The Exploratory Study for the Psychological Perception and User Attitude toward the Add-on Devices for the Elderly

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Abstract: As the rising proportion of elderly in society, utilizing personal computing devices should be fundamental application to assist health management for the aged people. The common solutions proposed by related projects have been always wearable personal computing, applying add-on devices on the outlook of the users, and result in the mental awkwardness or discomfort while wearing in the public area. The main objectives of this study are to explore the elderly's psychological perception and user attitude toward smart wearable system, and then to propose design guidelines and directions for further product development.

In this study, three different types of personal monitoring devices are investigated - the devices attached to the wrist, upper arm, and the neck. The subjects are asked to wear the three devices for ten minutes in the public area, and then accept the questionnaire interview. The subjects' opinions are collected and analyzed. The result does show the differences of the elderly's attitude between three types of add-on smart wearable system. The opinions collected from this survey are valuable, and can provide the design guidelines and directions for further product development.

Keywords: Smart Wearable System, Elderly, Design guidelines

1. Introduction

As the rising proportion of elderly in society, utilizing personal computing devices should be fundamental application to assist health management for the aged people. Most of the interaction interface, created by current devices, is focused on the passive guiding assistance for the users, but not intelligent enough to predict the user needs. To enhance the interaction and connection anytime and anywhere, the real-time monitoring for physiological signals is a crucial key to create a considerate and thoughtful interaction for the Elderly. To record this signal, an add-on device, including an electric board with wireless transceiver and sensor components, as well as battery module, must be attached to human body. This device contains certain physical volume and can be visible. The common solutions proposed by related projects have been always wearable personal computing, applying add-on devices on the outlook of the users, and result in the mental awkwardness or discomfort while wearing in the public area. To explore the psychological perception and user attitude toward the add-on devices

for the elderly, the research problems are listed as following:

1) Do personal attributes of the elderly affect the psychological perception and user attitude toward smart wearable system?
2) Do the wearing positions of smart wearable system attached to the elderly's body affect the degree of acceptance and user attitude?
3) What are the elderly's expectations for smart wearable system?

2. Literature review

As the improvement of technology, Telecare can perform more sophisticated and better physical examination remotely for the elderly without going to hospital. It can also issue the alarm and prevent unexpected accident. Furthermore, fragmented and inefficient service might always be the enormous issues of home care [1]. LeRouge claimed that the impacts of Telecare can be divided into three dimensional levels: Health Infrastructure, System Structure, and Patient Service. It can be the outcome or process of Social-Technical integration, accomplish the control of the health care resources, and reduce the expense of health care [2].

"Aging in place" Strategy is welcomed and encouraged by the government, as well as the Long-term Care System. The strategy was established originally on northern Europe, to avoid the restricted activities of daily livings and the lack of privacy in Elderly Caring and Nursing institute. "Aging in place" encourages the elderly to reside at their own home in the aging process [3]. Lee and Kuo stated that, with the increase of the economic ability and understanding about elderly care, more elderly people have stronger will to stay at home, and can afford the home care service to maintain their dignity, privacy, and quality of life independently [4].

As applied in early stage, health technology can help to delay the aging process, and increase the quality of life and the independence of elderly, as well as to help reducing the cost of social care [5]. Some research also proves that health-monitoring technology is beneficial to decrease the hospitalization and death rate, improve the spiritual life, and cultivate healthier lifestyle for the elderly [6, 7].

To accomplish these achievements of Preventive Care, Smart Wearable System, integrated with wireless technology and information management, should be applied to acquire the physiology data and monitor the health conditions of the elderly anytime and anywhere [8].

This study assumes that, for monitoring the physical data, the elderly have to wear add-on device all day on visible position of their body. Can they accept to wear this device in daily exercise in public area? How much will they care about their detailed difference of outlook by wearing this?

Supportive devices can help individuals to increase their independence. But if the user need is not satisfied, it might results in high rate of abandonment of supportive devices, and causes negative psychological impact to users. Many researches indicated that understanding the importance of social and cultural psychology of the elderly is more important than designing a product itself.

3. Methods

3.1 Research Framework and Process

After defining the research problems and purposes, literature review focus on the study of phenomenon of

aging in place, physiological and psychological change of the elderly, and the mental acceptance to smart wearable technology. After that, the research framework is constructed, and the pilot questionnaire is designed and tested to revise the final questionnaire. Finally, the subjects' opinions are collected and analyzed. The results and suggestions are then proposed.

To ensure the successful data collection, following experiment process is designed:

1) In the beginning, researchers explain the research background and purpose, obtain the subjects' agreement, and then proceed the main experiment.
2) Subjects answer the basic information in the first section of questionnaire.
3) Subjects are asked to wear three different smart wearable systems in the public area for about 10 minutes.
4) Subjects are asked to answer the questionnaire with 7-point Likert Scale interview.
5) Finally, researchers perform open-ended interview to subjects to collect the elderly's opinions and suggestions.

3.2 Questionnaire Design

The questionnaire includes three sections: 1) The basic information- participant's age, gender, educational level, experience of using smart phones, the requirement of recording physiological data, and the need of visiting the hospital regularly for health examination. 2) The 7-point Likert Scale- to collect the elderly's physiological data, psychological perception, and reading usability toward smart wearable system；3) Apply open-ended interview- for collecting the elderly's opinions and suggestions for smart wearable system.

This main purpose of this study is to compare the differences of personal attributes effect on elderly's psychological perception in three parts of device, and the differences of personal attributes effect on the comfort of wearable and convenience in wearable. The 7-point Likert Scale questionnaire is designed based on the six groups of metrics, measuring the physiological and psychological Comfort Rating Scale, proposed by Knight and Baber [7]. They applied Affinity Diagram and MDS (Multi-Dimensional Scaling) to construct the Comfort Rating Scale, including the Emotions and Anxiety for psychological metric; Attachment, Harm, Perceived change, and Movement for physiological metric.

This questionnaire also collects the usability of smart wearable devices with three attached positions on human body. The readability and accessibility of these devices are compared.

3.3 Subjects & Stimulus

1) Subjects:

The subjects are 50 to 65 years old in Miaoli area, Taiwan, without the mental and physical illness. They can speak Chinese and Taiwanese for daily communication fluently, and all have self-care ability.

2) Stimulus:

To avoid the interference of color and style preference, the stimuli (Figure 1) are designed as the black and white paper boxes with simplified form. The dimension is decided by the average size (115.2 x 58.6 x 9.3 mm) of popular mobile devices (3.7-inch Touch Screen Smartphone) and the detail suggestions by Lin & Lee [4,6].

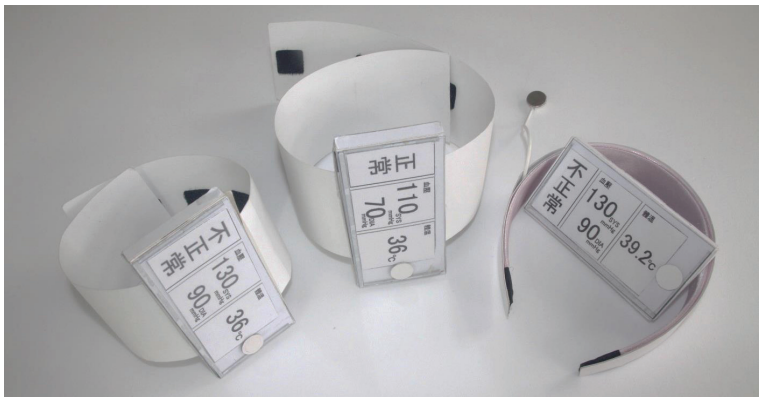

Figure 1. Stimulus - black and white paper boxes with simplified form

4. Results and Discussions

The basic information of the subjects show that they are all older than 50 years, and 79% of them are older than 65 years. 43% of subjects are male, and 57%, female. 21% of subjects have the experience of using smart phone. After comparing the devices attached to the three positions of human body, following are the result summary of the questionnaire, including Gender Difference (Table 1), Smart Phones Experience (Table 2), Recording Requirement of Physiological Data (Table 3), and Visiting Requirement to Hospital (Table 4):

Table 1. The result summary of the questionnaire - Gender Difference

Willingness of showing device	1. Male subjects show higher willingness to exhibit wrist device, but lower to neck device. 2. Female subjects show less willingness to exhibit any of the three types of devices.
Oddness	1. Male subjects feel oddness with wearing devices on arm and neck. 2. Female feel less oddness with neck device. 3. Overall, female feel less oddness than male with all types of devices.
Fear of Others' Negative Reaction	1. Male subjects fear of society's negative reaction with all types of devices. 2. Overall, female subjects fear less society's negative reaction than male with all types of devices.
Anxiety	1. Male subjects show strongest anxious with neck device. 2. Female subjects feel less anxiety with wrist device.

To summarize the attitude differences by gender factor, both sexes have the highest acceptance to wrist device, and the lowest, neck device. Female subjects perceive more positive image to the smart wearable system than male subjects do.

Table 2. The result summary of the questionnaire - Smart Phones Experience (The effects of subjects' experience with using smart phones)

Willingness of showing device	1. Wrist device gains the highest willingness degree to exhibit by experienced smart phone users. 2. Neck device gains the less willingness degree to exhibit by inexperienced smart phone users. 3. Overall, the experienced smart phone users show higher willingness of exhibiting all types of attached devices.
Oddness	1. All subjects feel less oddness with wrist device 2. But smart phone users feel higher oddness with arm and neck device.
Fear of Others' Negative Reaction	Inexperienced smart phone users fear less of others' negative reaction with wrist / arm device.
Anxiety	1. Smart phone users are less anxious with wrist device, but higher with arm and neck device. 2. Inexperienced smart phone users show most anxious with neck device.

To summarize the Smart Phones Experience factor, it can conclude that smart phone users show higher acceptance to wrist device, but less to neck device. Inexperienced smart phone users perceive more positive image with arm device.

Table 3. The result summary of the questionnaire – Recording Requirement of Physiological Data (subjects' requirement of recording physiological data regularly)

Willingness of showing device	1. Subjects with the need of recording physiological data regularly show highest willingness to exhibit the wrist devices. 2. Subjects without the need of recording data show least willingness to exhibit the neck devices. 3. Subjects with the need of recording physiological data regularly show higher willingness to wear all types of devices.
Oddness	1. Subjects without the need of recording data show less oddness feeling to wrist device, but feel highest oddness with neck device 2. Subjects with the need of recording data show less oddness feeling to neck device.
Fear of Others' Negative Reaction	1. Subjects with the need of recording data wearing the neck device fear less of society's reaction. 2. Subjects without the need of recording data wearing the neck device worry most of society's negative reaction.
Anxiety	Subjects without the need of recording data feel highest Anxiety about wearing the neck device, but less anxiousity, the wrist device.

To summarize the factor above, subjects with the need of recording data show higher acceptance to wrist device, and perceive less negative image to the neck device. Subjects without the need of recording data show higher acceptance to wrist device, but against to the neck device.

Table 4. The result summary of the questionnaire - Visiting Requirement to Hospital (the need of visiting the hospital regularly for follow-up health examination)

Willingness of showing device	1. The subjects with visiting requirement to hospital show the highest willingness to exhibit wrist device. 2. The subjects without visiting requirement to hospital show the least willingness to exhibit wrist device.
Oddness	1. The subjects with visiting requirement to hospital feel less oddness for wearing wrist device. 2. The subjects without visiting requirement to hospital feel oddness for wearing all types of devices.
Fear of Others' Negative Reaction	1. The subjects with visiting requirement to hospital fear less of others' negative reaction for wearing wrist device. 2. The subjects without visiting requirement to hospital fear of others' reaction for wearing all types of devices.
Anxiety	1. The subjects with visiting requirement to hospital feel less anxiety for wearing wrist device, but higher anxiety for neck device. 2. The subjects without visiting requirement to hospital feel anxiety for wearing all types of devices.

To summarize the factor above, the subjects without visiting requirement to hospital show fewer acceptances to all types of devices, and tend to perceive negative image with the devices.

To conclude the results of four groups of questionnaire, comparing the device attached to the three positions with Likert scale for psychological perception, the wrist device gains the highest acceptance rates. On the contrary, neck device the lowest rats. Subjects feel oddness with wearing neck devices, but less oddness to wiest devices. Wearing the neck device make subjects feel anxiety and fear of others' negative reaction, but less for wiest device. For physical comfortableness, neck device occurs the most uncomforting and disturbance, and is noticed its existence occasionally. For readability, wrist is better than neck, and then wrist.

5. Conclusions and Suggestions

Most of the subjects in this study do not live with their child/children, and have some chronic diseases such as hypertension or diabetes. The main reason why they welcome this device is its function for informing their family about the health condition, easing off the children's worry to their parents. With positive attitude, the subjects look forward to these devices in the market in the near future.

The results show that, for all subjects with different individual attributes, the wrist device gains the highest acceptance rates. According to semi-structured interview, the subjects stated that the image of wrist device is similar to accessories such as watch or bracelet for daily life. For the other two positions, the subjects claim that the arm device is not easy to read, and interfere with putting on or taking off the clothes. For this reason, the arm device is less welcomed than wrist device. For the device attached to the neck, the subjects show opposite opinions. Some of them said its image is easy to be associated with negative objects such as dog collar. Comparing with female subjects, male subjects' tendency of rejection to this device is more obvious. By contrast, the other subjects stated that they can accept the device attached to the neck because of its sensor functions for detecting comprehensive physiology data. One of the subjects prefers the function for brainwave monitoring, because of her previous cerebral disease. Some subjects suggested that, because these devices need to be attached on the body for a long time, the volume of these devices can be reduced, or might be hid under the clothes, and should be better have the function of waterproof and dirt-proof.

In addition, the size is found to be the important factor for wearable devices. Most of subjects stated that the stimulus is too large, but for the benefit of health, they can compromise the available sizes. Elderly needs a large screen for better information presentation, but a compact device for portability. In the future, the balance between these two factors is hoped to be achieved.

The result does show the differences of the elderly's attitude between three types of add-on smart wearable system. The opinions collected from this survey are valuable, and can provide the design guidelines and directions to inspire designers for further product development. If the schedule, the numbers of subjects, and the adequacies and representative of stimulus can be improved, this research can obtain more useful and in-depth knowledge and experience for further research in the future.

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