PRoF Award abstract – Call 2016

Ingenieurs@WZC

1. Research Outline

Acronym	I@WZC
Project name in English	Engineers@carehomes
Pitch (1 sentence)	Developing assistive technology for older adults involving all stakeholders
Executive summary (max. 10 lines)	

As the number of people above 65 continuously grows the demand for appropriate support to allow this group of people to live independently increases as well. Consequently, a lot of research effort is focused on the development of new technologies that can provide this support. In contrast, only a limited number of these new developments are successfully launched on the healthcare market. In order to facilitate this penetration of the healthcare market, an intense collaboration strategy between healthcare workers, older adults, informal caregivers and engineers is set-up in the engineers@carehomes project. This collaboration ensures that the developed technology better fits the needs of all stakeholders.

2. Cause and context of the research

Due to the continuously growing group of older adults the demand for technology, which can help older adults maintain their independence, increases. A lot of research effort is therefore focused on the development of this technology. Concerning this development a wide variety can be perceived in both application areas and the used sensors.

Research facilities can produce long list of success stories regarding the development of these techniques. New developments, however, are seldom introduced to the healthcare market. Moreover when introduced to the healthcare market these developments are often met with limited success.

The reasons for this are threefold. Firstly, there is the fact that the perceptions of the researchers concerning the needs of the healthcare sector are often the driving force behind the research. The developed technology is therefore not always sufficiently tailored to the needs of the healthcare sector [3].

Next, the number of test performed to validate the new technology is often very limited. This is for instance often the case when regarding the development of fall detection technology where new algorithms are often validated in lab environments without taking into account the challenges which accompany real-life falls and real-life environments [1]. These limited tests often result in algorithms which perform splendidly in simulated environments but who often suffer a severe reduction in accuracy when introduced in real-life. Thus limiting the usability of the technology [4 – 5].

Finally, only a limited set of developed technology is validated in real-life. This validation is furthermore often done in very small test groups. Although this is an improvement to only validating in simulated settings, these tests only give an indication of the usability of the technology in real life. In the eyes of the clinical community this limited validation does not provide enough prove of the accuracy of the technology. They demand large scale clinical trials. The lack of these clinical trials often leads to companies which are hesitant to take the proposed technology into production. Moreover, both health care professionals and informal care givers are often skeptical towards the adoption of new technologies.

To overcome these shortcomings the engineers@carehomes project set-up an intensive collaboration between care-providers, older adults and researchers while researching new assistive technologies. By involving all stakeholders in this process, the developed technology will better fit the needs of the healthcare professionals and a broader validation of the proposed technology is feasible. Thus facilitating the penetration of the healthcare market for the resulting developments.

To establish this active collaboration an engineering lab was installed in a nursing home (WZC Eduoard Remy, Leuven). In practice, an engineer is present in the nursing home for one day a week. While present in the nursing home, the engineer is test driving several technologies together with the different stakeholders. The test driven techniques are not only evaluated based on technical accuracy but the opinion of the different stakeholder experiencing techniques are also taken into account.

Feedback concerning the different techniques is gathered both during pre-arranged formal meetings and during frequent informal contacts. In the formal meetings several questions are submitted to the different stakeholders which will lead to group discussions concerning the different aspects of the technologies. Also through the presence of the engineer in the nursing home and in the different wards, informal contacts between the different stakeholders and the engineer follow naturally. During these informal contacts, the different stakeholders are more inclined to voice certain concerns in an open way than during formal meetings, providing the engineer with different kinds of feedback.

The engineers@care homes project is funded by 'provincie Vlaams Brabant' started on January 1st 2015 and will end December 31st 2016. A long term collaboration is however envisioned and new funding channels will be approached to ensure this.

3. Innovation results achieved

Three use-cases were defined to experiment within this collaboration strategy. The first use-case concerned fall detection system. During this use-case academic and commercial fall detection systems were installed in several nursing home rooms. The systems were evaluated based on technical soundness and on the comfort of the participant.

Three types of fall detection sensors were used: webcams, a combination of 3D and infrared camera and accelerometers. To evaluate the technical soundness of these systems several algorithms per sensor are used. However since at this point of the study no real-life falls were recorded these systems were evaluated based on the number of false alarms they triggered. The preliminary results showed that the accelerometer based fall detection system has the lowest number of false alarms.

When evaluating usability and wellbeing of the older adults however it was observed that when using the accelerometer some trouble with wearing the sensor was experienced. Although a belt was foreseen on which the sensor could be placed participants forgot to wear the sensor and/or forgot where/how the sensor should be worn. One participant who was wheelchair bound, for instance, carried the sensor next to her in the wheelchair, causing the sensor to remain in the wheelchair when she fell out. Another participant sometimes wore the sensor around her neck instead of around her waist which is potentially hazardous.

On the other hand it became apparent that the participants were surprisingly open towards the video cameras. In contrast with the expectations of the researchers, participants were very willing to have the cameras installed in their rooms and even suggested the placement of these systems in their bathrooms. They also had several other suggestions for applications in which camera systems could provide useful information.

The next use case was the clinical validation of a previously developed fall risk assessment tool using the Wii Balance Board. During this test a person is asked to stand on the Wii balance board for 40 seconds after which an analysis is done labelling a person as with or without an elevated fallrisk [2]. A clinical study was performed where 120 participants took the fall risk assessment test and were subsequently followed during 6 months to assess the predictive value of the system. The system was also evaluated based on the usability for the different stakeholders.

As the data from the clinical trial is not fully available no technical results can be communicated at this time. Concerning the usability it was observed that for cognitive impaired older adults 40 seconds is a very long time. However, only three out of the 120 tests were interrupted. Two persons stepped off the Wii Balance Board during the test and one experienced some weakness in the legs during the test. The other participants completed the test without significant trouble. Additionally, the physical therapists of the nursing home expressed particular interest in this tool and indicated their desire to experiment with it themselves.

The last use-case was centered on the development of tools to monitor food intake. Since nutritional status has a big impact on a person's health status, preventing malnutrition by means could greatly improve the quality of life [6]. Detecting malnutrition is typically done with pen-and-paper tools such as food diaries and questionnaires. These methods, however, often contain mistakes or are incomplete. The goal of this use-case is to develop a system that can automatically detect a person's food intake and generate an accurate food diary automatically.

As this was a very new research topic, the first step was to gather input concerning the views of the different stakeholders on the types of sensors which can be used to monitor food intake. After several meetings with the different stakeholders it was decided to construct a first measurement tool using an accelerometer attached to a pair of glasses. With this prototype, we developed an algorithm to detect chewing motion of the person wearing the glasses during the meal. Furthermore, data from 14 elderly adults was recording during dinner and lunch time. This data was used to further improve the quality of the developed algorithm Some other Activities of Daily Living were also recorded. The technical results were very promising and the users responded very positive towards the sensor and were open to wearing a system like this.

Further explorations are the incorporation of tremor patients in the study and the development of a smart plate that will measure the amount of food removed from the plate during the meal. This system will be used to estimate the amount of ingested calories. Lastly, the use of low-cost sensors built into a drinking cup will be evaluated for the detection of fluid intake.

Apart from the results of the different use-cases, it is also worth noting the overall interest in the project. Several articles concerning the project were published in both newspapers as well as health care magazines. The project also received a lot of attention from researchers when presented at the ‘Engineering For society’ conference and an article concerning the project was published in the Anthropology and Aging journal. These different publications provides the researchers with the opportunity to inspire other researchers to use the same approach. The overall response from the health care community is also very positive. For example, following the publications in the different newspapers, other nursing homes already indicated that they want to participate in future projects and therefore also creating the opportunity for other researchers to set-up similar collaboration strategies.

4. Link to the PRoF values

Already at the beginning of the project it was clear that older adults are very happy to participate in the development process. They feel more appreciated because their opinion is taken into account. Another selling point of the project is that the participating older adults received a lot of extra attention. An engineer visits them every week, a lot of other residents are curious towards the system and they even receive some attention from the press. All this gives them the feeling that they still matter and can provide a valuable contribution to science. One participant who was showing early signs of depression prior to participating in the project recovered during the project, his social interaction improved and he became more active.

During the first meetings it became apparent that clear cut communication with older adults is key to overcome possible resistance to the technology. Regarding the camera systems, for instance, the different processing steps on the video image were demonstrated. Thus demonstrating that in the finished product they were no longer identifiable. It was, however, clearly communicated that during the study the original images were gathered and looked at by the researchers. After ensuring them that the images would only be used for research purposes and would not be available to family members, nurses,… the majority of the older adults present were open to installing the system in their rooms.

Another point which was clearly very important was that older adults wanted to be in control of the sensor set-up. This control was given by installing a ‘stop’-button. If an instance occurred in which they would not want to be recorded they could press the button and the recording would be stopped. If they were ready to be recorded again they could then restart the system. The status of the system (on or off) is communicated to the older adults via LEDs.

While our camera system is still in a prototype phase, i.e.: it does not look like a finished commercial product and there is a full sized PC present in the room, we took extra care to make sure that the system did not impact on the older adult’s level of comfort. The cameras were installed in locations where the elderly would least notice them. During installation, the older adult was typically present and their input was asked on the location of the cameras, ensuring they would be in agreement with the positioning. During our weekly visits we asked the older adults about their thoughts to make sure they did not experience any problems with the system. None of our participants had any issues with the system.

By combining clear cut communication with giving control over the sensor system and extra attention it was not difficult to find willing participants. The researcher in turn gathered valuable information concerning the different sensing systems which is now used to ensure that the finished product will better fit the needs and desires of the older adults. Thus facilitating an adoption of the technology by the users.

5. Applicable IPR rules

IP generated by the different research partners remains property of that research partner.

6. Information on the partners

Three partners are involved in the Engineers@carehomes project. The engineers which are present in the nursing home (Greet Baldewijns and Gert Mertes) are linked to the AdvISe research center from the KU Leuven. The promoters of both PhD researchers are: prof. dr. ir Hans Hallez, prof. dr. ir. Tom Croonenborghs and prof. dr. ir. Bart Vanrumste.

OCMW Leuven is another partner in the project by providing the accommodation and extra support towards the engineers. The social services from the Eduoard Remy nursing home, in particular Marijs Meul one of the social workers, provide an extra link between the engineers and the different stakeholders. This is done by gathering feedback when the engineers are not present at the nursing home. They are also responsible for the link with the families off the participants and making sure that they also are involved in the project. Finally, Marijs assists in the search for participants for the different formal meetings and for test driving the technology.

The last project partner is InnovAGE. An Mondelaers is our guide in this new venture. With the support of the other InnovAGE members she organizes and chairs the different meetings and makes sure that no communication is lost between engineers and the other stakeholders.

Addendum: Contact information

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References

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