User-Centered Activity Management System for Elderly People

Empowering older people with interactive technologies to manage their activities at the retirement home

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Abstract — **This paper presents the preliminary results of a multi-disciplinary project aiming at studying technology supported life in a retirement home. The results of semi-structured interviews conducted with a group of 40 (semi-) autonomously living elderly persons are presented. In general they point in the direction of a "differential indication" of technologies in the sense of identifying personal solution for individual needs. Second, results show that the crucial dimension underlying the acceptance of technologies is the notion of personal control. The paper also identifies ten key design factors to build successful applications for elderly people. Finally an initial version of a new system mixing RFID, tactile screen and large display is described.**

Older people, Elderly people, RFID, Tactile Terminal, Retirement Home Management

I. INTRODUCTION

Computer scientists and social scientists agree that information and communication technologies (ICT) can improve the living conditions and foster social interactions among elderly persons. There is also a consensus that some factors might limit the use of ICT and its usability in this target population. First, some elderly people feel uneasy with modern technologies, which often do not take into account age-specific changes in sensory, motor and cognitive abilities. Second, ICT are sometimes too unfamiliar or far away from the world in which older people are used to living. Especially, the lack of experience or negative experiences can foster mistrust towards the use of modern technologies. This paper describes the preliminary results of ongoing research in this domain.

II. TECHNOLOGY AND AGEING

The study of "technology and ageing" has been promoted during the last decades in several disciplines. "Gerontechnology" represents a new discipline within gerontology aiming at the study of those factors that ensure an optimal technological environment of all aging and old people up to a high age. Technology in various domains is crucial for the daily life and social participation of the elderly, and technologies may have both facilitating and complicating effects depending on the usability of the application under consideration, as well as the physical and functional status of the elderly person. Bouma and colleagues [1] point out that gerontechnology has to intervene in five domains of daily life: health and self-esteem, housing and daily living, mobility and transport, communication and information, and work and leisure with four goals for development: (1) enhancement and satisfaction, (2) prevention and engagement, (3) compensation and assistance, and (4) care support and organization.

When it comes to the implementation of comparatively new technologies one has to realize that several complicating factors may exist for the use of these by the older people. These factors comprise characteristics of the elderly person, characteristics of the technology, as well as their interaction (for an overview see [2]). A decreased functional and physical status may always severely limit the individual motivation to deal with new technologies, and technological solutions for the elderly have to be fitted to the special needs and limitations of this group. The design of the technology being implemented and the similarity to common devices (e.g. TV remote control) also plays a significant role with respect to its acceptance. Crucial is also the dimension of control, i.e. the feeling of being able to steer the technology under question and to avoid negative effects. A clear-cut description and the supervised training with new technologies in general will help here.

Some research has been undertaken for several years to explore how digital technologies can support the coming 'grey' age. For instance, researchers from Georgia Tech [5] have a purpose-built aware home where they conduct research projects exploring support for older people using ubiquitous computing technologies. As another example, Hagen et al [4] assessed the usefulness of assistive technologies for people with dementia. Findings showed that subjects were able to carry out daily tasks that they were previously unable to do with the help of these devices.

Previous work about scheduling technologies for elderly people has mainly addressed medical aspects (e.g. medication times). To the limit of our knowledge, few researchers have

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explored how digital technologies can be used to involve the older people in a system managing their social activities in a retirement home.

III. TIVIPOL PROJECT

The TIVIPOL research project was launched in fall 2007 with the purpose to investigate how new interactive technologies can be used by older people to support their social life in retirement homes. This inter-disciplinary initiative regroups computer scientists (experts in Human-Computer Interaction) and psychologists specialized in gerontology. The mixed project team appears to be clearly an advantage. The computer scientists' temptation to design and develop a system based on cutting edge technologies is tempered by the psychologists who insist on the consideration of specific cognitive and social features of the older people. Symmetrically the psychologists are made aware of some technological opportunities but also of the limitations of the current state of computer science.

A nursing home of Luxembourg was chosen for the implementation of the new system. It was selected since its clientele comprises seniors of comparable good health who live autonomously in apartments provided within the setting.

IV. KEY DESIGN FACTORS

Identifying the success factor of a new information technology has been largely studied in the management of information system (MIS) literature. Despite our project focuses on a completely different target group (older people of a retirement home instead of managers or office workers), we were inspired by some of the research in MIS. The famous technology acceptance model (TAM) [3] points out that the perceived usefulness and the perceived ease-of-use are essential elements influencing the adoption of new IT systems. The Unified Theory of Acceptance and Use of Technology [6], claims that performance expectancy, effort expectancy, social influence, and facilitating conditions determine the usage intention and the user behavior. We combined these findings with others issued from the gerontology research (e.g. [2]).

After several joined brainstorming sessions followed by domain specific analyses the project team finally identified ten key design factors for our specific case. The first ones relate to the usefulness and the ease-of-use of the new system. We also add two categories of factors: the pleasure to use and the evolution of the system. The former is important in our case because the fear of computer has been cited as a potential factor hindering the use of software by older people (on these and other issues associated with technology use see [2]). The latter is mentioned because it can influence some technological choices to be made at the very beginning of the design process. All these elements are intended to facilitate the final adoption of the system and make it become a success story.

Usefulness:

F1. The system must fulfill a real need of the users. It should be a new optional way to carry out some existing and recurring tasks of the home residents.

F2. The system must offer some advantages for the retirement home staff in order to get full support from the stakeholders from the management side.

Ease-of-use:

F3. The initial version of the system must be very easy to use and must require a very short learning phase. Intuitiveness and affordance are essential.

F4. The (software) user interface should not require prior skills or experience in computer usage. The expected effort to use it must be low. Among others, it should not look like a classic application with pre-existing design decisions (e.g. look-and-feel of buttons).

F5. The (software) user interface of the system must be as personalized as possible. As it is acknowledged that each person has a unique way to get older, the system must adapt itself as much as possible to the skills and needs of each individual user.

Pleasure to use:

F6. The users must enjoy using the system in order to generate a positive feedback loop at both the individual and the group level.

F7. The system must support social life either directly or indirectly.

F8. The hardware and especially the end user terminal must have a nice design (to be attractive), be reliable (to avoid bad experience) and robust (to convey the feeling that it can be operated without being damaged). In addition it should not look like a computer.

Evolution:

F9. The system will evolve with time progressively proposing an increasing number of functions. According to the adoption rate some complementary features will be added to the system. Each new feature should be individually proposed (instead of imposed) to each user.

F10. The technological back end of the system must be generic and must support significant improvements with low development resources.

In fact, many of these key factors are well known and they should always be taken into account when designing a new computer-based system. In our case, they become critical due to the specific nature of the target users and the environment where the system has to be deployed. The global purpose is to bring the older people to think about the features of the system rather than about the technology. Moreover, it is crucial to generate a positive first impression otherwise there is a risk to reinforce fear or distrust in digital systems. A strategy relying on iterative steps to fix bugs cannot be adopted in our case.

V. FIELD STUDY

The project follows a user-oriented methodology. Therefore before implementing any aspect of the new system the context of use and the user characteristics were carefully studied.

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For this purpose two institutions for elderly in Luxembourg were invited to participate as partners in the project. The first institution "K" is a retirement home for elderly people having no severe health related problems (i.e. health-care requirements of the residents must not exceed 12 hours per day). At the moment there are 118 residents living relatively autonomously in apartments provided within "K". The second institution "R" comprises - besides a large offer of activities for elderly persons - a "senior academy" proposing different education and training offers to persons aged above 50 years. This institution is by contrast no retirement home but rather a "day training center" for elderly persons.

First the project team discussed with the manager of the "K" home. We learned that numerous activities are proposed to the home residents, such as choosing their menu for the coming days, visiting some exhibitions in the city, being transported by coach to go shopping or participating to cultural activities within the home.

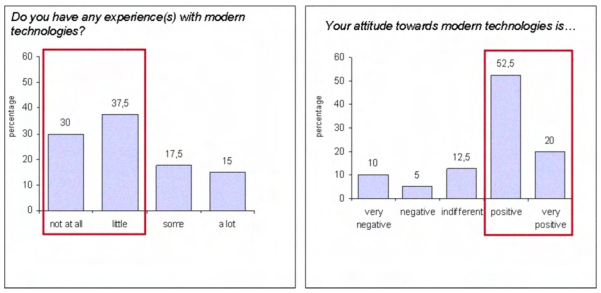

Figure 1: Experience with and attitudes towards modern technologies in a sample of elderly persons.

In order to get a first description of the target population, semi-structured interviews have been conducted during the initial phase of the project. In detail, social networks and social support resources have been explored. Furthermore, attitudes towards and experiences with modern technologies have been studied. A sample of n=40 older persons has been interviewed by trained student interviewers in the two institutions (n=20 in each of them). In both cases, home managers facilitated the recruitment of the sample and further supported the project and its implementation in their institutions. Participants were on average 78.6 years old with a slight overrepresentation of women (57%) in the sample. With respect to marital status most participants were either married (40%) or widowed (40%), while 12.5 percent were divorced and 7.5 percent single. Furthermore, none of the participants had a severe psycho-physical or functional condition. Results of this preliminary study showed that the elderly used in first place telephone calls for social contact and they reported in general to have little or no experiences with modern technologies such as the internet and mobile phones. On the other hand, attitude towards modern technologies in general were quite positive and accepting. Few persons however felt ambiguous about modern technologies or even reported negative experiences (see figure 1). We remind at this point that the subjects were in good mental and physical conditions. Therefore those results should not be extrapolated to other categories of older people.

A two stages strategy was used to identify the system features. A very generic purpose (i.e. a class of problems) was first chosen. Then some specific instances of this problem were selected to be implemented in the initial version of the prototype.

We have observed that the numerous activities proposed to the home residents were manually managed. For instance, the registration to a given activity was made with a form on paper to be filled by hand. Moreover they were very few connections (and in many cases none) among the activities. The participation to several activities was not handled as a whole but as disconnected events.

Using a new computer-based system to tackle this issue was rapidly identified as the appropriate generic issue we were looking for. Indeed, the first condition (F1) is fulfilled as the system does not change the daily life of the older people but simply offers a new opportunity to register to a given activity. The second condition (F2) is also satisfied because a central and computerized management of the home activities allows the staff to better plan and organize them.

To sum up the new system is intended to allow the home residents to register to a set of activities and to set the required parameters related to this registration. In cooperation with the home staff, the first activity chosen to be implemented in the system is the reservation of the menu for the next week. This information is centralized and sent to the cook for helping him to optimize the catering management.

It must be noted that the system handles a limited set of identified users, namely the home residents. This element has several consequences in terms of design and support.

VI. System Description

A. *Hardware*

The computer scientists of the project team had a sound experience in software design and engineering. Nevertheless, as key requirement is to hide any element looking like a computer the hardware part of the new system could not be neglected. The eighth key design factor (F8) insists on the necessity to use pleasant, reliable and robust devices. Therefore a market study was carried out. Three types of technologies were selected to be integrated into the new system.

The identification of the users (i.e. how to log into the software application) is supported by RFID tags and reader. This technology is nowadays mature and sufficiently reliable. The tags can be attached to key rings, be embedded in a card similar to a credit card or inserted in personal objects. In addition they are very easy to use (F3) and most of the older people already know how to handle them (F4).

The interaction with the application (i.e. how to register to a given activity) relies on a tactile screen. This technology is also popular for several years (F4). However, the challenge in this context concerns the graphical design of the user interface and the navigation issues into the application.

A recent device combining a RFID reader and tactile display screen is used as terminal (see Figure 1.). In addition to

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the reliable technology it is based upon the terminal also looks nice and professional. The prototype-looking effect is then avoided. The terminal will be placed in the entry hall of the retirement home.

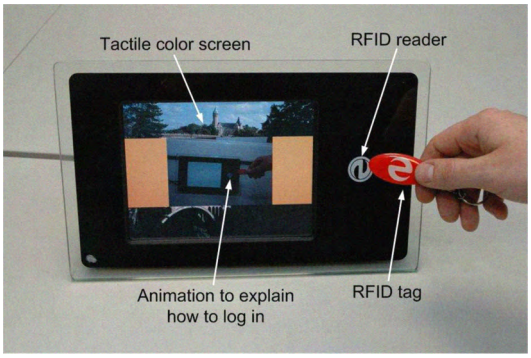

Figure 1. User terminal

The diffusion of general information is based on a large display screen also located in the entrance hall. This device will be used to diffuse general information about the activities organized in the retirement home. The purpose is to motivate the user to join the activities. In addition, both the large screen and the small terminal can be considered as social attractors where the older people gather and talk, which is intended to support social life (F7).

B. *Software*

The first step to use the application is to log in with one's personal RFID tag. In order to make this operation as simple as possible an animation showing where the tag must be presented is permanently displayed on the terminal screen. This feature reminds to the users how to use the system. Moreover the dynamic nature of the animation acts as an attractor for the people passing near the terminal (F7).

Once the user is connected some screens are presented to register to some instances of a given activity. The screens do not adopt a classic software look-and-feel (F4). They do not appear as windows of an application with menus and other similar controls. This approach is motivated by the fact that we target users with potentially no previous skills in using computers. We only use few large buttons with clearly visible labels. Most of the people who are daily users of computers take it for granted to have a "*close window*' or a "*cancel*" button in every window. However, in our case, we believe that the user interface has to be completely designed from scratch to take into account the specific knowledge of the older people and the context of the retirement home. For example, a socially positive "*I have chosen my dishes*" button can advantageously replace an impersonal "*OK*" button.

In addition, according to the fifth key design factor (F5), the application is fully multi-lingual because the home residents potentially use three languages (French, German, and Luxembourgish). Some personal messages can also be displayed to the users through the terminal.

C. *Future works*

In the coming weeks, an empirical evaluation will be carried out with five pilot users (i.e. real residents of the selected home). Then the system will be refined to integrate the results of this evaluation. Next a small scale deployment is planned for a limited number of real users (~20 older people). If the feedback is positive the system will be proposed to all residents (~ 120 persons). This process of technology implementation will be accompanied by a psychological study; within this qualitative interview study, the diverse aspects of usability and other factors fostering the acceptance of the system will be explored and fed back into the technology development.

In a next step of the project, new features improving the pervasive nature of the system will be integrated. For instance, the information displayed on the large screen will also depend on the people present around it. For instance, the people who recently logged into the system are still near the screen. Consequently the information displayed can be adapted to encourage them to attend the activities that they like and that they are not yet registered to. As another example, the confirmation of registration could be sent by SMS to the users. They could also be displayed in digital pictures frames located in the apartment of the home residents.

VII. CONCLUSIONS

The field of gerontechnology offers new possibilities for cross-disciplinary collaboration as well as for the combination of basic and applied research. The TIVIPOL project represents in this sense a prototype for this kind of new interdisciplinary studies since it links technology development and the psychological analysis of usability and end user empowerment.

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