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Embedding Engineers in Elderly Care Homes When Researching New Technologies for Care

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Abstract

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 proposed in this paper.

Keywords: *aging, healthcare, collaborative research, technology*

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Embedding Engineers in Elderly Care Homes When Researching New Technologies for Care

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Introduction

Due to a combination of both high birth rates in the 1950s and 1960s and increasing life expectancy, the number of people above 65 continues to grow. This results is an increase in the demand for long-term specialized care. However, at the same time the group of professionally active people gets smaller. It is estimated that in 2060 for each person older than 65 there will only be two working age people as opposed to four which is the case now (European Commission, 2014). As there is already a shortage in the number of available nursing rooms, and care professionals are already heavily burdened, it is questionable if long-term care will remain affordable for the growing group of older adults.

To compensate for this shortage, policymakers as well as care professionals and informal caregivers look towards the technology sector to provide additional support. They expect clear-cut technology-based solutions for a wide variety of problems coupled with old age. As a response to this question, a lot of technological research groups are focusing their research efforts towards technology which can alleviate the burden of healthcare workers and support older persons who want to live in their own home as long as possible.

This research is focused on a wide variety of application areas within elder care. These areas include for example detection of early onset dementia (Rashidi 2013), monitoring of the fall risk of a person (Baldewijns et al. 2013, Mertes et al. 2015, Howcroft et al. 2013) and automatically detecting fall incidents (Bourke et al. 2007, Xiaodan 2009). For these different application areas, a variety of sensors is used such as radar (Phillips et al. 2012), both 2D and 3D cameras (Baldewijns et al. 2013) and audio sensors (Xiaodan et al. 2009).

The results of this research focus on elder care applications is mainly visible in the large increase in the number of published papers. This is the case for instance in the number of published papers concerning fall detection, an important application area within the technology for elder care research field. To illustrate this increase, Figure 1 gives an overview of the number of papers published per year concerning fall detection as listed in the Medline database.

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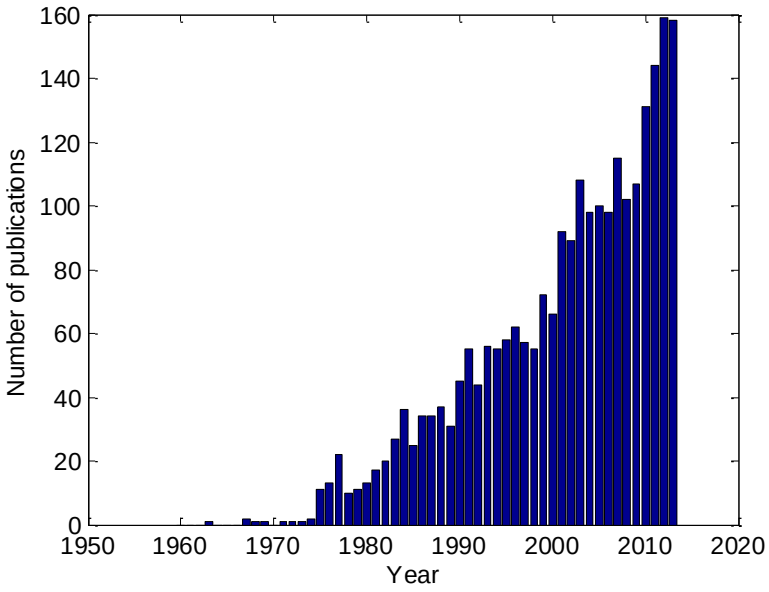


Figure 1: Number of published papers concerning fall detection through the years as listed in the Medline database

It is thus clear that technological research groups can produce long lists of published papers and thus seem to be successful in fulfilling the wishes of the healthcare sector and policy makers. On the other hand, when these new developments are introduced into the healthcare market, caregivers and older adults are often reluctant to buy them.

Pitfalls when researching technology for elder care

As previously mentioned, technological research groups are achieving their aims and can produce large numbers of success stories concerning technology for elder care. In contrast, only a limited number of these developments are successfully introduced into the healthcare market. One important cause for this lack of success is the technology push approach (a new invention is pushed into the market without proper consideration if it satisfies the user's needs) that is often used by technological research centers. Other causes are the limited number of validation tests that are performed and the lack of large-scale clinical trials. The next paragraph discusses these causes in more detail.



Firstly, there are a very limited number of studies concerning the needs of different stakeholders with regards to elder care technology. It is consequently difficult to gain insight in these acute needs when using literature as a research base. Because of this lack in the number of studies, researchers often use their own perception concerning the desires and needs of healthcare professionals, older persons and their informal caregivers as a starting point for their research. This often results in novel technologies that do not match with the actual needs of the different users, which in turn leads to a lot of user disappointment when testing these new applications (Chan et al. 2009). This is for instance the case when data resulting from new technologies is not integrated in existing frameworks, making it difficult for care providers to access the data.

Often only a limited validation study is performed to validate if the new technology reaches all the technical requirements. When considering for instance fall detection algorithms, the tests are often performed in an artificial setting where an often young test subject is asked to perform some basic falls and some walking and bending exercises. Based on these activities, an algorithm is trained and validated to detect falls that do not trigger a high false alert rate. When the majority of these simulated falls are detected and the number of false alerts is low, the algorithm is considered successful. Older persons however usually do not fall in a 'textbook' way. Moreover, they perform a large variety of other activities that could trigger false alerts that are often not simulated when validating the algorithms. Consequently, the performance of these validated algorithms would not be reduced after an introduction in a real life setting (Debard et al. 2012), thus often resulting in an algorithm that looks good on paper, but is not acceptable for a launch in the healthcare market.

Lastly, failure to provide tests on a large group of users often results in a failure to convince healthcare professionals on the validity of the new technology. As with a new drug healthcare professionals demand successful large scale clinical trials before advising their clients on the use of certain technologies. The academic world on the contrary often strives towards a successful proof of concept. Furthermore, clinical trials are very time consuming and difficult to finance, so they are often not done and consequently leaving a lot of healthcare professionals skeptical towards new developments in this research field.

This technology push approach, which is often used in research groups combined with the limited testing and lack of clinical trials furthermore results in a hesitation with companies to invest in the results of these different technological research groups. Hence, the new developments often do not reach the healthcare market and the consumer.

How to avoid some of these pitfalls?

In order to avoid the previously mentioned pitfalls, an intensive collaboration between care providers, healthcare workers, older adults and researchers is needed. Ideally, this collaboration should be set-up during the whole research phase resulting in demand-driven developments instead of the now often used technology push approach.

However, research which is further advanced can also benefit from input of the different stakeholders. The input of these stakeholders concerning this further advanced research could still provide important insights in the usability of the technology, giving the researchers the opportunity to guide their research in a different direction when needed.

Both the demand-driven approach and the guiding of the research when it is more advanced should result in technology that better fits the needs of different stakeholders, therefore eliminating user disappointment when the product hits the market.

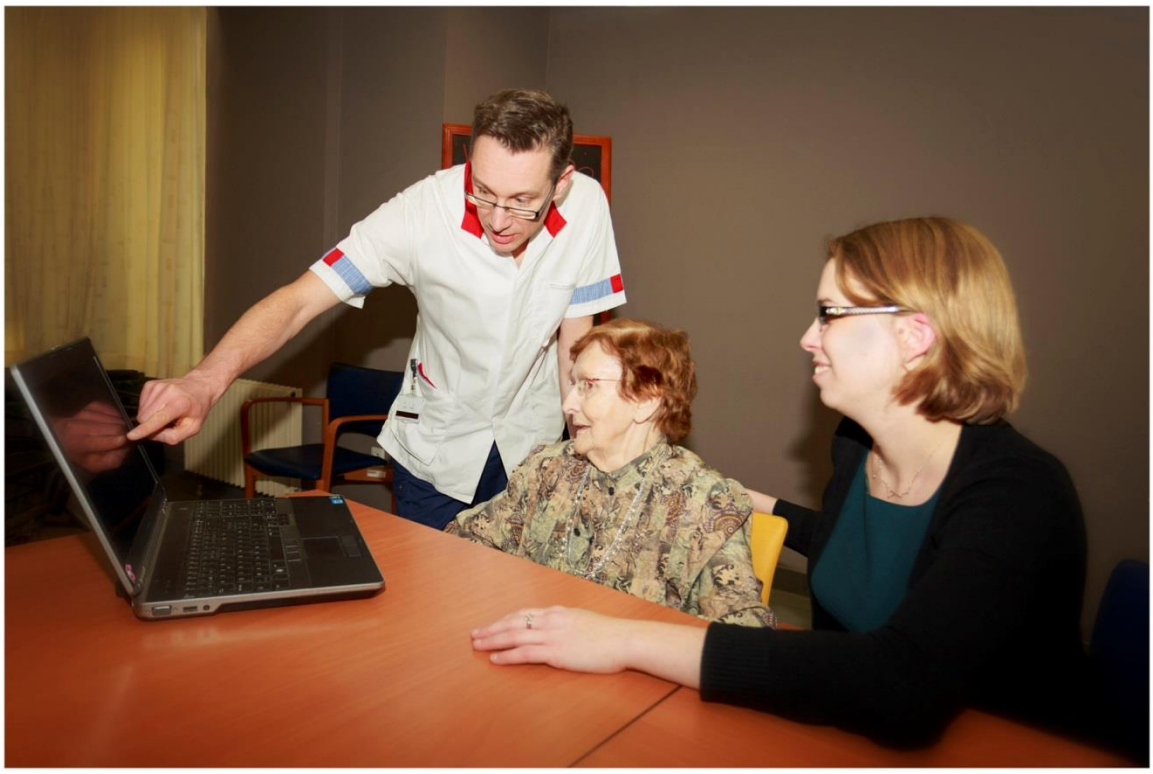
Furthermore, such collaboration opens the door to more extensive user testing of the different technologies as all stakeholders are already involved in the research process. From this testing, researchers will gain important insights in the technical limits of their system, giving them the opportunity to resolve issues which would previously only come to surface after a market launch. It will also provide researchers with the arguments needed to convince companies to take the new technology in production as well as to convince healthcare workers that the new technology can be used successfully.

Setting-up a collaboration between healthcare workers, informal caregivers, older adults and researchers

Setting up such an intensive collaboration between the different stakeholders and the researchers is the aim of the Engineers@carehomes-project through the installation of an engineering lab in a nursing home (Baldewijns et al. 2015). In practice, a biomedical engineer will be present in the nursing home for one to two days a week. During these days the engineer will test drive several technologies together with the different stakeholders.

To insure that these tests are performed efficiently and that the information exchange is optimal an action plan consisting of three work packages was implemented. Firstly, there is a

work package in which the short-term collaboration is set up. Next, there is a work package in which three different technological use-cases are defined to test drive the short-term collaboration set up. Lastly, there is a work package in which the long-term collaboration is set up, based on the outcome of the first two work packages. The 'Engineers@carehomes' project started in January 2015, and even after its two-year period of initial finance, long term collaboration set ups are still being envisioned to take hold over the medium term future.



Short-term collaboration set up

In order to insure that the information between healthcare workers, older adults, informal caregivers and engineers starts to flow as soon as possible, a short-term collaboration strategy was devised. First, two co-creation sessions were scheduled in which different groups of stakeholders were consulted concerning the project and the various technologies that will be used in the use-cases. These sessions were informative and offered the participants the opportunity to voice their opinion concerning both the project and proposed technologies. This shed insight into some of the issues that could arise when looking for participants in technology trials. Most of the raised issues however could be resolved by giving enough information to potential participants. Overall the participants of these co-creation sessions showed a positive attitude towards the project and the technology trials. Four of the five older adults present at these sessions were furthermore interested in participating in the technology trials. During the remainder of the project, similar co-creation sessions will be set up to allow the older adults, their informal caregivers and healthcare workers to voice opinions concerning the different systems and further steer the research when needed.

Although these sessions were and will be very informative for all participants (stakeholders as well as engineers) in this kind of intensive collaboration the information should also reach the engineers, through other channels. To reach this goal, a more informal approach is devised. 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 can be more inclined to voice certain concerns in an open way than during formal meetings, providing the engineer with different kinds of feedback.

Technological use-cases

To explore the knowledge transfer between different stakeholders and engineers, three different use-cases were selected. During these use-cases, the short-term collaboration set up will be tested, and adjusted when needed.

As one in three older adults older than 65 falls at least once a year, falls are a major problem in the older population (Milisen et al. 2004). The first use-case therefore aims to test drive different fall detection technologies both present on the commercial market as well as systems which are currently under investigation in different research centers. Although a lot of research has already been performed concerning fall detection, the input from the different stakeholders can still be valuable for the engineers. As a result of this use-case, engineers will gain insight into what is still needed to develop a fall detection system which is both technically sound (e.g. detection of the majority of fall incidents but with a low number of false alerts) and which the target audience is willing to use. Care providers will gain insight in what is technically feasible, ensuring that the expectations from the care providers match the technological possibilities.

The next use-case focuses on fall prevention rather than fall detection. By automatically assessing the fall risk of a person and triggering an alert when the risk is elevated, appropriate fall prevention strategies can be put in place to reduce this risk, consequently preventing fall incidents. During this use-case, several algorithms currently under investigation to automatically assess the fall risk of a person will be validated. On the technical level this use-case will look for the best parameter to assess the fall risk of a person. In addition, important questions such as which information to provide to caregivers and when and how to present this information will be answered. Again the input of health-care workers, informal caregivers and older adults will provide important insight to answer these questions.

The last use-case will focus on the malnutrition problem in the older population. As 60% to 85% of the older adults living in nursing homes are at risk of malnutrition, this can lead to diminished muscle strength as well as to wounds that do not heal properly (Donini et al. 2013). Similar to the automatic fall risk estimation system, the first step is to identify older adults at risk of malnutrition by automatically monitoring their food intake. After this, preventive measures can be taken to reduce this risk. In spite of the severity of this problem, the research concerning automatic monitoring of food intake with older adults is sparse. Because of this, the use-case will provide a starting point for the development of such a monitoring system. Different sensors that could be used to monitor food intake will be validated on technical soundness as well as on usability for the older adults and the care providers.

Long-term collaboration set up

Lessons learned from the different use-cases will be used to establish a long-term collaboration between health-care workers, older adults, informal caregivers and engineers. Questions that will be answered based on the experience of all the stakeholders include:

- Which communication format provides the most valuable information?
- Which information can be gathered from the different stakeholders in the different technology development stages?
- How can the different stakeholders (health-care professionals, older adults and engineers) be convinced to participate in such projects?
- Which communication format works best for each stakeholder?
- What are, outside these use-cases, important needs of the different stakeholders and future research questions?

The project aims to list all the lessons learned and provide a guideline to inspire other multidisciplinary research groups to set-up similar collaborations. These results will furthermore be used to improve the further collaboration between the partners in the 'Engineers@carehomes' project. This future collaboration can be implemented in different forms. First, there are new project proposals that will be submitted, based on additional wants and needs from different stakeholders. Next, there is the possibility to provide additional support to local companies that want to approach the healthcare market.

Advantages to the proposed collaboration for different stakeholders

The main advantage for the healthcare professionals is the opportunity to provide valuable feedback that will be used to steer the technological research. As a result of this steering, the new technologies will better fit their needs and will thus enable the introduction of this technology in their work environment, possibly alleviating some of the burdens associated with their jobs.

For the engineers, there is the possibility to test drive the technology in a real life setting and hence receive accurate information regarding the technical soundness of their developments. Additionally, a better assessment can be made of the acceptability of their technology. Moreover, the engineers can now include the suggestions of the stakeholders in their research process. The combination of these advantages will subsequently allow for a better valorization and more successful introduction of the finished product on the healthcare market.

While the advantages for professional healthcare workers and engineers are quite clear, the advantages for older adults and their families are initially unappreciated. However, as was apparent during the first co-creation sessions, older adults and their families are quite aware of the importance of their participation in this research for helping future generations of healthcare workers and older adults. This in itself seems to be a huge driving force for participation in the presented project.

Project Risks

The success rate of the project will mostly depend on the commitment of the different stakeholders in the project. The initiative for this collaboration came from the engineers who felt the need to gather input from all the stakeholders during the research process. Not all health care professionals who will come into contact with the project will therefore be convinced of the usefulness of this project. However, critical voices concerning the project aims, use-cases and project set-up are also needed. By engaging with not only friendly users but also skeptical users, a well-balanced view on the project and the different technologies will be developed. Engaging with skeptical users in an early stage of the development process steps furthermore allows countering their remarks in the final product.

Although the suggested method will result in a better product, the approach can be time consuming. It could therefore be challenging to convince companies or other researchers to cooperate in the project. The hope is, however, that more companies and researchers can be convinced to participate in future collaborations when they see the results from this first project.

Lastly, implementing a multidisciplinary research approach could provide additional information for all stakeholders. Combining the engineers approach with that of a business analyst or a specialist in user-centered design could lead to a better overall view of the researched technologies. In future projects such a multidisciplinary approach will certainly be test driven.

Conclusion

Although technological research groups can produce long lists of successful research projects, the results of these projects often do not penetrate the healthcare market. To improve the marketability of these new developments, an intensive collaboration between engineers, healthcare workers, older adults and informal caregivers is needed. The aim of the 'Engineers@carehomes'-project is therefore the setup of such an intensive collaboration by installing an engineering lab in a nursing home. The collaboration will be test driven for three previously determined use-cases. The results of these use-cases will subsequently be used to put in place a long-term strategy for the proposed collaboration.

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