Translating assistive robotic technology to aged care practice

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Summary of final report

This project aimed to bring practical improvements to residential care services for aged care residents through assistive robotic devices, which can work collaboratively with a range of human users; as assistants, as tools and as companions. Working closely with an IRT Expert Advisory Group, the research team set the project's primary objective as designing, developing and evaluating an aged care resident lifting assistive robotic device, the Smart Hoist. Additionally, design, development and evaluation of a walking aid assistive robotic device, the Intelligent Walker, was set as a secondary objective.

Smart Hoist

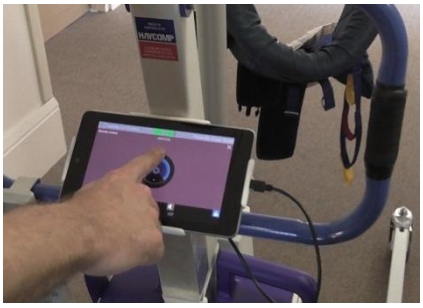
The process of designing, developing and trialling a single Smart Hoist (shown in the figure below) was performed over a period of 20 months commencing in December2012. The Smart Hoist, equipped with several innovative sensors and intelligent algorithms, is designed to provide assisted navigation to aid nurses and care assistants transferring non-ambulatory residents. The primary aim is to reduce lower back injuries in nurses and care assistants, and to improve the safety of nurses, care assistants and aged care residents during transfers. The Smart Hoist provides nurses and care assistants with:

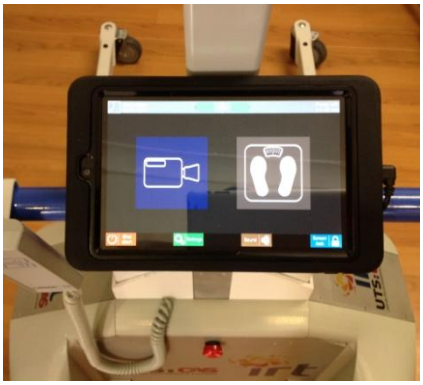
- assisted manoeuvring and navigation
- a resident weight measurement and Body Mass Index (BMI) calculation
- the facility to monitor the environment under furniture and behind the operator, and
- obstacle detection and collision avoidance.

An initial user trial involving 15 volunteers provided valuable feedback and many hardware and software changes to the initial design were made.

Final version of the Smart Hoist

A second trial included 50 care staff and nurses who participated in an interactive training workshop of a complete resident transfer from bed to bathroom in a simulated environment. The exercise included several complex manoeuvres such as lifting a resident from a bed, navigating through corridors and around tight corners and lowering the resident into a chair. The aim of this experiment was to assess the intuitiveness and responsiveness of the Smart Hoist in comparison to a standard hoist in a routine exercise. The outcomes of the second trial upheld the results from the first user trial.





To evaluate the effectiveness of the Smart Hoist in comparison to the standard hoist, a pre-post analysis was conducted to assess eight aspects related to the use of the hoist: swinging, jolting, attachments, seat, assistance, familiarity, strain and satisfaction. Taking into account the nurses' and care assistants' limited experience with the Smart Hoist in comparison to a standard hoist, the pre-post analysis results confirm the hypothesis that the user (nurse or care assistant) can perform push, pull and in place rotation (clockwise and counter clockwise) manoeuvring tasks with much less effort compared to the standard hoist.

Furthermore, we have measured that the standard hoist requires a force of more than 40N per handle to perform push and pull operations, while the Smart Hoist only requires a force less than 30N per handle to perform the same action. In addition, it has been observed that performing an in-place turn with the standard hoist requires much more force confirming that the nurses and care assistants felt significantly less strain while using the Smart Hoist than the standard hoist.

The research team has published two scientific papers related to the Smart Hoist device at two international conferences. Based on the practical experience gained during this project, the research team has also conducted a workshop on the development of socially acceptable assistive devices for use in aged care practice.

In addition to R&D work, the research team, in collaboration with UTS Research and Innovation office and IRT, has exhibited the Smart Hoist device at several events, involving professionals from the aged and health care sector, academic researchers, representatives from industry and the general public.

Intelligent Walker

The second part of the project focused on enhancing a standard walking frame with technology to improve the mobility of aged care residents enabling them to engage in physical activities for longer. This was achieved by adding electric motors to the back wheels and sensors to the handles to make pushing and steering the Intelligent Walker easier.

Similar to the Smart Hoist design approach, the research team used the co-design approach to collaboratively identify the needs of the Intelligent Walker. A small volunteer group consisting of five residents with varying degrees of mobility was formed to take part in the co-design workshops with the Intelligent Walker.

Understanding important factors regarding the use of the device, such as the way the walker supports the user, the way the user's feet move, the way the user applies force over the walking frame and the intended movement of the user, was crucial to build a practical walker. Therefore, after the initial workshops, the research team built a passive Monitoring Walker shown below to monitor and record these vital measurements and patterns. This Monitoring Walker was deployed in August, 2013 at IRT Woonona facility over a month to monitor the usage pattern of several residents with different capabilities.

Monitoring walker

Intelligent walker

The main outcome of this subproject was the Intelligent Walker shown in the above right figure. It is designed for the residents at the IRT Woonona residential care facility while unobtrusively assisting the residents to safely overcome some of his/her physical limitations. The Intelligent Walker is equipped with sensors and embedded with computing designed to recognise the user's intended action. The simple navigation assistance algorithms incorporated in the Intelligent Walker make sure the Walker doesn't bump into things when being pushed around.

Extended trials with the Intelligent Walker could not be conducted due to delays in recruiting residents and extended delays in acquiring some of the critical components to build the device. However, limited trials involving three residents were conducted during November 2014. The feedback received during these trials was incorporated in the device. The Intelligent Walker will be further refined during the upcoming research project "Evaluating the benefits of smart technology in in-home care practice" with IRT.

Summary

The development of socially acceptable robots for aged care practice is a very challenging process. There is much to be learned in the area of assistive robotics as a part of aged care practice in the future. The project provided a huge amount of insight, and acquired very interesting, promising and motivating findings. These findings have demonstrated, to both technical and nontechnical partners, that assistive robotic devices can add significant value to aged care practice in improving the quality of care.

This project was funded through a grant from IRT Foundation.

IRT Foundation directly aligns with IRT Group's mission to create age-friendly communities where older Australians can age without barriers.

We support research projects promoting a greater understanding of the ageing process and the care and wellbeing of seniors. IRT Foundation also funds community grants and educational activities.

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Our Foundation is a key pillar of IRT's commitment to enrich 20,000 lives and give back $20 million in community dividends by 2020. In doing so, we will create age-friendly communities – a society for all ages.

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