

A Study on the User Interface Environment for Digital Home Service Applying Emotional Convergence Technology

Eun Young Park, In Soo Lee, Min Sun Kim, Beom Soo Lee, and Woong-Hee Shon

Abstract—The digital home service proposed here is intended to implement an emotional interface in relation to each user's condition by applying living-related convergence technology including IT, BT, electronics and architecture to the residential environment. The digital home service system operates in the order of information recognition, signal transmission, integrated control, expression. We have implemented a system that works with the concept step by step weight forest, the sea, healing, depending on the body weight of the signal. To find out user preferences for the proposed system, a demonstration setting was installed. A questionnaire survey was conducted with 300 participants in the setting. The survey results showed user satisfaction was high in the order of lighting, sound, vibration. The user recognition sensing, systerior and LED/optical fiber emotional lighting system are integrated into the proposed digital home service. The emotion-oriented customized service based on the information of user condition allows users to control their surroundings at their own discretion. And this study implemented the service infra capable of accommodating user preferences with the convergence of heterogeneous technologies and industries in a relatively less objective field of emotion, which is prone to individual differences.

Index Terms—Emotional convergence technology, digital home service, user interface, system interior, interaction.

I. INTRODUCTION

Korean industry used to value production growth, functionalism and quality improvement in the course of fast-paced economic development in the past. However, the paradigm has shifted towards person-centeredness emphasizing emotion and art in modern times. In the 1970s~90s, consumers preferred simple, uniform and new products with high performance and tended to purchase goods based on price, quality, small size and high performance, whilst companies established systems capable of mass production and development of cutting-edge technology. In the 2000s, with the emerging trend of customized emotional products focused on technology plus emotion, consumers turned to differentiation and emotional propensity, preferring design, eco-friendliness and attractive images. Accordingly, companies formed a new market focusing on developing the convergence technology capturing customer emotions. The age of emotion commenced against the backdrop of the shift of market environment from suppliers to consumers. The shift

toward consumer-oriented market reflected the strong propensity of consumers to choose products meeting their emotional needs in terms of design, tactility and user interfaces [1]. To implement user interface services, emotional recognition technology is indispensable. Emotional recognition refers to using machine to identify human emotions. Emotional recognition is a highly important technology in business, science and engineering application.

In this context, the present study focuses on user-centered communication features via interface interactions between peripheral devices and users, and digital home services applying emotional convergence technology including biometrics, sensor networks, system interior and emotional lighting system.

In this article, Section II deals with previous studies on digital home services and emotional recognition technology. Section III schematizes the concept of digital home services and defines each of component technologies implemented. Section IV describes the implementation and results of digital home service system. Section V discusses the findings, implications and suggestions for future studies.

II. THEORETICAL CONSIDERATION

In the 21st century when diversity is acknowledged and demanded, cultural values increase whilst emotion and expression being valued. In this vein, it is important to analyse lifestyles and to read cultural codes of users. The essential components in pursuit of customer-oriented values include emotion, expression, culture, identity, diversity, sympathy, communication, interactive interface, new technology, space environment and users [2]. In the field of home service and interior, not only digital service provision through an indoor inter-device network but also the service meeting the demand for more agreeable and psychologically comfort housing environment capable of flexibly responding to residents' psychology or behaviour [3] tends to grow. In future-oriented housing environment, interactions between residents and peripheral devices are becoming ever more important with user-centered communication features being stressed. In this regard, this study is to review the literature on emotional recognition, system/infra and digital service.

Concerning the emotional recognition, Lee & Kwon (2005) [4] set up a multi-dimensional module design (3D structures of floors, walls and ceilings are used and applied in design process, reflecting residents' demands) in line with emotional information system mirroring residents' lifecycles and lifestyles by constructing space in accordance with residents'

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behaviour/psychological changes and by selecting specific component materials based on residents' emotional information. As for the emotional measurements, physiological measurement includes EEG, ECG, EMG and EOG, while psychological measurement includes SD technique, comparison method and differentiation. Physical measurement involves thermal environment, light environment and sound environment. Also, Kwon & Jung(2011) [5] developed an emotional lighting system capable of controlling the LED colors according to emotional quotients based on multi-modal environment of mixed approaches encompassing image, voice and biometric signals to recognize the emotions of users.

From the perspective of system/infra, modular construction refers to a construction method of delivering factory-produced modular units to a site for assembly and completion [6]. That is, modular construction means reconstructing new styles with free modular replacement of a part, not a whole, without affecting the rest of the system [6]. As it is possible to diversify each modular combination for a transformation into a new style, modular construction is characterized by multi-functionality and practicality. The proposed system (system + interior) here is a method of modularized system for interior production, where the system is incorporated in interior walls.

Recently, LED lighting of emotional lighting system has gradually been used as so-called 'emotional or well-being' lighting, apart from a simple function of illumination, using various characteristics of light, which affects human visual and non-visual experiences [7]. This study attempted to use LED lighting for the production of user-centered emotions and in a concept of healing for entertainment purposes [8]. It aimed to create an organic network using a smart device or communication technology and produce a surrounding entertainment by implementing a system that can control the user in terms of communion of the user's emotions.

III. APPLIED TECHNOLOGY

A. Digital Home Service

The digital home service proposed here is intended to implement an emotional interface in relation to each user's condition by applying living-related convergence technology including IT, BT, electronics and architecture to the residential environment. The conventional interior space comprising lightings, cameras, electronic appliances and furniture is connected to a communication network to make a home network system providing diverse services, which is in turn integrated with the interior so as to implement the interface that enables user-centered communication, allowing users to change lightings, lights and colors in accordance with their needs. The interface can control overall interior environment including interior lights, colors, temperature, humidity, switching on/off, security and energy saving. Moreover, customized services are available such as emergency information transmission, health care, emotional engagement service and healing service based on user condition information collected through a range of sensing including bio-data, motion and temperature. Fig. 1 is a

diagram of digital home services.

B. Emotional Recognition Technology

Emotional recognition technology processes and corrects signals, e.g. biometric and environmental signals, to recognize, verify and standardize human emotions as information, underlying the provision of human emotion-based living convergence goods and services [1].

This study intends to provide customized services recognizing user condition information by focusing on body weights and making up scenarios of interactions between users and surroundings.

The weight of a person can be tailored for each family member, and a scenario can be composed depending on each member's preference for an indoor environment, which can change the surrounding environment. For example, if the father sits on the couch after work in the evening, his weight is detected, and ambient lighting and sound are expressed as he set in advance. In addition, if a 10-year-old son sits on the sofa, his weight is identified and an appropriate program set for him is operated.

Sensing human weights can be measured by a load sensor (see Fig. 2). The circuit was configured by setting up different stages in line with different weights, so that weight signals in each stage can be transmitted to the controller. Also, each different scenario for each stage leads to a different expression of lighting, sound and screen. That is, a user can make up a scenario to control the surroundings at will.

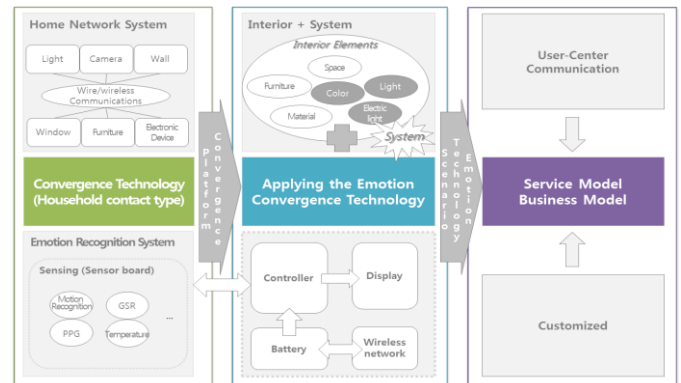


Fig. 1. Digital home services applying emotional convergence technologies.

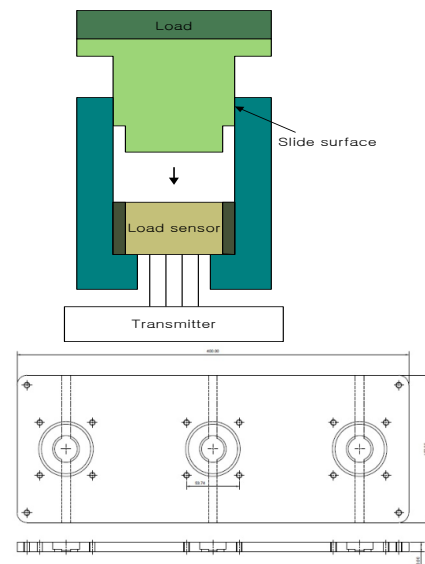


Fig. 2. A load sensing device concept and a prototype.

C. Systerior

Home network system makes use of ubiquitous technology, allowing interior peripheral devices to interact with users in various ways, where the user interface controls appliances (doors, windows, telephones, heating/cooling, lighting and video cameras) based on the sensor-collected information of temperature, light, wind and gas, the expression on terminals, the sensing of user actions and conditions and other information recognized [9].

The present study employs a concept of systerior (system +interior) (see Fig. 3) [10] where communication, wires and other infra system are inserted into walls, with a view to implementing a user interface environment for the aforementioned digital home service system that enables users to interact with appliances and interior. Systerior is an eco-friendly interior with sensing, communication and controlling features incorporated in modular walls which are ready for assembly. The separate modular walls are constructed in the order of ‘top and bottom of the rail → installation of top and bottom moldings → attachment of high-tension magnets’. Electric wires are placed inside the steel structures, enabling the entire system to be controlled by one power supply. Optional systerior modules include touch pads and lamp mirrors, which can be mounted on the wall modules and applied to study rooms, studios, office-tel units and hotel guest rooms.



Fig. 3. Systerior's components.

D. Emotional Lighting System

Emotional lighting refers to the lighting technology that can change spatial ambience by matching the temperature and brightness of colors from lighting fixtures to human psychological conditions and biorhythms [10]. The latest lighting items go beyond their primary goal of lighting up the darkness to the extent that the intensity and color of lights can be controlled in combination with air purification, color therapy and healing effects, which trend is led by products designed to stimulate emotions. To create the emotional effects of cosy and soft ambience with subdued lights which can be seen in indirect lighting, firstly, lighting products are developed using fiber materials, and secondly, the colors, brightness and switching on/off can be controlled at users' disposal with system interior products. Such system lighting based on the convergence of IT and LED provides not only diverse services such as monitoring, integrated management,

sensor linkage and customized situational management but also eco-friendliness with 50% energy saving. This study is to design various optical fiber wallpapers (see Fig. 4) with light emitting + weaving following optical fiber fabrication, as well as the LED system that varies with users.

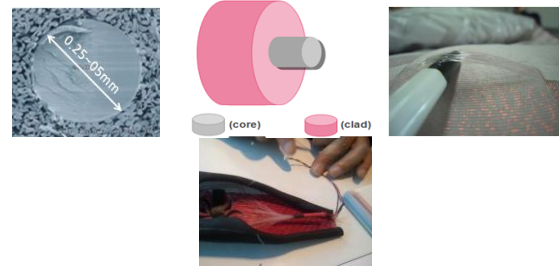


Fig. 4. A fiber optics structure and a fiber optics fabric.

IV. SYSTEM IMPLEMENTATION AND RESULTS

A. System Configuration

The digital home service system operates in the order of ‘information recognition → signal transmission → control → expression’. Information is recognized through the load sensor that reacts to body pressure, whilst the signal information is transmitted to the controller through the sensor network, which is a wired/wireless communication module. The controller sends out expression signals so that lighting and sound can vary with the scenario for each weight stage. The user interface is designed to serve as a mediator [9] controlling the lighting and sound on PCs and mobile terminals. Fig. 5 shows a flow of “Digital home service’s technology”.

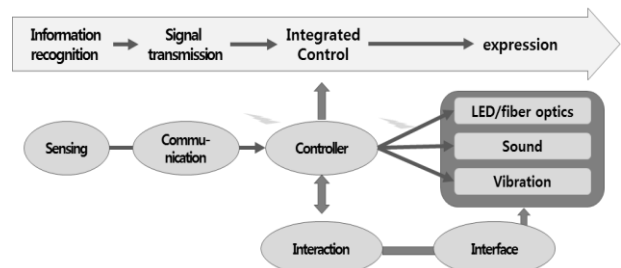


Fig. 5. A digital home service technology's concept.

B. Results

The interface environment implemented here maintains optimal conditions for each user through the interactions between users and interior environment by integrating emotional lighting with changing colors and brightness (LED), optical fiber wallpapers and sounds. Three scenarios were made up based on different body weights with the intention of producing composure, calmness and healing concepts (see Fig. 6). Three scenarios were made up based on different body weights with the intention of producing composure, calmness and healing concepts. To give psychological composure, the image of green forest is implemented by visualizing a forest background on the screen with green general lighting and bird-chirping sounds. For psychological calmness, the image of a blue ocean is built by visualizing the oceanic background on the screen with blue general lighting and the sound of the waves. Finally, to maximize the healing

effects and psychological composure, a peaceful and leisurely scene is visualized on the screen with violet general lighting and classical sound effects.

To find out user preferences for the proposed sound, lighting and vibration services, a demonstration setting was installed. Then, a questionnaire survey was conducted with 300 participants in the setting. Excluding 16 copies of incomplete or negligent responses, a total of 284 copies were analysed. Each question item was rated on a single balanced 5-point Likert scale. The responses were collected anonymously. The survey results showed user satisfaction was high in the order of lighting → sound → vibration, where the reusing rates were expected to be high.

Further studies need to select subjects with more diverse demographics, obtain a sample including different classes and investigate factors affecting the intention to accept services based on user characteristics. Also, development of user interaction services, system implementation and component technology development need be explored.

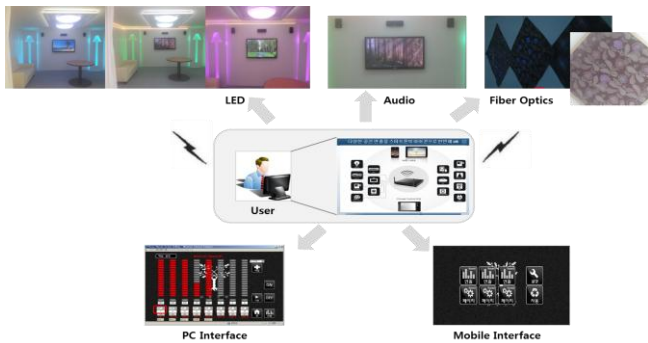


Fig. 6. Implementation results.

V. CONCLUSION

The user recognition sensing, systerior and LED/optical fiber emotional lighting system are integrated into the proposed digital home service. To monitor and control the proposed digital home service, user interfaces need be implemented on PCs and mobile terminals, enabling users to interact with the lighting, interior and other peripheral devices.

The emotion-oriented customized service based on the information of user condition allows users to control their surroundings at their own discretion, which suggests that diverse services can be derived from interactions between users and peripheral appliances. In addition, this study implemented the service infra capable of accommodating user preferences with the convergence of heterogeneous technologies and industries in a relatively less objective field of emotion, which is prone to individual differences.

More human-oriented interactions will require developing services from diverse perspectives based on broad

understanding and application of human behaviour and psychology, convergence of IT and other technologies and empirical findings in lieu of being limited to emotion.

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