

Improving the Elder's Quality of Life with Smart Television Based Services

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Abstract—The increasing number of senior population gradually causes to demand the use of information and communication technology for their satisfactory lives. This paper presents the development of an integrated TV based system which offers an opportunity to provide value added services to a large number of elderly citizens, and thus helps improve their quality of life. The design philosophy underlying this paper is to fulfill both technological and human aspects. The balance between these two dimensions has been currently stressed as a crucial element for the design of usable systems in real use, particularly to the elderly who have physical and mental decline. As the first step to achieve it, we have identified human and social factors that affect the elder's quality of life by a literature review, and based on them, build four fundamental services: information, healthcare, learning and social network services. Secondly, the system architecture, employed technologies and the elderly-friendly system design considerations are presented. This reflects technological and human perspectives in terms of the system design. Finally, we describe some scenarios that illustrate the potentiality of the proposed system to improve elderly people's quality of life.

Keywords—Elderly people, human computer interaction, quality of life, smart television, user-centered system design

I. INTRODUCTION

IMPROVING the quality of life for the aging population has gained more attention from governments in recent years. Elderly people usually experience a decline in their physical and cognitive ability making them more inactive and dependent on other people's support to keep their life healthy.

As the United Nation reported, the world is growing older. In the year 2000, there were about 606 million people aged 60 years and above [1]. And the record rose to more than 737 million in 2009. The senior population is expected to reach to approximately 1.2 billion by 2025 [2]. The increase of elderly population increases the demand for services that will help elders to independently maintain their wellbeing. This highlights the need to apply information and communications technology (ICT) in improving elders' quality of life.

However, elderly people with physical and mental decline encounter many age-related difficulties in using high-technology devices. Many attempts to develop ICT-based systems that provide quality of life to elders have been rejected. These systems usually contain inappropriate contents, using unfriendly devices and having a poor user interfaces.

This paper presents the development of a smart TV based system which overcomes the elderly people's anxiety in using technology, making it an ideal tool to provide them with the highest quality of life. The major characteristics of the proposed system are as follows:

- 1) The system was constructed from four major services such as information, healthcare, learning and social network service, which have been identified by a thorough review of previous researches. These services were methodically generated from factors that affect elderly people's quality of life, thus, providing them with an adequate set of required services.
- 2) The system is a suitable facility to deliver services to elderly people with the following reasons. (a) Smart TV is an integrated system which offers features of both traditional TV and personal computer [3]. (b) Smart TV provides big screen, is easy to use and always ready, requires less attention and has few technique problems [4]. (c) TV is the most elderly-friendly electronic device in the high-technology world since watching TV is the basic activity of elderly people in their daily life [5].
- 3) Design issues of smart TV for the elderly are carefully considered to improve user experience.

II. QUALITY-OF-LIFE SERVICES

In this section, we present a literature review to determine the key factors that affect the elderly people's quality of life. Based on these, four major services are proposed.

A. Factors Influencing the Quality of Life of Elders

According to Bowling *et al* [6], quality of life is a multi-level and amorphous concept which reflects both macro societal and socio-demographic influences as well as micro concerns, such as individuals' experiences, health, social well-being, values, perceptions and psychological ability. Their study stated that social relationships, social roles and activities, health, psychological outlook and well-being, home and local neighborhood, and financial circumstances and independence are factors affecting to elders' quality of life. Among these factors, they suggested that having good social relationships and good health are the most influential.

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By a survey [7], Leung *et al* presented the importance of psychological needs, social activities and independence to a vigorous life among elderly people. They emphasized that good relationship with relatives and friends as well as awareness and acceptance of aging are crucial in old age.

Davis and Friedrich [8] concluded that the greater knowledge of aging leads to a higher life satisfaction. They divided the said knowledge into three categories, namely: knowledge of physical aspects of ageing, knowledge of psychological aging correlates and social knowledge.

Hirsch *et al* [9] presented that elderly people often become unmotivated to interact with the unpredictability of the world because of functional limitation and misperception of their own ability. Neuvo *et al* [10] stated that a higher level of knowledge about aging could increase the predictability and perceived control over potential threats associated with the aging process. By this, elderly people will be more confident and involved to social and daily life activity. They suggested that educational program could serve as a preventive strategy for anxiety in old age.

Walker [11] considered the feeling of independence, control and autonomy are essential for the elders' well-being. Thus, maintaining their independence, social participation, growth, autonomy, social role functioning, cognitive ability, adaptability, well-being and life satisfaction are crucial to their quality life.

Based on this literature review, there are five factors that affect the elders' quality of life mostly. These are basic and functional need, health, autonomy, knowledge of aging and social relationship. These key factors are reflected in our proposed four basic services for elder care system: information service, healthcare service, learning service and social network service. Details of these four services and their affect will be presented in the following section.

B. Four Major Services

The smart TV system with four major services of information service, healthcare service, learning service and social network service helps to improve certain aspects of elderly people's quality of life (Figure 1). We discuss the impact of these four services on the users' well-being and relationship between these services and the factors that affect their quality of life.

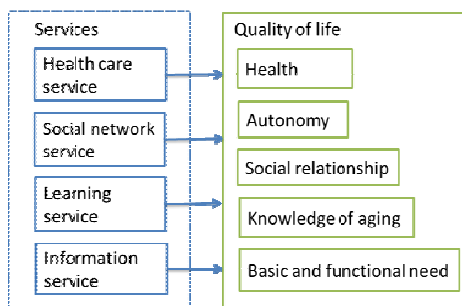


Fig. 1 Four major services supporting quality of life

Information Service: This is an indispensable service which provides elderly people with the basic and functional information that they need in their daily life, such as news and weather forecast. An informative feature with question and answer function is also included in this service to help elderly people quickly solve any issue they may encounter in their everyday living, thus, maintaining the feeling of autonomy and independence. The information was carefully selected based on the actual need of elderly people in the performance of their daily activities to increase the usefulness of the system.

Healthcare Service: This is a crucial service since health highly influences the elderly people's quality of life. Prevention, alarm and treatment are three healthcare solutions. They are integrated into a complete TV based healthcare system.

Learning Service: This service comprises appealing lessons to develop the perception of aging and life satisfaction. The lessons were designed meticulously to make elderly people use it and forget about their age related limitations. Learning games were included in the system to encourage the users to use the service while unconsciously gaining knowledge about aging.

Social Network Service: The major goal of this service is to help elderly people maintain their social relationships. Participating in social network and staying in touch with their children and companies make elderly people more involved in physical activities. Therefore, social network service also indirectly improves their physical well-being.

III. SYSTEM CONSTRUCTION

This section presents system construction. The system architecture, used technologies and design considerations for elderly-friendly system are mentioned.

A. System Architecture

The system was designed with the adaptability, and so third party services can be easily integrated into it. Figure 2 describes the system architecture in which smart TV is represented by the combination of a traditional TV and a set-top box. Client installed in set-top box interacts with "quality of life" server through a set of pre-defined API (Application programming interface). The four major services of information service, healthcare service, learning service and social network service were implemented in the "quality of life" server. Other third-party services (e.g. Particularly SNS like Facebook and Twitter) can be utilized and integrated into the system by the existing API.

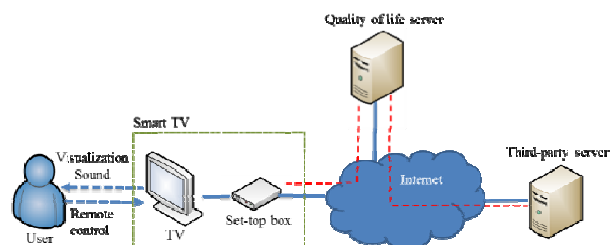


Fig. 2 Overview of system architecture

The technology to develop the system was chosen based on the current availability of smart TV products. The client on smart TV was developed on Google TV platform which is a software stack built on Android including an operating system, middleware and key application. Google TV has been the chosen platform for development of the client because it is an emerging technology that provides an ease to use software development kit. Client has been developed on Java programming language using Google TV Add-on and Android SDK (software development kit). This SDK provides the needed APIs to create appropriate applications for Google TV. The development tool used to create the application was the Eclipse IDE (Integrated Development Environment) classic with the ADT (Android Development Tools) plugin and Google TV Add-on. Another reason for choosing Google TV platform is that it has features similar to android mobile, making the Android mobile developers quickly adapt to Google TV application development.

B. Design Consideration for Elderly-Friendly System

Hirsch *et al* [9] stated that the types of services have an impact on the elders' sense of identity and their estimation of their functional ability. Services that cause users to feel ashamed and powerless may contribute to late-life depression. So, user perception needs to be consciously considered in the design stage.

Elderly people usually have very limited experience with technology, and therefore, a considerable tradeoff between simplicity and functionality is highly required. The system must have easy to use interface with simple navigation patterns and minimal rarely-used functions. Complex interactions must be avoided for easy performance of the desired actions [12]. As shown in Figure 3, people intentionally want to be relaxed and comfortable when watching TV. Thus, any difficulty in using the device will be a barrier to its acceptance.



Fig. 3 People want to be relaxed when watching TV

Some support in performing tasks with the system, such as the availability of application wizards and allowance of confirmation option before executing critical actions, are also recommended.

Designers need to be cautious with the color, size, and layout of objects displayed on the screen because elders often experience a decline in their vision, hearing, psychomotor skills, attention span, and memory. The legibility of texts, images, and other details is directly affected by the distance between the viewer and the television, and the brightness of the display.

With regards to distance, all details on the display must be clearly seen within 10 feet. Navigation and text input would be difficult if texts and object are too small, whereas scrolling would be annoying if objects are too large [13].

IV. USE SCENARIOS

By illustrating three scenarios, this section demonstrates the potential possibility of using smart TV as an assistant device for elderly people in order to improve their quality of life, reflecting four smart-TV-based services: information service, healthcare service, learning service and social network service.

Scenarios 1: This scenario describes the possible use of smart TV in healthcare service which motivates the elderly users to follow a health care program for preventing from obesity. By using smart TV with advantages of relaxed sitting in the living room, ease of use and familiar interface, the service has a high chance to be accepted by the intended users and provides them with better physical well-being.

"Steward lives independently. He has obesity problem and is in a diet. In the morning, when he turns on the TV to watch the news, a notification displays at the corner of the screen telling him the day's menu with image and encouraging him to do some physical activity. After that Steward eats the suggested diet and does exercise. In the evening, Steward opens the healthcare service and input his BMI and his physical activities. The service calculates the data and displays a funny image telling him that he has done a great job and encouraging him to repeat it tomorrow".

Scenario 2: This scenario describes a situation in which the elderly need the support of ICT to do their usual activities. This scenario emphasizes the importance of information service and social network service.

"John and his wife are living independently. The couple wants to invite her friends for a barbecue party in the weekend. John gets the remote control of smart TV and opens the weather forecast service which has been pre-installed. He can quickly check the weather and know that it will be fine in the weekend. After that, John uses the smart TV to send inviting messages to his friends through the social network service."

Scenario 3: This scenario illustrates a situation in which an elderly person is sitting in the living room and following his friends' activities intuitively. This scenario emerges the benefit of using social network in elderly people's daily life. TV-based social network service can provide elders a wonderful experience to stay in touch with their relatives and encourages them to participate in social activities.

"Thomas is watching TV. Suddenly, there is a notification display on the screen. The notification tells him that his friend has updated some photos and asked if he wants to view the photos. Thomas gets the remote control and press the "view" button. A slideshow of his friend's pictures showing his hiking activity with another group of peers displays on the TV screen. After viewing the photos, Thomas was excited. He pressed the "comment" button on the remote control and let his friend know that he wants to join the next trip."

V. CONCLUSION

Improving quality of life for the aging population has been the concern of many governments in recent years. New trends in smart TV technology have opened a new way to provide quality of life to a large number of elderly people. The system presented in this paper was developed to provide the intended users with services that fulfill their needs in their daily life. It also solves the limitations of personal device assistants (providing inappropriate contents, a poor user interface, and running on a hard-to-use device) and, therefore, has high probability to be accepted by elders.

In this paper, we have proposed a framework to improve elders' quality of life, dividing smart TV services into four categories of information service, healthcare service, learning service and social network service, and presenting some scenarios describing the advantages of smart television. The design considerations presented are useful for designers who want to develop value added services for smart television. Using smart TV to provide quality of life for elderly people is promising, when they and their behaviors are well analyzed. In future work, improvement of interaction between elderly people and smart TV should be considered. Usability test is also important to verify the usefulness and ease of use of the system.

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