

Japan-Sweden Academia-Industry International Collaboration: Challenges in developing a robotic assistive eating device for frail elderly's independent life

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Abstract. This project aims at making a mock-up of a multi grip tool for a robotic assistive device and a camera system which enable frail elderly to live more independently and to keep track of their food intake. The robot will be developed through user centered design with analyses of real use cases in Japan and Sweden. Thanks to the collaborating researchers with a strong applied research approach as well as the companies with a strong experience in engineering solutions in both the Japanese and Swedish teams, the functionalities of Bestic, an assistive eating device, could be enhanced for commercial use, and distributed to municipalities and to the general pub

Keywords: Eating assistive device, user centered design, user test.

1 Introduction

Following the Memorandum of Cooperation concluded in June 2015 between the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Ministry of Enterprise and Innovation in Sweden; in the 2016, the Japan Science and Technology Agency (JST) and the Swedish equivalent Vinnova launched a bilateral call for proposal: Japan - Sweden Academia-Industry International Collaboration Program on Innovative Solutions, Community Design and Services for Elderly People [1]. Building on earlier long-standing fruitful co-operation in promoting and funding Japanese-Swedish research collaboration, JST and Vinnova have decided to work together to promote innovation oriented collaboration involving research organizations and industry in both countries.

The aim of this program (currently under the Phase 1) is for the joint project consisting of one Japanese academia–industry team and one Swedish academia–industry team to develop new solutions and/or to combine solutions in each respective country in order

to propose and verify the innovativeness and potential effectiveness of new equipment, services and community designs [2].

As for the Phase 1, four different projects were selected [3]. As one of the selected projects, our project entitled robotic assistive device with multi-grip tools and vision system for frail elderly's independent life has started in January 2017 and will end up until March 2019. In the following sections, we describe the background, challenges and preliminary findings from our joint meetings.

2 Background

Undernutrition is a large problem amongst elderly. In Sweden many elderly lives alone with the help of home care services and then it is often many different care givers involved, so to keep track of what a person is eating over the day and over time is difficult. These problems occur as well in Japan in the long-term care (LTC) system. Japan and Sweden share the same problem with the demographical development and both countries are robot and technical friendly. This gives a common goal to manage to take care of our elderly 2022.

For most people, chopsticks or knife and fork is sufficient as eating aids. But some need a bit more advanced eating aids due to accident, neurological disease, or congenital disabilities that have caused mobility impairment in arms or hands. Potential users of an eating aid are persons with different neurological disease such as multiple sclerosis, polio, ALS, Parkinson's disease, cerebral palsy, spinal injuries or ataxia.

The eating aid, Bestic, is made to get the food from the plate to the mouth, controlled by the user (Figure 1). The development of Bestic started as a master thesis by Ann-Louise Lindborg at Chalmers in 2004 [5]. Meanwhile, Sten Hemmingsson has established a company around the product, called Bestic AB. The design concept, where contact with the users during the whole development process [4], was focused on getting friendly, kitchen-aid looking shape with the following characteristics: small, quiet and portable.

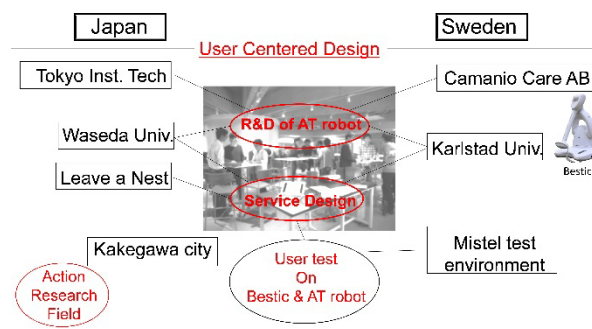


Fig. 1. Overall international organization and approaches to the proposed project

In our project, we are aiming to enable Bestic to new functionalities and to create food intake reports in order to decrease undernutrition among frail elderly. For this purpose, the authors have proposed the following objectives: to adapt the eating assistive robot to Japanese customs and meals; to create food intake reports; to provide new possibilities for independence by adding new functionalities with multi-grip tools and to elucidate the social system that supports frail elderly with eating.

3 Eating device with multi-grip tools and camera

In this project, the authors intend to introduce robotic devices to maintain the independence for elderly that have got decreased functionalities in their arms. To be independent and not need to ask for help or describe how the help/work shall be done is highly valued by most persons. It may also save families or care professionals time. We have a vision for aging society which support and widen the possibility of their independent life by introducing novel multimodal and multipurpose robotic assistive device.

For this purpose, the authors have proposed the following possible approach:

- User centered design and challenge oriented approach
- User tests and interviews to gather data about: the whole mealtime situation, how the assistive eating aid works, how caregivers and relatives are affected and what more do they wish to use the assistive aid for (except for eating for the users) by testing Bestic in Japan and Sweden.
- Agile prototyping of safe multi-grip tool for the eating assistive device in order to widen the usability in different ways.
- Make a feasibility study of the vision system and test different potential applications with innovative technology.

We propose implementation system for both societies based on the investigation on perception of Bestics and the mealtime environment. We will also investigate the regulation barriers in order to create prospective services using robotic assistive devices and the system of society that can provide and ease the use of technical aids.

4 Preliminary findings

After Japanese and Swedish teams joint meetings in Stockholm, Sweden in March 2017, we have the following preliminary findings.

- User test is very important for the success of this project. We can find the possible problems of our proposed system as well as user's needs.
- We need to adjust food preparation on a plate in each country owing to their big differences in eating culture. The Japanese food styles are very different from that of Sweden.
- The related ethical regulations in Japan and Sweden for users' personal data should also be clarified in the early stage of the project

In October 2017 the Japanese and Swedish team met in Tokyo, Japan and had the following actions:

- Internal tests of a multi-grip prototype.
- Workshop in a care facility. It was especially good for the Swedish participants to see a Japanese elderly care facility and to see and try the food that were served to the care takers.
- Meetings for planning and discussing the ongoing work.

5 Challenges to implement and ease the usage of new technologies

In Japan is the custom that children take care of their parents when they get old and in need of help without any other assistances. It is likely that it forces women to bear a heavy burden. In Sweden we have seen problem with caregivers feeling insecure about how to use technical aids. They do not only need to know how to use the new aids but also supporting the user to choose what kind of help he/she wants, even if it is a technical aid. If the caregivers are negative, it is hard for the users to demand to be able to use aids. These cultural and social issues are very important elements to implement robotic assistive devices.

Therefore, in this project, we aim to find a methodology to evaluate assistive devices in Sweden and Japan with the persons involved in the eco-system related to assistive devices for frail elderly, e.g. frail users, care givers, relatives, neighbors and manufactures, etc. In the process of implementing a technical aid to weak elderly we have defined the following challenges.

The development of Bestic started during 2003-2004 by Sten Hemmingsson who developed Bestic for his own use due to polio. During an interview with Sten Hemmingsson done by Ann-Louise Lindborg in Stockholm 5th of December 2017. Karin Hemmingsson, Mr. Hemmingssons wife also attended. The interview was held in English to prevent misunderstandings in translation. After the interview, the answers were sent to Mr. Hemmingsson for approval. He and Karin added a few rows and we have used the answers they sent back. The interview was about what challenges he had met during the development of Bestic and development of the company around it, now called Camanio Care AB.

“What do you think has been challenging during the development of Bestic?”

First of all to find the people with the right fantasy and competence, and to understand that development is an iterative process developing testing, learning from mistakes and never lose sight of solving the problem. Many times you ask yourself a question – is it worthwhile to continue having persons close to you supporting the process. And then there is the money aspect. I have used the factor 3.14 to multiply the time and cost first estimated to arrive at the final result. This comes out of my experience in project management of new ventures.

How do you think that it has been received by the society?

This has been a situation that has matured over the years from a rather negative attitude from the start to an acceptance. An example of this is that Bestic is funded by public means for the individual users in Sweden.

How long did it take?

Now we have been working with Bestic for 13 years. We started to work with Bestic 2003-2004 and the first one we sold was 2012. But then we met quite a lot of skepticism. Today the interest is much more positive.

What would you think are the main factors to facilitate aid-robots to merge into society?

Man machine interface, developing the robot, if you like, in such a way that gives a natural interface to the individual without sacrificing integrity and independence, the machine shall never be allowed to take over from the individual. One should be careful using the right description of what you are offering – Bestic is in the true sense not a robot as important functions are controlled by the user. However, robot technology is used in the development of Bestic.

What would you think is the main role of industry and academy when developing aid-robots?

Industry because a lot of ideas behind development has been tried and tested, the academy to give scientific input and understanding of the needs. Both for the individual and society at large.

What would you think are the possible consequences while merging aid-robots into society?

Needs and adaption of programs for caring for people. The work environment will change for quite a lot of caregivers. Then there is the question of different age groups. The generation now growing up are used to surround themselves with advanced technology. There is also the question of culture – what is considered a good development can very well meet resistance elsewhere.“

Based on the knowledge from our network and the persons in this project, we aim to find a methodology to evaluate assistive devices in Sweden and Japan with the persons involved in the eco-system related to assistive devices for frail elderly. In the process of implementing a technical aid to weak elderly we have defined the following questions."

1. What do the user think of the assistive device?
2. What do the persons involved in the eco-system related to assistive devices think of it?
3. How can the community around frail elderly best support them?
4. How do you clarify the roles and responsibilities of stakeholders related to the decision-making process of purchasing and paying for AT-device?
5. How do we best evaluate the value and efficiency of technology for homecare?
6. What is the costs for different parts of homecare? Can it be reduced with assistive devices?
7. Is care is generally managed from the care givers' perspective rather than user's perspective?

8. How do society work with the implementation process of new technology since it will lead to new work routines?
9. What makes innovations difficult to classify in current product registers for assistive devices?

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