Design of an Assistance System for Elderly Based on Analyses of Needs and Acceptance

Stefan Lutherdt[1], Carsten Stiller[2], Katrin Lienert[3], Sabine Spittel[3], Fred Roß[2], Christoph Ament[2], and Hartmut Witte[1]

[1] Ilmenau University of Technology, Dept. of Biomechatronics
[2] Ilmenau University of Technology, Dept. of Systems Analysis
PF 10 05 65, 98684 Ilmenau, Germany
[3] AWO Alten-, Jugend- und Sozialhilfe gGmbH
Pfeiffersgasse 12, 99084 Erfurt, Germany
{stefan.lutherdt,carsten.stiller}@tu-ilmenau.de,
lienert@awo-thueringen.de,sabine.spittel@awo-thueringen.de,
{fred.ross,christoph.ament,hartmut.witte}@tu-ilmenau.de

Abstract. The changing demography requires new kinds of support for elderly people. The project WEITBLICK aims to give seniors assistance to gather information about several services and their providers, relaying the access to such services and offer them in an individualized manner. To determine the requirements of elderly users a broad analysis will be performed in four stages. To fulfill the aims of the project the system has two principles incorporated: the service relay can be triggered by the users' former activities or by the users actively themselves. The base for both is a database with user and service profiles.

Keywords: assistance system for elderly, requirement analyses, user and service profiles, changing demography, information gathering, individualization.

1 Introduction and Motivation

Besides normal but individual changes (in a medical-statistic meaning) dissociations of physical and cognitive abilities become more important relatively and absolutely because of demographic shifts and an increasing life expectancy. Highly mobile Dementia patients as well as mobility handicapped with normal mental and social abilities surrounded by young people are going to be not the exception but the accustomed way in everyday life. The growing need of assistance in daily-life executions and activities is an extra-risk which is no longer securable by the national insurances but belongs more and more to general, not assurable life risks. At one hand this will be boosted by an increase of spatial and social mobility with the linked breakup of classic families as the former generation-overall structure of solidarity. At the other hand women's part in our society changes towards working women, which are no longer all-time available service providers for their families. This situation will get more complicated by the increase of single-person households. The percentage of single households has changed f. e. in Thuringia[1] from 25% in 1991 to 38% in 2006. Further

[1] Thuringia: a German Federal State with about 2.3 million inhabitants.

C. Stephanidis (Ed.): Universal Access in HCI, Part I, HCII 2009, LNCS 5614, pp. 96–105, 2009.

38% of persons from these households were older than 64 years. (Data from Thuringian State Office for Statistics, given from AWO).

By now it is an across-social consensus that changing demography of our society as mentioned above also causes new requirements on support for elderly people. This group will grow more and more like is to be seen in fig. 1. It is expected that in 2020 the German population will consists more from people over 60 years than all other in working age.

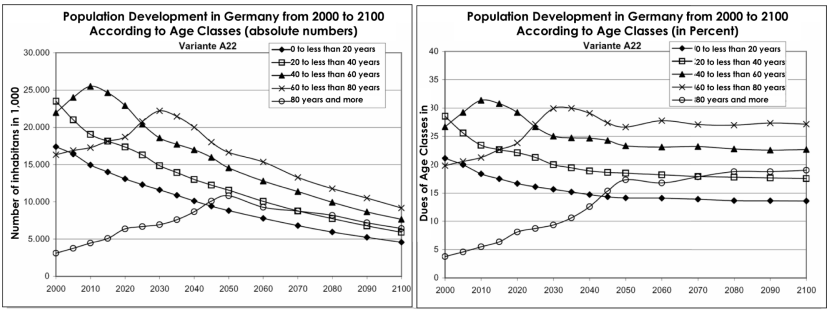

Fig. 1. Population development in Germany until 2100 according to age classes [acc. to 1]

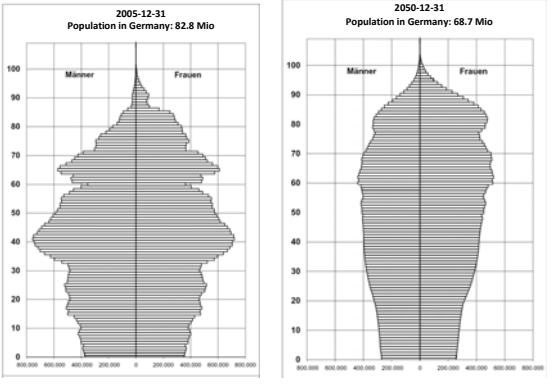

Fig. 2. Population development in Germany until the year 2050 (population pyramids according to [1])

This above-mentioned fact already has an effect today in health- and custodial care areas. So the number of long-term care facilities in Thuringia has increased by 6% (693 absolute) between December 2005 and December 2007 and the number of ambulant custodial services by 3.3% [2]. During the same time the number of patients has ascended to 72,213, which is an increase of 7.7% [3].

Additional to this rise of the absolute numbers the (future) seniors will be more active and mobile and have a higher level of technical affinity (and experiences) than seniors today. This also causes new requirements for assistance systems to organize their daily life.

2 Aim and Core of the Desired System

Employees in social care services are more and more confronted with off-topic tasks. But as they work in rigid organizational structures (because of the assignment of tasks of these care services) they cannot react flexible to day-to-day accumulating wishes of their patients: The coordination of services coming from outside does not belong to the duties of the care personnel. But there is an insufficiency for people with mobile deficits or discrepancies between cognitive and physical mobility, which enormously complicates the self-determined organization of the daily life. Even meetings with like-minded people become to an exception because of the lack of adequate communicational facilities. The left hand side of fig. 3 shows the situation described above schematically.

Fig. 3. Organization of daily life without (left) assistance and with the newly assistance system for elder people (right) (according to [4])

To design an assistance system with the focus on these organizational issues like shown at the right hand side of fig. 3, a consortium was founded by partners from science, economy and eldercare. This consortium with the funding by the German ministry of education and research (BMBF) has the ambitious aim to create, design and prototype an interactive assistance system for seniors with several grades of autonomy, activity and mobility. This system will be both integrating and individualizable. With the system described here deficits in support of elderly should be overcome to realize a better access to necessary information, attendances and to other elderly with the same interests and similar conditions. This access is an essential component to a self−determined arrangement of daily-life routines. At the same time the system is able to compensate mobility deficits by an individualized planning as well as to optimize the custodial services. With the deployment of the system it is possible for elderly people to extend the residence in their own domesticity. Furthermore the system brings benefit to the eldercare service provider.

The core of the system is its capability to adapt to personal preferences and psycho-physical conditions of users. Thereby questions of age-correlated perceptual and mobility constrictions play a decisive role as well as the eligible interest of the elder, their relatives and the operating company on safety aspects. Therefore components for

personal monitoring and tracking on an individual settable level and components for data and communication security are integral system elements.

The main and most important element of the system will be a broad but complementary communication structure linked with a dynamically self-adapting knowledge base. By this general structure it is possible to request services well adjusted to the needs, to coordinate the supply chain of services and to integrate (new) users into the system. The kind of services, which are integrable and relizable within this assistance system is not limited. But during the first stage the main focus lies on care and custodial services and spa added by social activities.

3 Technical Components and Principles

To fulfill this complex needs it is necessary to design the system as much adoptable to the user as possible. Therefore the aim is to create a platform capable of dealing with a wide selection of handling concepts, preferable concepts already known to the users. Possible devices to interact with the system include stationary systems as TV/set-top box-combinations or personal computers as well as mobile systems like PDAs, mobile phones and specially designed easy to use front-ends. The deficit of lacking information caused by the missing ability to interact with modern technical devices can also be addressed if the "interface" to the system is represented by the social interaction with a care giving person. All these diverse ways of accessing the system require a flexible communication infrastructure as described in [5].

Information deficits as described above can lead to decreasing social contacts and loneliness. To remedy those deficits an "Assistance Module" is implemented for the system. It is used to relay services to users who otherwise possibly would not know about these services. For that purpose two basic principles of gathering information from the system had been described in [6]:

- A user initiated service relay starts with a query to the system, which is then augmented by information from a user profile, including interests and abilities. A recommender system is used to match this query with service profiles to select one or more possible services. If necessary additional information, i.e. about availability of services at a certain timeslot, can be added after an enquiry to the service provider and as a last step the recommended services are shown to the user. (See fig. 4a)
- An event initiated service relay (shown in fig. 4b) might be triggered by previous actions of the user, i.e. to recommend a transport service to a previously booked opera concert, or to inform users about new services entered in the system. In contrast to the former procedure in this case the recommendation process is used to predict how services match to users. If the event does not specify the services appropriate service profiles have to be found in the first step. These service profiles are then matched with the user profiles and the according interests and abilities of the user. Here again the event itself can specify the user or a range of users can be chosen by the system.

Further development within the project will include a "Monitoring Module" to assist users with different deficits. One application is the monitoring of spatial boundaries for Dementia patients. An individualizable route planning and navigation algorithm

developed in a previous project (see [7] for details) will be integrated into this module to provide personalized navigation for each user.

Both modules described here will be implemented to give an example how further functionality can be added to the system. To open the system to other system providers to add their existing services and functionality standardized interfaces are used. Thereby it's possible to support and augment existing services from care and recreational domains but also to offers the opportunity to create new services not realizable or existing before.

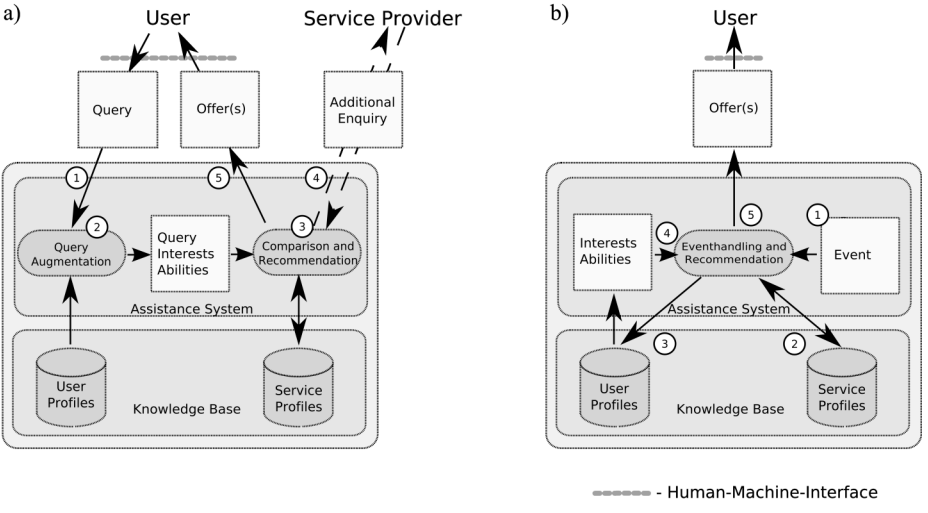

Fig. 4. Offer relaying in the WEITBLICK assistance system [6]. a) user initiated relaying, b) event initiated relaying.

4 Strategies to Fulfill the Users Needs and Expectations

As shown in previous research projects (e.g. TAS – a tourist assistance system for handicapped, see [8, 9, 10, 11]) it is necessary and beneficial for the outcome to involve potential future users into the development process at a very early stage. This maxim of usability engineering has also to be incorporated into the design and development of assistance systems. Because of the lack of time during such projects on one hand and in most cases also a lack of an adequate number of available test persons to execute multiple cycles of design iterations, a widely linear design process should be performed. But the wanted information has to been gathered to reach the design goals anyhow. To bridge this gap two main strategies will be applied:

1. Shifting the complexity from the commonly cyclic executed design items toward the analysis and determination of the user's requirements at the beginning of the whole process, especially to an extensive study of their needs and tasks.

2. To avoid that the system will be created only from a very technical point of view it is necessary to involve experts from social and health services into the design process. Their task is to supervise all stages of the development process and to compare consistently the results with the user terms.

5 Execution of the User Requirement Analysis

5.1 Common Analysis and Questions

It is obvious that the first task to solve is to bring all relevant information about services and activities they can use to the seniors. But the group of these so-called "seniors" is highly heterogeneous. This leads to a large variety of interests and abilities and beyond that to a different grade of acceptance of technical equipments and the use of it [12, 13].

The requirements of elder people and their use, acceptance and approach to technologies were well and often analyzed in a number of studies like project *Sentha* from the TU Berlin [14]. Norbey [15] analyzed the use of home entertainment technologies by seniors of different age classes partly in the same area in which the project WEITBLICK will be executed (see [18]). But in this project the focus does not lay on technologies of home entertainment, and otherwise the results of these studies are not unlimited representative for the project aims. Another interesting system called SOPHIA (see (http://www.sophia-tv.de/) does not cover the area of WEITBLICK because it has the focus on emergency tasks.

Because of this lack of information and the general strategy of this project (see chapter 4) a broad requirement analysis was planned and already partially performed. The base of all examinations is the two modules of WEITBLICK: the assistance module and the monitoring module. For both of these modules the acceptance and the needs have to be determined. To simplify the inauguration process of the test persons into the special problems of the system design three model scenarios were defined:

- Scenario "HOME" contains typical, every-day actions in home environments of self-dependent living seniors including basic outdoor activities like shopping, hairdresser, hobbies, cultural events and basic care services (home assistances)
- Scenario "MOBILE" contains typical and every-day actions around assisted living and home for aged with all their particularities under inclusion of hobbies, walking, visits of relatives and care services (home assistance)
- Scenario "ACTIVE" covers activities like day trips, (short-time) holidays, leisure-time activities and so on including the use of the previously developed tourist assistance system (TAS, see [10])

5.2 Executing of Requirement Analysis

Based on a review of literature, congresses and other projects as well as first contacts with the addressed users some initial hypotheses were formed to start the analyze process. These first hypotheses where that the users are strong affected by their actual living condition and their biography, esp. their profession and their social status (esp. family structures). Another wide influence is expected from age and existing

handicaps or diseases. The acceptance of and interest in new technological items is expected to be very poor and to depend on the (visible and perceptible) benefit for the elderly users.

The starting point for examinations was the usually executed analyses during the usability engineering in other technical areas like software development (see Section 4). The whole process was parted into four stages (qualitative and quantitative parts):

- Initial expert interview (structured interview with about ten experts)
- Pretest with a set of questions given by the expert interview (five to ten potential users by a guide-lined interview)
- Focus group (about ten persons covering all of the three scenarios)
- Interrogation in form of individual or small group interviews (at least ten of each scenario, altogether 30-40 persons) for quantitative analyses

For the finished guideline-based expert interviews twelve persons were recruited from all domains involved around the future system. Those were relatives of long-term care patients, employees and executives of these long-term facilities, staff of information centers and personnel of ambulant services.

The focus group will be oriented at facilitation guidelines for focus groups by Krueger [16]. Special considerations for those focus groups with elderly like suggested by Barrett and Kirk [17] should be following in achievement of the analyzed interviews. The usefulness of focus groups for this user clientele was already demonstrated amongst others by Demiris et al. [18]

6 First Results

So far the expert interviews and first pretest interviews (currently not analyzed) were executed. During the expert interviews 550 minutes of data were gathered. All interviews were transcribed; the data were extracted, counted and analyzed according to Grounded Theory [19].

The first analyzes confirm some results from Friesdorf and Heine [14], who state that elder people are not generally reluctant to new technologies. This is shown amongst others by the high rate of used electronic devices used for gathering information (57.1% of all nominations) and of the existing electronic devices (20 nominations, amongst these five times telephone, mobile phone and PC three times each). Of course this is influenced by the fact that everyone has a TV set and is using it heavily. But only 21.4% named the TV as the main information source, but the same rate named the Internet (both three times). The most important way to get information about services and special activities is word-of-mouth-recommendation (50% of all interviewees) and different kinds of print media (which was named 24 times by the 14 interrogated). The most named in this category were “Gathering information by daily press and local newspapers” by eight interviewees and “Notices or placards”[2] by six interviewees. This shows the strong local affected answers because these media are only accessible in a small surrounding around the area where the interviewees live

[2] These notices principally could hang everywhere, but a control question had shown that the interviewees meant notices within the care facilities and assisted living houses.

and work. It appears that the most influence to the seniors by word-of-mouth-recommendation have the care service employees (71.4% of nominations) and other seniors (28.6%). Nobody named the family in this item.

Another interrogation item was possibly missing offers for the seniors. Here the experts were not in complete agreement. At least five of them said that there are no offers missing, the remaining distributed the nominations to care and supervision offers (four interviewees), to engagement offers for the seniors (eight nominations) and subsidiary assistance offers (nine nominations). A special focus was laid by three of the interviewees on periodic recurring offers regardless of which kind.

The estimation of the attendees concerning possible problems in everyday life of seniors brought out two emphases: problems with missing health and various kinds of diseases (14 times) and problems with simple everyday activities (like shopping, cooking and so on, 17 times). Third place of nominations reached missing mobility (nine times).

Very important for the further design work were the information about design details of the new system as well as its user interface components. Eleven times the attendees estimated that the system should have or use a (large) display, maybe with touch functionality. Of course they want a simple use (six times), easy understanding and handling (six and three times). Other items with more than two nominations were: handy or light-weight, big and easy to find, accessible and everywhere usable, always with support function.

The kind of information gathering depends on the kind of living facility. Individual ways like print media or electronic devices will be used by self-determined living seniors in their own domesticity or in assisted living facilities. Word-of-mouth-recommendations, notices and placards will be more used by residents of long-term care facilities.

The decreasing mobility caused by several diseases and age-related problems leads to transport problems to and away from offers outside the residence and finally to miss an appointment or activity offer.

All of the answers (and therewith the whole design process) are remodeled by the age and the personal biography of seniors. These items will be a good first indicator for a classification in combining with abilities or existing handicaps to choose the right user interface and kind and amount of wanting information.

7 Conclusions for Further Work

From the data of the expert interviews some hypotheses and operation guidance for the further work can be extracted. At first it is indispensable to explain in detail the meaning and benefit of an assistance system in that area of life - as well for the employees in custodial services as for the seniors as the first addressed use group. Activity offers outside of the facilities are as far as possible irrelevant, the same applies for cultural and sport offers. Here is a lack in retrieving information about such offers as well in the integration into the daily life routines. That boosts the project because it is one aim to fill this existing gap with an assistance system for all involved.

With the extracted results and hypotheses the focus groups and user interviews will now be executed to get more information about interests, missing offers, the kind of a

possible use of the system as well as of the offers. These interviews will be analyzed quantitatively and qualitatively to get the initial data to form the database and its query algorithms. Also from these data some basic design decisions will be derived, especially about the used front-end and user interface(s).

Acknowledgement. This paper emerged from a project funded by the German Federal Ministry of Education and Research (BMBF) under the support code 01FC08029 named "WEITBLICK". The authors would like to thank all the involved members of staff of the Ilmenau University of Technology from the Depts. of Communicational nets and Audiovisual Technology and the partners from outside the University: the AWO Alten-, Jugend- und Sozialhilfe gGmbH, Falcom Wireless Communications GmbH in Langewiesen and KDS Services GmbH & Co. KG, Erfurt.

References

1. Birg, H.: Die demographische Zeitenwende - Der Bevölkerungsrückgang in Deutschland und Europa. C.H. Beck, München (in German). Data and images (2003), http://www.herwig-birg.de/downloads/simrechnung/
2. Thuringian State Office for Statistics. Press Release 366: 389 Ambulant Custodial Services and 304 Stationary Long-term Care Facilities at the End of 2007 in Thuringia. Actual Index of Ambulant and Stationary Long-term Care Facilities in Thuringia Released (in German) (2008), http://www.tls.thueringen.de/
3. Thuringian State Office for Statistics. Press Release 367: More than Every 32nd Thuringian Was in Need of Care at the End of 2007 (in German) (2008), http://www.tls.thueringen.de/
4. WEITBLICK Knowledge Based Technologies and Services Adjusted to the Needs of Seniors by Individualized Care Concepts. Grant Application of Ilmenau University of Technology to the German Ministry of Education and Research (BMBF), Support Code 01FC08029. (in German) (2008), http://foerderportal.bund.de/foekat/jsp/
5. Renhak, K., Stiller, C., Schade, H.P., Seitz, J., Schön, E., Roß, F., Ament, C., Hildebrandt, H., Oswald, M.: WEITBLICK – Wissensbasierte Technologien und bedarfsgerechte Leistungen für Senioren durch individualisierte Care-Konzepte. In: Proc. of Usability Day VII 2009, Dornbirn, Austria (2009)
6. Stiller, C., Roß, F., Ament, C., Renhak, K., Seitz, J., Schön, E., Schade, H.P., Hildebrandt, H., Oswald, M.: WEITBLICK – Infrastruktur für eine bedarfsgerechte Dienstleistungsvermittlung. In: 2. Deutscher AAL-Kongress 2009, Berlin, Germany (2009)
7. Stiller, C., Roß, F., Karimanzira, D., Rost, R., Stein, M.: A Framework for Individualized Route Planning and Navigation for Pedestrian Users. In: Proc. of 51st IWK 2006, Ilmenau (2006)
8. Lutherdt, S., Fröber, U., Witte, H., Kurtz, P., Wernstedt, J.: Development of assistance systems for user groups with specific handicaps – a challenge for the ergonomic design process. In: Proc. XIX ISOES 2005, Las Vegas (2005)
9. Fröber, U., Lutherdt, S., Stiller, C., Roß, F., Witte, H., Kurtz, P.: The design of a tourist assistance system for several handicapped and elderly. In: Proc. of IEA 2006 - 16th World Congress on Ergonomics. Elsevier Ltd., Amsterdam (2006)

10. Lutherdt, S., Witte, H.: TAS – Touristisches Assistenzsystem für Urlaubs-, Freizeit- und Bildungsaktivitäten – Ein InnoRegio-Projekt der TU Ilmenau. In: Leidner, R., Neumann, P., Rebstock, M. (eds.) Von Barrierefreiheit zum Design für Alle – Erfahrungen aus Forschung und Praxis, AG Angewandte Geographie Münster e.V. Heft 38. Münster (2007)
11. Roß, F., Lutherdt, S.: Abschlussbericht TAS - Touristisches AssistenzSystem für barrierefreien Zugang zu Urlaubs-, Freizeit- und Bildungsaktivitäten Förderkennzeichen 03I2808. Technische Universität Ilmenau (2006)
12. McCreadie, C., Tinker, A.: The acceptability of assistive technology to older people. Ageing and Society 25, 91–110 (2005)
13. Hensel, B.K., Demiris, G., Courtney, K.L.: Defining Obtrusiveness in Home Telehealth Technologies: A Conceptual Framework. Journal of the American Medical Informatics Association 13(4), 428–431 (2006)
14. Friesdorf, W., Heine, A.: Sentha – seniorengerechte Technik im häuslichen Alltag. Ein Forschungsbericht mit integriertem Roman. Springer, Berlin (2006)
15. Norbey, M.: Die Erwartungen älterer Menschen an Geräte der Unterhaltungselektronik – Ergebnisse einer explorativen Studie. Diskussionsbeiträge, Inst. für Medien- und Kommunikationswissenschaft, TU Ilmenau, Ilmenau (2007)
16. Krueger, R.A., Casey, M.A.: Focus groups: A practical guide for applied research, 3rd edn. Sage Publications, Thousand Oaks (2000)
17. Barrett, J., Kirk, S.: Running focus groups with elderly and disabled elderly participants. Appl. Ergon. 31, 621–629 (2000)
18. Demiris, G., Hensel, B.K., Skubic, M., Rantz, M.: Senior residents' perceived need of and preferences for "smart home" sensor technologies. International Journal of Technology Assessment in Health Care 24(1), 120–124 (2008)
19. Flick, U., von Kardorff, E., Steinke, I. (eds.): Qualitative Forschung. Ein Handbuch. 4. Auflage, pp. 32-42. Rowohlt Hamburg (2005)