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## **User-Centred E-Health: *Engaging Users into the e-Health Design Process***

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### **Abstract**

*Being familiar with the benefits of e-Health, Telekom Slovenia and the Faculty of Medicine from the University of Maribor along with other partners have initiated an e-Health project. In order to achieve high and effective user adoption of e-Health services, the user-centred design approach is used in the e-Health project. Since broadly known conventional UCD methods and techniques are not completely appropriate for a large diversity of users, this paper describes how we have modified traditional UCD methods to support study researchers for carrying out their user studies with older adults on the example of a SOS@home service.*

**Keywords:** e-Health, User-Centred Design, Modification, Older Adults, SOS@home

## **1 Introduction**

In recent years, the number of Internet users worldwide has dramatically increased. People around the world are using the Internet for various purposes. Some of those purposes are also health-related. In their study, Per Egil Kummervold et al. have discovered that the use of the Internet as a source for health information is growing in all age groups and for both man and woman. In their population study, they have furthermore experienced that Internet health users are using the Internet also as a communication channel, both for reaching health professionals and for communicating health issues with their peers [24]. The term e-Health was firstly introduced in the late 1990s as a new term that describes the combined use of information and communication technologies (ICT), especially the internet, in the health sector [25]. The field of e-Health represents the promise of ICT to support, improve or enable the health and healthcare system [27]. Various studies have concluded that E-Health [11], [13] and [20] is effective in terms of:

- Significant cost reduction for both patients and the health system.

For example, it can reduce the need for travel and the need for transfer to a secondary or tertiary health institution.

- Increased health service efficiency.

For example, using new ICT can reduce the time that health workers spend on data-handling tasks. As a result, health workers will be able to spend time for another, more valuable health interventions. Additionally, by making health data accessible on the desktop, ICTs can also enable faster health decisions and actions. Furthermore, ICTs can enable health processes to handle more cases without raising staff numbers or associated costs.

- Increased technical quality and usability.

For example, ICTs can improve the quality of data held in health systems, which can make for better-quality health decisions and actions at the operational level and at the managerial and policy levels.

- And increased user satisfaction.

For example, ICTs can make things better in easier to use and operate, in deeper and less tangible ways.

However, the e-Health benefits cannot be considered universal because of the existence of disparities related to socio-cultural, behavioural, economic, environmental, or societal factors [14]. Additionally some individuals are limited by digital and information literacy or access to the internet [9]. Most of the current systems, software in particular, are traditionally designed for younger people with high digital literacy [26]. As a result, such software can be either difficult or impossible to use by people with low digital literacy, especially by the elderly. Various guidelines exist to support user interface design for all different types of users. However, designers and product architects cannot simply rely only on existing guidelines. They need to involve the intended users of the products and/or applications throughout the entire design process. Insufficient user involvement in the design and product architecture of e-Health applications and the lack of evidence demonstrating impact bring difficulties for user adoption of such applications. Numerous user-centred design (UCD) methods and techniques are well known and widely used. Nevertheless, conventional UCD methods

and techniques are not completely appropriate for a large diversity of users. Part of this problem lies in the differing user characteristics, languages, cultures, environments and motivations among the vast number of users. This paper describes how broadly known conventional UCD methods were modified to support researchers for carrying out their user studies with selected type of users on the example of a real e-Health project.

## 2 E-Health services

Being familiar with all the benefits of e-Health, Telekom Slovenia and the Faculty of Medicine from the University of Maribor along with other partners, have initiated an e-Health project. The project group is developing various e-Health services that are based on modern ICT solutions and will be available on several screens, such as: television, personal computer, smart-phone and tab. Depending on the purpose of use, the specificity and utility, the e-Health services in the project can be roughly divided into two groups:

- Fully integrated telecare services for easy and safe independent living at home for older adults;
- Fully integrated telemedicine services for remote monitoring of patients with chronic diseases, for home-care or for general-practice care.

### 2.1 Telecare services

Telecare services, as showed in Figure 1, are intended for the older adults in order to provide them with longer, easier and safer living in their homes. The telecare services enable older adults to choose where and how they would like to spend the autumns of their lives. This way, the need of any institutional care could be released and thus the pressure on the nursing homes.



**Figure 1:** e- Health project: the process of the fully integrated health-care delivery

## 2.2 Telemedicine services

Telemedicine services, as shown in Figure 2, are intended for remote monitoring of various chronic diseases, increasing the availability of specialist medical services in rural areas, specialist support for general practitioners, health workers, health resorts and insurance companies, obtaining a second opinion, etc.

The primary objectives of the development and deployment of telemedicine services in public health is to enhance the availability of specialist services in rural areas, to reduce queues and to provide direct financial savings to the health fund. Additionally, the introduction of the telemedicine services into the system will minimize medical errors, shorten the hospitalization time, reduce the number of hospitalizations, provide enhanced flow of information, optimize health processes and health professional's time, raise the utilization of medical techniques and improve the quality of life.

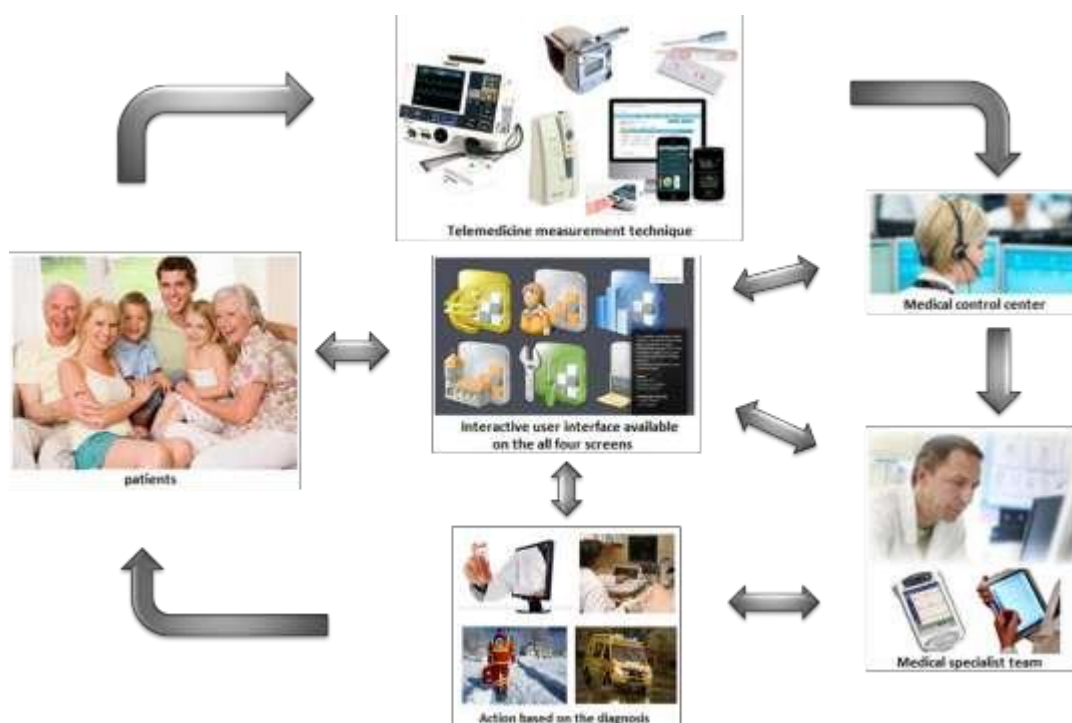


Figure 2: Telemedicine services

## 3 User-Centred Design Methodologies for E-Health Applications

The term user-centred design (UCD) has its origins in the mid 80's. UCD represents a design philosophy and a process in which the needs, wants, and limitations of an end user of a product or application are given extensive attention at each stage of the design process [33]. One of the best known guides in implementing the UCD approach in practice is ISO 13407, which defines standards that support the design, development and evaluation of usable products [3]. The standard represents a general reference and describes five main activities for a software life cycle: plan the human centred process,

specify the context of use, specify user and organizational requirements; and produce design solutions.

Taking into account the described activities in ISO 13407, the criteria for selecting methods in UCD [2] and the Usability planner tool [4], for the purpose of the e-Health project, the following methods were selected:

- Wants and needs analysis. It is quick and inexpensive, brainstorming method for gathering data about users' wants and needs from multiple users simultaneously;
- Focus group. It is a group of six to ten people, who are brought together to discuss their experiences or opinions about a topic presented by the researcher;
- Card sorting. Involves writing objects that are in – or proposed to be, in the product or application on cards and asking users to sort cards into meaningful groups;
- Interview. It is one of the most frequently used methods for gathering user requirements;
- Questionnaires (SUS and AttrakDiff).

## **4 Target Users**

The conceptual framework for the e-Health pilot project that would be implemented in UKC Maribor includes:

- Support for cardiovascular patients,
- Support for people with diabetes and
- Support for people with Crohn's disease.

Both, cardiovascular and diabetes diseases are on the list of the top five most common age-related diseases [19] and [1]. Crohn's disease, on the other hand, tends to present initially in the teens and twenties, with another peak incidence in the fifties to seventies, although the disease can occur at any age [30]. Apart from the patients with Crohn's disease, cardiovascular patients and people with diabetes are usually older adults.

As already stated, broadly known conventional UCD methods and techniques are not completely appropriate for a large diversity of users, because of differing user characteristics, languages, cultures, environments and motivations. Because of that, conventional UCD methods have to be adapted to support researchers for carrying out their user studies with target users, in this case, older adults. Modified UCD methods will enable the researchers to find out what features and functionalities are important to older adults, what motivates them to use a specific product or service, what factors affect the usability of a product and how older adults' life could be improved by technology.

## **5 Some Characteristics of Older Adults**

Older adults represent a widely diverse group [16]. For appropriate UCD methods adaption it is necessary to firstly conduct a research on the characteristics of older adults

and to find some important common characteristics that make these people different from the other groups of people.

- **Sensory processes.**

Sensory processes, particularly vision and hearing, are critical when obtaining and processing information since the senses are the mode by which information is obtained from the environment [5]. Vision and hearing, as well as reduced motor control, are also the most common sensory changes associated with aging.

Sensory changes influence older adults' ability to read or hear and can affect interactions with technology as most software communicates with users through graphic display accompanied by the use of a sound. Additionally, fine motor skills affect the performance of users in pointing tasks and the ability to use certain devices with touch screens [34].

- **Cognitive changes.**

Although working memory remains the same in relation to storage capacity, the processing efficiency declines as people get older. Due to procedural memory declines over age are also observed with the complexity of tasks and long-term memory declines in relation to episodic memory. However, semantic memory is maintained the same over time. That means that memory is preserved for prior known faces and places if supported by contextual knowledge. Yet new, complex tasks can be difficult for older adults [28].

As people get older, they maintain the ability to learn new things, but the learning process takes more time [23]. They also start to lose the ability to filter irrelevant information [21].

- **Lifestyle characteristics**

Older adults spend their time in different ways. Some of them have a very busy retired life since they take care about their grandchildren or other members of the family, do all the home activities, do sport activities or get together with other people for social activities. However some of the older adults have a lot of free time and feel isolated and lonely.

- **Education level**

Although most of the older adults are literate, still many of them do not understand what they read and have problems with technical jargon, scientific terms and search engines [6]. Moreover, the lack of educational levels among the older adults can mean that they are not familiar with experimental techniques [8] that are important for different studies.

- **Experience**

The experience with technology that people have during their early life, form their attitudes towards the way of handling with technology [34]. Since today's elderly people did not use modern technology in their early lives, they are not confident in the use of technology [21] or are often embarrassed by their lack of familiarity with technology and try to hide their discomfort [6].

Below we will present how we have modified selected UCD methods to carry out our user studies with older adults on the example of the SOS@home service from the e-Health project.

## 6 User-Centred Design Methodologies for Elderly People

The SOS@home service is used for 24/7 user monitoring and protection via a personal GSM alarm, which is shown in **Error! Reference source not found.**. Basically, the service triggers a call to the national call-control center every time, the SOS button is pressed. Adequately trained operator diagnoses the nature of the call and in case of emergency calls, coordinates the emergency process with competent services, such as: ambulance, police, fire-fighters, relatives or user's social network previously defined by protocol.



**Figure 3:** GSM terminal used for the SOS@home e-Health service.

When working with and for older adults, user researchers have to analyse characteristics of older adults and consider those characteristics in the user studies. In our previous work [31, 29 and 17] we have used findings from different studies on older adults' characteristics along with various design guidelines [6, 7, 8, 16, 21, 26, 28 and 34]. Afterwards, we have designed the health applications by ourselves, without involving the target users in the design process. Target users were only involved at the end, where they were evaluating the developed health applications.

However, in this project, we have chosen a different approach. At the beginning, we analysed the older adults' characteristics and studied how those characteristics affect the selected UCD methods. Afterwards, we adapted the UCD methods to be suitable for older adults. At the end, we will consider the UCD approach to design and develop the health applications i.e. we will involve older adults throughout the entire design process.

Even though gathering requirements from older people is vital for user adoption of a product or application, eliciting requirements from the elderly is considerably more difficult than it is from other groups of people. For example, most of the elderly people



have not used modern technologies and services similar to SOS@home. Consequently they do not have any experiences with such services. Hence when asking them questions about their wants, needs and expectations from the service they are not familiar with, they will not always know what they would really like. Additionally, when presenting them a single option for the service, they might have problems estimating whether they like the option or not. Another problem that might appear with older adults is they often think that not liking a presented option might be understood as an inappropriate behaviour to the researcher.

In order to get valuable results for what our intended users want and need from the SOS@home service, we presented them some basic use-scenarios of SOS@home, so that they got acquainted with the service. We clearly explained them that we will not be offended if they do not like the service or do not find it usable. Afterwards we made some stories and asked users to play a certain role.

For example: Imagine you are cooking dinner in the kitchen. In the meantime, you hear the news started on TV, which is in the living-room. Since you do not want to miss any important news, you go to the living-room to turn the volume up. When you return to the kitchen you see a fire started. What will you do? What do you need?

Presenting the service in a real case scenario makes it easier for users to think about it and express their options about it.

Several authors reported [8] it is not easy to keep a focus group of elderly people focused on the subject being discussed. Unfamiliar environments and social meetings with unfamiliar people may exhaust elder people really quickly. In order to overcome such problems, we conducted focus groups for the SOS@home in the elderly people's premises, where they were in a familiar environment. Focus group participants were selected among relatives and friends i.e. they all knew each-other from before. This provided an atmosphere in which participants were encouraged to value their own opinions, express themselves honestly, and enjoy their experience.

Traditionally, when doing card sorting, study participants are asked to sort cards with pieces of information or tasks into meaningful groups. In order to make the method easier and more inspiring, we introduced some game elements in the card sorting method. The modified card sorting technique included a set of ten cards, each labelled with a different emergency decision, such as: call relative, call the police, exit the house etc. Every participant received a set of ten cards. The researcher then described possible emergency case, for example: fire, fall, or attack. Afterwards the researcher asked the participants to select five or fewer cards and rank them according to their importance in the specific emergency case. All selected cards were put on the table anonymously for participants, respecting the order of importance of the cards in each pile. For each emergency case, the cards were photographed together in order to analyse occurrence and order frequencies.

Widely used interviews present a guided conversation in which the researcher seeks information from the participant. Interviews depend a lot upon participants' self-reporting skills. Elder people with little experience with modern technology may find it

difficult to identify and report anything other than a general impression, such as “I think this is complicated”. Confusion among older beginners is often general, poorly reported and non-specific. To overcome this kind of problems, we provided the study participants with appropriate technology close to hand. For example, a mobile phone where the SOS@home service was available. This allowed participants to demonstrate their use of SOS@home, which is much easier than trying to describe it with words.

Questionnaires are another type of method, regularly used by researchers when conducting user studies. The problem that appears with elderly people is they are more likely to use “don’t know” responses to questions that have complex syntax or are semantically complex [7]. Additionally, most of the questionnaires include technical terminology that elderly people do not use in their everyday lives and because of that are not familiar with it.

For example, the fifth item in the SUS questionnaire is:

I found the various functions in this system were well integrated.

To obtain usable results, we modified both questionnaires (SUS and AttrakDiff) in a way that we used terminology understandable by the elderly. Furthermore, we tried to use sentences and questions that are syntactical and semantically simple. After the modification, the fifth item from the SUS questionnaire is:

I found various functions in SOS@home are well connected together.

## **7 Conclusion**

Being familiar with all the benefits of e-Health, Telekom Slovenia and the Faculty of Medicine from the University of Maribor along with other partners, work on a Health project, where they are developing various e-Health services. Since insufficient user involvement in the design and product architecture brings difficulties for user adoption, we have used the user-centred design approach in the-Health project. For that purpose we have selected to use some broadly known UCD methods. However, conventional UCD methods and techniques are not completely appropriate for a large diversity of users, because of differing user characteristics, languages, cultures, environments and motivations. We have found out that most of the e-Health services that will be implemented in the pilot project in UKC Maribor will be used by the elderly people. As a result, we had to modify the traditional UCD methods for the elderly people. In this paper we are describing how we have modified previously selected, conventional UCD methods to support us for carrying out our user studies with elderly people on the example of the SOS@home e-Health service.

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