

The CONFIDENCE system and the contributions of older people during its development

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Abstract: The CONFIDENCE project aims at providing an ICT support to older people who want to live independently and autonomously. The system will be able to detect falls and other abnormal situations. The aim of the research presented in this paper was to obtain information on the end-users needs, attitudes and expectations, and to elicit user requirements for the development of the CONFIDENCE system. The results suggest that the participants would prefer remain living at home with the support of CONFIDENCE and would feel safer under continuous monitoring while they could trust that the system works and they get help in case of sudden emergencies. Most of them reported that the system would not violate their privacy and that they would learn to use it. The information on the end-users needs is an invaluable resource in the development of usable and acceptable technologies to facilitate their independent living.

Keywords: older people; independent living; user-centered

1. Introduction

Falls are among the most common and serious problems of older people. Both the incidence of falls and the severity of fall-related complications increase steadily after age 65 [1]. The experience of falls can add to the development of fear of falling in older people, which in turn, can decrease quality of life, independency and reduce the ability to lead active daily life [2]-[5]. By reducing falls and fear of falling older people remain active and autonomous longer, and the costs of health and social care may be reduced [6], [7].

The CONFIDENCE project aims at providing an ICT support to older people who want to live independently for longer periods before a sheltered accommodation would be adopted. Briefly described, this system will be able to reconstruct the user's posture and detect abnormal situations, such as falls or loss of consciousness. The intelligence of CONFIDENCE will be able to discriminate changes in the user's typical behaviour that could entail impending health problems or functional

deterioration. When a fall will be detected, an alarm will be transmitted to a designated alarm receiver or the emergency services. When atypical behaviour will be noticed, the user will receive a warning informing about the possible risk and enabling him or her to seek medical consultation. The intelligence and predictive capabilities represent some of the main innovations of CONFIDENCE. The users will be able to control whether the alarms are forwarded to the alarm receiver or not. In addition, warnings could be dismissed by the users if these were not considered relevant. The technology supporting these functions is based on wearable radio frequency (RF) sensors/tags and wireless communication channels. The hardware components include RF sensors/tags, a processing unit or base station, and a portable device. The portable device serves as the interface between the user and the system. Ethical principles are considered throughout the development process.

The CONFIDENCE project has adopted a user-centred approach to support the research and development of a Ubiquitous Care System to Support Independent Living in an attempt to close the gap between users and technology. This study addresses two research questions: Firstly, what are the needs of older people in their activities of daily living and associated requirements of the system? Secondly, after the technical specifications have been defined, what are the opinions and reactions of the end-users when facing a detailed description of CONFIDENCE, its components, interfaces, and the alarm handling protocol? Similar steps as in Finland have been performed also in Italy and Sweden.

The aim of the first stage was to gather inputs about end-users needs, expectations, viewpoints, and to elicit user requirements for the design and development of CONFIDENCE. The goal of the second stage was to obtain answers to the second research question regarding the opinions and feedback about the technical specifications of participants in the first stage. Semi-structured questions were used because participants usually did not possess extensive background knowledge about care systems similar to CONFIDENCE.

2. Method

During the first stage, 23 people from the city of Jyväskylä, Finland, volunteered for this study (average age 75.5, range 65-92, female = 12, male = 11). The participants were recruited from the Central Hospital, a day centre, and the Centre for Care and Rehabilitation of War Veterans. They all lived in their own homes. During the second stage, ten participants from the sample of the first stage volunteered to participate in individual semi-structured interviews (average = 75, range 68-88, female = 6, male = 4).

Semi-structured interviews were carried out by two experienced adult female interviewers in the home of the participants as the place of their choice. At the interview, the interviewer provided information about the project. When a person asked for clarification or additional information, the interviewer answered and made sure that the matter had been understood. Before initiating the interview, the participants read and signed the informed consent form as the CONFIDENCE project has established in its ethical procedures for the research tasks involving human subjects. The interviews lasted approximately 1 h.

The procedures in the first and second stages were similar. The different goals of the two stages involved thus different levels of detail of information provided, and the questions about CONFIDENCE.

3. Results

3.1 First Stage

In the following sections, the needs of the users, expectations and their opinions are organised in five categories, i.e., health and ageing effects, use and attitudes towards the system, ubiquity and uninterrupted operation, privacy, and acceptability.

3.1.1 Health and ageing effects

The majority of participants defined their own health mostly as average or good for their age while one third indicated that their health condition was poor. The most frequently reported health problems were asthma, amputations, chronic pain, heavy medication, rheumatism, heart diseases, and reduced ability to move.

The system should be controlled through multi-modal interfaces. People with poor eye sight cannot use the system properly if the interaction is only based on visible symbols. People with hearing impairment cannot use voice control adequately. Possible ways of controlling the system can be at least visible symbols on screen, voice recognition and alarm sounds, interaction through haptic information, e.g., vibration, should also be considered.

3.1.2 Use and attitudes towards the system

Four fifths of the participants demonstrated positive attitudes towards learning to use the CONFIDENCE system. One fifth had a negative attitude considering it difficult to understand. The most frequent expectation of CONFIDENCE was that it should be simple to use, e.g. that the system does not provide too many options. Other expectations included a price sufficiently cheap or affordable, similarity to other familiar technology and expectations that consider the perceptual and motor impairments, e.g., sight, hearing, rheumatism, pain.

Almost all of the participants reported that health care service, home health care and other public service should have the main responsibility to receive the alarms. Some would like for a nurse to come and check on the situation while few prefer an automatic call to the spouse.

3.1.3 Ubiquity and uninterrupted operation

In the first interviews 91 % of the participants reported that they participated in social and physical activities, and the majority of the participants practice regularly some form of physical exercise. About half of the participants reported that they are afraid of falling. Only one fifth were afraid of going out. Not surprisingly, in this study, the presence of another person often increases the feeling of safety. The

main reasons causing insecurity are health problems, fear of falling, being alone and not being able to perform one's own activities of daily living.

3.1.4 Privacy

The majority of the participants thought that the “system does not violate privacy, if the information collected is confidential” and “if obtaining help relies on the technology, it doesn't violate integrity”. But they also thought that constant monitoring could violate privacy.

The participants had positive attitudes towards using tags at home. All but three of the respondents would use them. Similarly, four fifths of them would accept the presence of tags in clothes. Surprisingly, nearly all of the respondents answered that it is acceptable that the tags are visible. This is interesting because most of us, members of the CONFIDENCE consortium, have argued repeatedly in favour of imperceptible tags.

3.1.5 Acceptability

The users should carry tags on their clothes, jewellery or on other suitable places such as the wrists and ankles also when leaving home. Users are willing to accept the presence of tags, but these should be imperceptible or hidden when the users are outside home. These should be designed for both men and women. The system would be useless if the user could not wear the sensors, i.e., tags, nor use it in risky environments like shower or sauna. The system should be as cheap as possible.

The tags and the portable device need electrical power supply. Power consumption should be reasonable.

3.2 *Second stage*

This stage aimed at revealing the opinions of end-users, who had participated in the first interviews about the overall system, the portable device, RF tags and sensors, base station, functionality of the system, alarm handling protocols and privacy. The results are presented in the following sections.

3.2.1 Overall system

The participants indicated that the system was complex. Some of the respondents also felt that they could not evaluate the system because it was complicated. The participants did not consider that the system violates their integrity or privacy.

A typical estimated price of the system was 1000 € The participants revealed that they would not be willing to buy the CONFIDENCE system. Instead, the public health care should provide such a service. In Finland, instruments and security services for old people are provided by the national welfare system instead of the individuals themselves.

Four fifths of the participants reported that their health condition would not cause any obstacles which may hinder the use of CONFIDENCE. Two participants indicated that they did not want to dedicate much time to learn how to use the system. Two participants thought that learning would not take many hours. All but one participants thought that they would learn how to use the system. One

third of the participants were not willing to teach the system to identify normal daily activities from adverse events and half of them could do that.

3.2.2 Portable device

Half of the interviewees made reference to the possible complexity of using the portable device. The participants were worried about whether they would be able to use the device. The other half believed that the portable device would be simple enough to use.

The size of the portable device was an important feature. Mobile phone- size device can be carried in the pocket easily. However, not every one of the participants would be willing to carry it all the time. In general, opinions towards the portable device were either positive or neutral.

The voice control/voice interface was described as an important function. Especially, the participants wanted voice connection between the user and alarm receiver.

3.2.3 Tags and sensors

All of the participants were willing to accept worn tags and sensors in their homes. Many, however manifested concerns about power consumption and batteries, which they would not be willing to change often. The size of the tags was unclear to the interviewees. Once the prototypes will be available, the size and its influence on their acceptance will be clarified.

3.2.4 Base station

The interviewees showed mistrust towards the base station. Their main concern was about misuse of the information collected and processed by the base station. Though the operation of CONFIDENCE does not need internet access, some participants questioned whether internet access would be necessary. Four fifths of the participants would allow data collection through the base station and sharing this information with home care services or the health centre. One third of them indicated that it would be important to be able to switch off the monitoring functions whenever they wanted.

3.2.5 Functionality of the system

Many participants had doubts about false alarms and thought that false alarms might be frustrating. They also wanted a system as simple as possible. Half of the participants reported that technical devices did not raise any fears or concerns in general. One third said that learning to use technical devices was difficult and one had memory problems which affect the use of devices. The devices of CONFIDENCE did not raise any special fears or concerns.

3.2.6 Alarm handling protocol indoors and outdoors

Some of the participants prefer automatic alarms without confirmation of the user. Some prefer confirmation and alarm if the user does not react to the alarm. Many indicated typical waiting times from one to five minutes between an alarm message to the user and user's action before an alarm is issued to the receiver. Two thirds of the participants mentioned health care, alarm centre or other

public service as an alarm receiver. Also children, relatives and spouse were mentioned by many participants. Responses did not vary between the indoors and outdoors situations.

3.2.7 Privacy

Four fifths of the participants thought that the system would not violate their privacy and integrity. The vast majority preferred hidden sensors and tags. Many had doubts about who could access the information and if it could be possible to misuse the information.

4. Conclusions

In this study, the Finnish older people have been valuable providers of information at the two stages of needs and requirements elicitation that has contributed significantly to the technical specification of CONFIDENCE. At the first stage, our aim was to identify end-users' needs and requirements to specify CONFIDENCE. At the second stage, we intended to gather end-user opinions about the system after the technical specifications had matured. In general, our focus was on the understanding of the user's goals, which possible obstacles they could encounter, and how they could avoid these obstacles. It was also important to understand the special needs of users and the context in which the users were immersed. In these interviews, we tried to form a holistic understanding about users' needs in their daily lives.

The participants were interested in CONFIDENCE. However, they also showed doubts. The vast majority of them showed interest in participating later in usability studies and validation trials with the prototype. According to the results, it seems that participants are willing to accept the system in their lives and homes. The general attitude towards devices monitoring their life was rather neutral. Older people reported that they would feel safer under continuous monitoring while they could trust that the system works and they get help in the case of sudden emergencies. Most of the participants would preferably remain living at home with the support of CONFIDENCE. Privacy does not seem to be affected by CONFIDENCE. Those who are responsible or allowed to scrutinise the location of the user should be clearly specified to the users for them to be able to trust the operation of the system.

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