Design and Implementation of a Cognitive User-Support System for Skin Progress Analysis Using a Smart Phone

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ABSTRACT

In this study, the authors design a user-support system employing a smart phone for skin progress analysis. The authors’ proposed system seeks to provide user support for a skin diagnostic service employing a smart phone’s camera, with the user’s photograph of a skin image and continuous diagnosis of the photographed area. The cognitive user-support module recognizes the processing and the user operation of the smart phone, and transmits advice on the operation to the user in real time, via voice or text messages. In addition, the cognitive user-support module can recommend contents suitable for the user, based on the user’s past situation. In the skin diagnostic service, the authors’ system provides the user with auto photography when the picture is taken, by recognizing the user’s situation and guiding the user via voice or text message. The authors’ system can recommend the skin area that was used for the last diagnostic service in order to perform continuous skin diagnosis. Using the authors’ system, the user can easily take a suitable skin picture and observe the skin care progress, so that in an esthetic room, the user and beauty therapist can verify the esthetic effect by viewing the pictures taken before and after treatment.

Keywords: Skin Diagnostic, Skin Picture, Smart Phone, Text Message, User-Support System, Voice Message

1. INTRODUCTION

In recent years, skin-care services (e.g., esthetic rooms) have rapidly expanded in the world market, targeting both women’s and men’s services, especially in Japan. The number of esthetic businesses was 5,877 (with 23,944 beauty therapists) in 2002 (Ministry of Economy, Trade and Industry, Japan, 2002), and that number continues to increase with growing demand (Yoon, 2009). Recently, facial esthetics (service that carries out the pore of a face, whitening, and the...
care to aging) has attracted much attention; however, exploitation of this new demand is also advanced. Cosmetics services, such as those offered by esthetic businesses, are rapidly developing. However, no related laws have been passed in Japan, no four-year university exists and almost no scientific research on the subject is available (Yoon, 2009). Therefore, customers themselves must judge the quality of esthetic services and beauty therapists.

In this study, we design a system that can verify the esthetic effect of the skin state before and after esthetic service, applying skin diagnosis using a cellular phone (Hiraishi & Mizoguchi, 2003). We use smart phones or tablet-type smart phones to take skin pictures. Although skin diagnostic services using cellular phones or smart phones are already used (Hiraishi & Mizoguchi, 2003; Nishiyama & Mizoguchi, 2011) it is difficult to photograph one’s own skin using the camera function. In addition, even if the photography is successful, it is impossible to carry out continuous skin diagnosis of the same skin area because the areas of photographed skin differ. Although many studies have been conducted in an attempt to solve these user-interface problems (Lazar, Feng, & Hochheiser, 2010; Moggidge, 2006; Norman & Dunaeff, 1993), it has been difficult to solve such problems with software improvement. Our system utilizes a cognitive user-support module that can automate the photography of a skin area and enables continuous skin diagnosis of the same skin area using the sensors of a smart phone. The cognitive user-support module recognizes the processing and the user operation of the smart phone and transmits advice on the operation to the user in real time, using voice or text messages. In addition, the cognitive user-support module can recommend contents suitable for the user, based on the user’s past situation. In our study, we define such service by recognizing the user’s situation and the user’s past situation as “cognitive user-support” in Cognitive Infomatics (CI). Our system recognizes the user’s state using input information that includes the visual data from the camera sensor, the data from an acceleration sensor, and the log data of the user’s skin diagnostic history. Using a voice message, it advises the user to rectify the position of the smart phone in order to photograph a suitable skin area, by recognizing the position of the user’s face from the camera sensor’s visual input. Our system takes a photograph automatically when it judges that a suitable skin image can be produced. It then recommends the skin area that was used for the last diagnostic service. As a result, the user only gazes at the smart phone and can receive continuous skin diagnostic service. Thus, in the esthetic room, if a tablet-type smart phone is used instead of a mirror, the user and the beauty therapist can evaluate whether the skin has improved, by viewing pictures taken before and after esthetic treatment.

2. SKIN DIAGNOSTIC SERVICE USING THE SMART PHONE

Esthetic rooms have introduced some skin diagnosis systems using cameras. However, these systems need specific camera devices. In contrast, our service requires only a cellular phone with a camera (Hiraishi & Mizoguchi, 2003). In our study, we propose cognitive user support using a smart phone to enable the maximum use of this service.

2.1. Smart Phone

In our study, the smart phone (Android) is a Samsung Galaxy Nexus SC-04D. The performance of this smart phone is summarized as follows (from a NTT DOCOMO press release).

- **OS:** Android 4.0
- **CPU:** OMAP4460 1.2GHz Dual Core
- **Communication Facility:** Wireless LAN, Bluetooth, HSDPA/DSUPA
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