PraxLabs as a Setting for Participatory Technology Research and Design in the Field of HRI and Demography

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ABSTRACT
In this paper, we choose a perspective on HRI from the standpoint of user-centered IT design for the aging society. Service robotics is an innovative research field with many hopes and visions aiming at leveraging the upcoming challenges of ageing societies. Many scientific disciplines contribute to the development of the scientific discourse, e.g. in form of technological innovations or sociological reflections and examinations of related discourses. However, from the perspective of user-centered IT design we see many challenges and opportunities not tackled thoroughly yet that will be discussed in our paper. We argue that our specific research approach, realized in the Siegen *PraxLabs* projects (based on Living Lab concepts, but different to most examples by long-term engagement in real user households) may contribute to the needs of HRI research, particularly in the field of service robotics for the ageing society.

Categories and Subject Descriptors
D.2.10 [**Design**]: Methodologies.
H.5.2. [**User Interfaces**]: Methodologies, User-Centered Design.
J.3. [**Computer and Society**]: Computer-related health issues.

General Terms
Design, Experimentation, Human Factors.

Keywords
User Needs, Ageing Society, Methodology, Living Lab, User-centered Design, Evaluation, Service Robotics.

1. INTRODUCTION
Research on service robotics is being seen as a promising offer for future strategies for both, industry and society. It promises attractive rates of economic growth and the creation of new jobs and at the same time responds to the challenges of demographic change. Technical feasibility and economic efficiency, however, cannot be the only factors in the introduction of robotic devices. Technology acceptance of the involved stakeholders plays a significant role and is influenced by socio-cultural backgrounds, legal and ethical considerations as well as social, psychological and individual factors.

From the viewpoint of personal approaches, the field of research thus seems to encompass controversial views, anxieties and stereotyping from both, researchers' and end-users' perspectives in imagining future practices on the basis of robotic support. We would like to contribute to this challenge in introducing the Siegen *Praxlabs* approach based on Participatory Design and ethnography-based technology design.

2. DESIGN METHODS FOR THE FIELD OF "IT FOR THE AGING SOCIETY"
Designing for and with elderly and technology non-affine end-users needs particular considerations to develop products that find a sustainable place in every-day life contexts. Barriers to technology adoption exist in a huge spectrum, which are based on low usability of devices, on low technology competences of the target group and – to a major extend based on social issues, such as hetero- and stereotypes based on societal and individual images of aging, of gender conceptions, etc. [10]. We think that these social barriers are even stronger in such a controversial field of research such as robotics. That's why we would like to introduce our methodological approach of the Siegen *Praxlabs* and transfer it on related methodological questions in robotics.

2.1 University of Siegen *PraxLabs*
Siegen *PraxLabs* combine the following methodologies: **Living Lab methodology** (see [11], [10], [1] and [9]), based on **Ethnography** and **Participatory Design** ([3]). In contrast to many Living Lab approaches our *PraxLab* research takes place in real households and every-day life contexts of end-user groups in long-term perspective (several months to years). By this overly holistic approach, the socio-cultural environment of the future target groups can be taken into account and thus researchers are able to span up a wider perspective on technology adoption by elderly and technically no-savvy people (such as mindscapes, overall concepts, and attitudes of future users towards new technologies). By creating close every-day proximity in the design process, it is more likely that researchers and user groups can establish a common sphere of communication, understanding and by doing so, enabling the design of realistic visions of future user scenarios.

This aspect is even more important when focusing on *older adult* users of technology (*older adults* defined here as being already retired or in the final stage of their professional life). In our multiple former and recent research-projects related to aging (see below), we found older users with a varying degree of experience, ranging from completely inexperienced over elementary knowledge up to sophisticated users of technology. These differences are not only determined by individual preconditions and preferences, but also largely by their every-day life and social context (for instance the regular contact to younger family members).

All of our projects aim at encouraging social participation and interaction to foster social wellbeing for elderly people by means of new media, e.g. smart phones, computer applications or interactive television. Cooperation with real households is our standard, from early pre-studies over prototyping phases to

evaluation of functional devices. In the following, some of our current and recently completed projects will briefly be described to provide an overview of implementations of our concept:

FoSIBLE: An AAL-funded 3-year project working with a local senior' club and 5 couples to co-design and evaluate iTV/furniture solutions with the aim to foster social interaction, especially for those people who have less social networks.

TOPIC (The Online Platform for Informal Caregivers): another AAL-funded EU-project that develops a digital information- and support platform for informal caregivers (30 households in Germany, France and Austria) to be used via Tablet-Pcs and Smartphones in their homes and everyday-life.

iStoppFalls: Aims at preventing falls and encouraging exercise of older adults with individual training programs via interactive television with 15 households over several months (also 3-year cooperation). In the center are questions of motivation as well as on joint sporting activities in order to prevent falls, a major source for getting care-dependent in older age.

Alzheimer Monitoring: The project investigated the design of navigation aids for people with dementia and provided location-based systems for people with dementia in advanced stages. A long-term evaluation within two families and two care homes was carried out.

SehrMobil100: The project aims at the mobility support for elderly people in the Siegen area. One of its goals is to improve the present mobility on offer, e.g. through barrier-free access to public transport. Its basis is a close cooperation with a local seniors' association and 15 households (elderly couples and singles).

2.2 Main criteria of the *PraxLabs* approach

Our proposed approach of implementing a relevant R&D design space for HRI in socially assistive robotics for an aging population is centered around a living lab based setting which includes the end-user in the middle of all activities, and in continuous co-work together with science, industry and policy makers (see Figure 1).

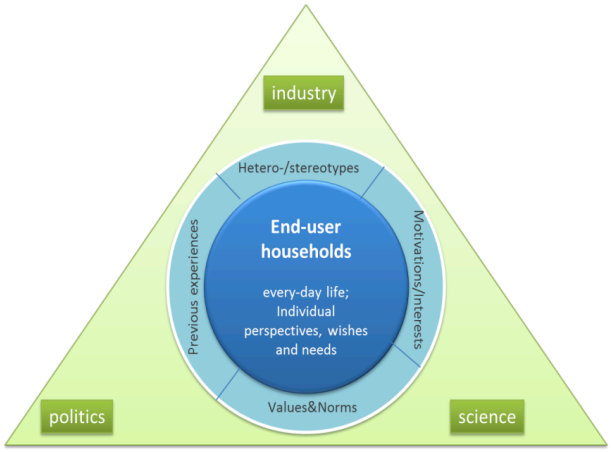

Figure 1. *PraxLabs*: phases and stakeholders [10].

Most important advantages of the *PraxLabs* approach are:

- Participation of real user households (or institutions) over a long-term period
- Set-up of a common design space among scientists, producers/providers, and users
- Main opportunities of the *PraxLab* approach can be seen in:
  - ***Exploration:*** by means of empirical (pre-)studies, common design activities with all stakeholders, and long-term prototype evaluations. By this identification of user needs and user perspectives, discourses and stereotyping of themes may become visible.
  - ***Co-Creation*** also comprises helping users to articulate their needs and helping them to improve their media competencies. Typically co-creation is built on action research-based approaches and participatory design.
  - ***Evaluation*****:** Users test functional prototypes in long-term real-life perspectives (over weeks/months/years). During these phases subsequent improvements and re-designs of the prototypes are being created.
  - ***Experiment*****:** This approach allows for practice-grounded development of different scenarios. By this, scenarios may include a deeper grounding in existing social settings, and include perspectives on relationships and situated and individual constellations.

3. SOCIO-CULTURAL ISSUES IN A *PRAXLAB* INFRASTRUCTURE SET-UP FOR HRI IN SOCIAL CONTEXTS

The advantages and opportunities described above have been reaffirmed in all of our projects. Nevertheless, this specific research and methodological approach is accompanied with a couple of requirements for the researcher as well as for the individual setting, involved people and households. Aiming at a long-term engagement and cooperation in a very private, often intimate setting (especially when sick family members are involved) means that the creating of an atmosphere of mutual trust, sensitivity and responsibility of the researcher is more than a catchword and needs time and commitment. These efforts are largely responsible for the success by getting access to the field of research, but also during the whole, long process of working together with elderly persons as co-researchers.

3.1 Access to the field

The development of test infrastructure in *PraxLab* research (i.e. real households or care institutions over a long period of time) often poses the first real challenge of the whole process. The first hurdle of user-centered design research with robots might be that some people are frequently reluctant or afraid to address the topic – and most certainly do not want to do it at home. Access for HRI design processes might prove to be even more complicated since no appropriation and learning processes have been possible yet due to the limited availability of such technologies on the market (in contrast to other countries such as Japan). Furthermore, subsequent social discourses have mainly been restricted to the exchange of visions.

3.2 Working with the elderly as co-researchers

Robot assistants are often being designed as possible aids (like a daily calendar assistant or for therapeutic work like the well-known PARO, see [2]), especially for elderly people with physical and cognitive restrictions [16]. When the application partners are restricted, practical design reaches its limitations as one must keep in mind possible scenarios of injury to the vulnerable. Evaluation

and appropriation areas have to be considered and furnished especially sensitively in order to secure the most successful solution to the conflict between the highest possible application and practical use with the least danger to application partners.

Especially for this group of elderly and handicapped users, questions of *acquisition and control* arise: How can the acquisition process for this potential group of users of the robots be realized to be particularly promising? Especially when dealing with people with restricted cognitive abilities, awareness and memory (like elderly [2], [15], [16] or people with dementia, [7]), researchers have to figure out an appropriate way to impart the knowledge.

Furthermore: Who will be in charge of the controls for the robot aid in every-day life? Supporting the autonomy of elderly and perhaps sick people is an important matter to the field of assistive technologies. With an eye to HRI research, the subject has gained new relevance that should be considered: how can a person control a robot when s/he is reduced in her/autonomy through a disease? So-called adaptive assistance systems and corresponding algorithms (KI) will play a considerable role in this, and must be enriched and validated by relevant ethical and legal aspects.

4. SOCIALLY ASSISTIVE ROBOTICS FOR THE AGING POPULATION: STATUS QUO AND FUTURE NEEDS

In the research field of socially active robotic assistance the status quo of available technology has already reached a considerable state of functionality and opportunities regarding basic behavior of assistive autonomous systems in real-life contexts of human beings. In real-world scenarios of daily living senior-assistive robots are sometimes moving and acting like kids, exploring more and more indoor and outdoor scenarios of assisting the elderlies, in order to achieve their first real world experiences and to learn how to behave and react socially in later life. But based on the projected life-cycle model of scientific research and outcomes in the domain of HRI and assistive robotics for the elderly, more socially based and related questions are appearing at the horizon of R&D, after more basic ICT and AI related challenges have successfully been solved recently and in the past.

Those socially based R&D challenges in the near future will aim for solutions and answers regarding social needs, attitudes and expectations in order to make robotic assistance truly useful and acceptable for the elderly population. In addition, ethical, legal and social principles need to be developed and evaluated to steer possible scientific and technological developments and thus the final robotic application to human and social needs (see [5]).

And there are already some R&D projects on their way addressing those important research questions like user-acceptance in real-life scenarios and associated needs by validating assistive robotic technology in Living Lab approaches, like Robot-ERA and DOMEO [5], [6]. Nevertheless, this research and evaluation methods were primarily carried out in either an arbitrary setting, i.e. not in users homes or outdoors [6] or only addressed socially-inactive robots. Whereby in the latter project [5] only activities of daily living (ADL) were evaluated in a rather socially active robot (tablet interface in a moving robot).

What we could learn from our current and past ICT based AAL projects focusing on non-autonomous assistive technology in various settings for elderly care and independent living is pointing into the direction that the needed R&D setups for exploring HRI for assistive robotic in the elderly population needs to be supported by more *PraxLab* oriented R&D settings, actively involving all users in their real-life circumstances, attitudes and practices, especially when dealing with socially active robots in independent daily living and care settings of an ageing population.

Even in our non-autonomous assistive technology applications a lot of ethnographical and socially based variety and heterogeneity of older adults could be observed which really defined a need for *PraxLab* based R&D settings [9], [10].

5. CONCLUSIONS

In reference to our experiences so far and as mentioned above: It's too easy to use stereotypes and to conclude that older people are general technological opponents, that they refuse to accept technology in general and robots in particular. But there is in fact a great variety of the degrees of the previous knowledge about technology as well as personal preferences for some kind of technology. Taking these preconditions seriously, methods are necessary that enable us to accompany the iterative co-design process properly and to gather the data from this highly complex personal context in order to use it for the design and evaluation process. From our point of view, *PraxLab* based research can be a very appropriate methodological access to examine the use and support the co-design and further development of socially assistive robots for older adults living independently at home or in care facilities.

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