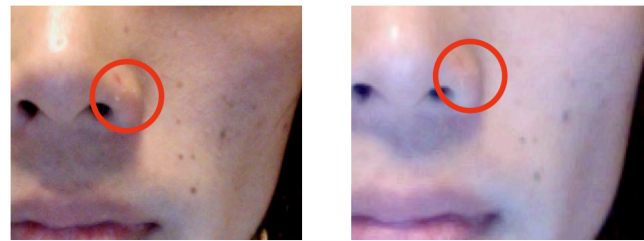


| the first week | the fourth week |

Fig. 12 Changes in the face of the male subject

### 7.9.3 Part 3

He mentioned that the advice was persuasive and motivated him. And he felt happy since the dry skin was quickly improved by the recommended skincare techniques.

Thus, the male subject also felt that the remote skincare advice was quite useful. We confirmed our approach was useful not only for skincare-oriented women, but also for skincare beginners.

## 7.10 Results and consideration of the skincare expert

The impressions and opinions of the expert were revealed as follows:

- I could identify even small changes in the skin condition since the pictures and other data were logged every day.

- For users who applied some kind of skincare product every day, like the female subject, the daily log data were quite useful to identify the causes of skin problems.

- For users who seldom applied skincare products, like the male subject, less log data (e.g., one a week) were enough for advice, since the skin condition of these users is definitely bad.

- I could give proper advice to each subject.

- For regular customers, I would like daily data regarding sleeping hours and basal body temperature[16] to give more appropriate advice.

According to these opinions, the five life logs (close-up skin pictures, face pictures, cosmetic usage, UV radiation, and humidity) were sufficient for the expert to give proper advice even over a long period.

## 8. discussion

According to both subjects' impressions of the expert's advice and changes in skin condition, the advice given to the subjects was useful. In other words, the expert could offer useful advice on the basis of life logs (pictures of the face, close-up pictures of skin texture, cosmetics usage, amount of UV radiation, and amount of humidity) and comments from participants instead of direct examination of the skin. Based on the change in the female subject's behavior, this system improves the sense of beauty in users who apply some kind of skincare product every day. Meanwhile, according to the change in the male subject's behavior, this system gives an opportunity to users to start skincare for those

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[16]Only for women.

who do not like face-to-face skincare advice. And according to the female subject's impressions on the remote skincare advice, it is easier to use than face-to-face skincare advice.

Thus, we confirmed that the concept of this system –remote skincare advice using life logs– is effective for long-term skincare.

On the other hand, both subjects mentioned that:

- *I grew tired of logging the amount of UV radiation and humidity.*
- *I also grew tired of taking pictures of my face and skin using the PC every day.*

As mentioned above, we did not use the prototype systems in this long-term evaluation. However, according to the short-term evaluations, the difficulty in taking pictures and logging the amount of UV radiation and humidity is reduced by using the SSD and SSC systems.

We also noted the importance of data regarding basal body temperature and sleeping hours for regular customers. The result of these evaluations showed that comments on skin problems are an important element of appropriate advice. Therefore, we plan to develop an input method to allow comments to be written more easily in the SSD. For example, when users write comments with mobile phones and upload them to the SSA, the system automatically integrates the comments and log data using a timestamp.

Thus, according to both the short-term long-term evaluations, users can easily obtain proper skincare advice from experts using "Remote Skincare Advice System Using Life Logs".

## 9. Related works

SenseCam [1] proposed a new camera that automatically takes pictures at regular intervals. Users can easily take pictures continuously simply by wearing the device around their necks. Our approach is unique in proposing a practical application using life logs; that is, that users can obtain skincare advice from the experts by sharing log data.

Hiraishi et al. [2] proposed a system that aimed to support the home selling of cosmetics. The system automatically evaluates skin textures by taking close-up pictures of the skin using camera-equipped mobile phones. In contrast, our system focused on more proper advice by skincare experts based on a variety of data including the amount of UV radiation and humidity as well as cosmetics usage.

There have also been several research projects that aimed at supporting healthcare using life logs. ReMoteCare [3] proposed a system that could monitor patients in hospitals using various sensors and cameras. Sand-Hyn Kim et al. [4] proposed a system that could support healthcare using wearable sensors. Peom Park et al. [5] proposed a system that aimed to offer healthcare advice based on vital data such as height, weight, blood pressure, and body temperature. Suomi et al. proposed a system that aimed to support healthcare with a web-based application [6]. Meanwhile, our system focus on offering proper skincare advice using specific life logs suited for skincare.

Yamazaki et al. [7] proposed a novel technique for the automatic evaluation of skin. Whereas this study focused on the analyses of skin texture, our system aims to support skincare by integrating a variety of life logs related to skin condition.

Smart Makeup Mirror [8] proposed a digital mirror that could help users to apply make up more easily. However, our system focuses on offering proper skincare advice by logging data related to skin condition and sharing them with skincare experts.

"Bihada Kantei" was a product that could automatically provide simple advice based on the measurement of skin moisture [9]. Our system focuses on more practical advice by skincare experts using a variety of life logs. We also plan to develop automatic recommendation functions based on stocks of advice from skincare experts.

## 10. Conclusion

We proposed a remote skincare advice system using life logs, called Smart Skincare System. The Smart Skincare System helps users automatically log information related to their skin condition and share these data with skincare experts in order to obtain appropriate advice. We built prototype SSD, SSC, and SSA systems and confirmed the effectiveness of our research through two types of evaluation.

We are planning to perform a long-term evaluation using the prototype systems, as well as develop devices for measuring body temperature and sleeping hours.

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