ICT for Housing

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1 Introduction: ICT for Housing - an Enabling Technology for Living at Home in Old Age

The World Health Organization (WHO) defines Active Ageing as "the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age. Active ageing applies to both individuals and population groups" (WHO 2002, p. 12). Leaving the question of existential provisions aside, for Europeans this translates into: prolongate the time span in which people can live in a decent way in their homes.

The topics "ICT for Housing" and "ICT for Health" are very closely connected. The history of ICT for housing for the elderly started with social, nursing, and medical support for elderly people. From this point of view it is impossible to discuss the topic "active ageing" and "ICT for Housing" without also considering ICT for health. This is the reason why in the following both topics are combined.

As a rule the location for health treatment and advice is a practitioner's ward and the hospital. In the following we will outline how the home might become the third location, if equipped by intelligently designed applications of information and communication technologies. A short history of ICT in (home) health care will reveal that technologically things have not really changed that much since the invention of the telephone (2); however, it is rather the design of the application of technological systems and the actual underpinning with accompanying services which is the bottleneck(3; 4). Here we confront a patchwork of concepts and pilot projects which would need some more clear structure and direction (5).

2 A Brief History of ICT for Housing

2.1 Phone Chains

ICT for housing designed for older people is not an invention of the 21st century. Early beginnings of ICT for housing in Germany can be traced back to the early 1970's. Phone chains were organized by elderly people themselves or were initiated by professionals. A phone chain uses the standard telephone equipment. A group of persons forms the social component of the phone chain. Whenever one member of the chain does not react to incoming calls the caller initiates a predefined action (e.g. informing the doctor or the kin). This ancient form of ICT for housing is in use to this day and is even a promoted by professionals (Görgen et al. 2002, p. 35).

2.2 Home Emergency Call Systems

The next step in ICT for housing were home emergency call systems. This development came along with the reorganization of ambulant nursing services.

Until the 1970's ambulant nursing in Germany was carried out mainly by district nurses. They were organized and financed by the Protestant and Catholic church. As fewer and fewer young women were willing to be a district nurse and the number of active nurses was steadily reduced by retirement, ambulant nursing in Germany had to be reorganized [1] . The result of the reorganization was the "Sozialstation" (social welfare centre). In 1970 the first German welfare centre was founded in the city of Worms (Weber 2005). In the old days of ambulant nursing one district nurse alone took care of a rather large number of patients. In the new social welfare centre, the district nurse became a member of a team of professionals. Such stations are (partly) funded by the state and health insurances. In the following years the new model of ambulant nursing spread out all over Germany.

In 1974 the St. Willehad-Hospital in the city of Wilhelmshaven opened a social welfare centre. It was the first hospital in Germany, which opened such an organizational unit. Along with the new organization of ambulant nursing a new approach was developed to improve the ambulant patients' situation by the use ICT.

[1] http://www.diakoniestation.de/default/geschichte/geschichte.htm

The hospital's administrative director Wilhelm Hormann experimented with ICT in ambulant nursing and today can be looked upon as the "father" of the home emergency call system in Germany. During the second half of the 1970's experimental versions of the system were developed. One of the first prototypes was a wireless system (Paul 1976). Its development stopped, because the "Deutsche Bundespost" (the former federal agency for mail and telecommunication) did not provide the reqired frequencies. Furthermore the reliability of the wireless equipment was not sufficient at that time. The following prototypes used the telephone net. In 1981 the time of experiments was finished and the HTS831 was presented (Marx 2006, p. 60). The system had been developed by the firm AEG. AEG also developed the technical equipment for the emergency call service centre. Later the AEG lab, which had developed HTS831, became a part of " BOSCH SICHERHEITSSYTEME" (Seibt 2005). HTS831 was a box, which was connected to the telephone line. Frequently the customer's telephone was placed on top of HTS831. The telephone and the box could be used without any modification of the telephone line. HTS831 had a red and green button. In case of emergency the user pushed the red button and was contacted by the emergency centre. If the user was unable to reach HTS831, he or she could initiate an emergency call via the "Funkfinger", a wireless transmitter, which the user wears like a necklace. The green button had to be pushed at least once a day. If the user did not send this signal, he or she was contacted via HTS831. If she or he did not react, the centre initiated a predefined action.

When Wilhelm Hormann started the development of home emergency call systems in the 1970's, similar projects were initiated in other European countries (e.g. France, Great Britain, Sweden, Switzerland) as well (Hormann 1980). Still it took until 1981 when the German Red Cross installed its first Home Emergency Call System in Berlin.

2.3 The Virtual Residence - A Video-Conferencing Based Emergency, Communication and Service Centre

In the early 1990's again a new type of system emerged in the area of ICT for housing: In contrast to the older systems not only audio-information but also video-information was transmitted. In 1991 the "Haus-Tele-Dienst" (Home-Tele-Service) was established. "This has been world-wide the first fully interactive broadband video

communications project implemented in a real setting and operating over an extended period of time."(Stroetmann et al. 1999).

In the middle of the 1990's the Institute for Work and Technology (IAT) invented the "virtual home for the elderly", a new concept for living at home in age. The technical basis of this virtual residence was a video conference system. In the "virtual residence", in reality the well familiar home, the range of services offered should not differ from that offered in real (good) residences for the elderly (Hilbert et al. 1999). IAT's theoretical approach was tested in a pilot project called TESS inkontakt (Teleservices für Senioren - Teleservices for Seniors). TESS was carried out by Evangelisches Johanneswerk, one of the largest providers of health care of the Diakonie, the German social welfare organisation of the Protestant church[2]. The technical infrastructure was provided by German Telecom, the successor of Deutsche Bundespost.

The technical core of the "virtual residence for the elderly" was a communication and coordination centre, which was connected to the elderly's apartments. The data were transferred via ISDN. In the participants' apartments video telephones respectively TV sets with setop boxes were installed. One important additional feature was the video conferencing with up to eight participants.

The centre offered the following services:

- responses to emergency calls
- responses to calls for "small talk"
- organization of different services: medical, nursing, entertainment, nutrition, household services etc. (Hilbert et al. 1999)

The project's results were rather ambivalent: The participating elderly appreciated TESS, especially the video conferences. Hence, while at the beginning of the project they had to pay no fees. only a few of them resigned when they were asked to pay for the TESS-services. The elderly had no problems with the handling of the visual telephones and modified televisions. Massive problems however occurred on the providers' side. The providers of technical, social and nursing services did not succeed in establishing a convincing and sustainable business concept. Such a concept was required to offer the innovative service on a continuous basis. The reasons for these problems were manifold. On the one hand in the beginning of the pilot project it was not clear, when the required technical equipment would be available at acceptable prices. On the other hand both involved firms - the social service

[2]http://www.johanneswerk.de/index.php? id=371

provider and the telecommunication provider - had quite some difficulties to agree on whether TESS would make sense for them or not. Both firms were deeply involved in ongoing processes of business reengineering at that time and did not really care for details. At the end of the day, however, TESS inkontakt could be labelled a successful barrel burst. As a concept it was a ground braking innovation, which was probably the reason why it was accepted in pilot projects, but did not find its way to the mass market.

3 Current Applications of ICT for Housing and Active Ageing in Germany

3.1 The Current State of Home Emergency Call Systems: Moderate but Steady Growth

The following table allows a comparison between the subscriber rates of home emergency system in different European countries.

Home Emergency Call System in Europe

Country	Inhabitants	> 65 Years	Subsribers	% > 65
Great Britain	57,7	9,2	3,500,000	37,9
Germany	82,2	18,4	350,000	2,9
Netherlands	15,1	1,9	180,000	9,2
France	59,3	8,0	175,000	2,2
Sweden	8,9	1,5	150,000	9,2
Spain	40,0		80,000	
Finnland	5,3		60,000	
Danmark	5,3		42,000	
Austria	8,1		25,000	
Switzerland	7,3		25,000	

Source: Bundesverband Hausnotruf

2,9% of the Germans older than 65 are subscribers of the home emergency call systems. In comparison with other European countries, this is a small number. In Great Britain there are about 3,5 Millions persons (37,9% of the British older than 65) subscribers[3] . In Sweden and the Netherlands 9,2% use it. In France only 2,2% of the people older than 65 use home emergency call systems.

[3]http://www.bv-hausnotruf.de/

To analyze the reasons for the different subscriber-rates in Europe, and thus to find out about reasons and modalities for the acceptance of such services, could be an interesting field for research, particularly if you compare the UK with the rest of Europe. One reason for the high subscriber rates in the UK might be that persons over 60 years and with income less than 20,000 £ do have not to pay for its use[4] .

From the beginnings in the 1970' s with a small number of subscribers the German home emergency call system expanded to a nation-wide one with more than 350,000 subscribers in the beginning of the 21st century . In September 2006 the German Red Cross, the largest German provider of home emergency call systems announced its 100,000th subscriber (Marx 2006, p. 56). Other important German providers are Arbeiter-Samariter-Bund, Arbeiterwohlfahrt, Johanniter-Unfall-Hilfe, Malteser Hilfsdienst, and Volkssolidarität.

While the technology of the home emergency call systems developed itself moderately over the years, the offered sevices changed from "emergency call" to "service call" (Marx 2006, p. 35). The system is not only used to call for help in emergency, but also for the organization of help for housekeeping, shopping, ordering meals on wheels etc.

Since 2006 the German Red Cross offers a mobile emergency call service via mobile telephones. For the localization of persons the Global Positioning System (GPS) is used. If the mobile telephone cannot receive the GPS-signal, the person can be localized by using the signals of the Global System for Mobile Communication (GSM). In metropolitan areas the localization via GSM is very exact. In rural areas the localization can be somewhat imprecise (Walter 2006).

3.2 The Current State of Video-Based Systems: Prepared for Roll-out - since 15 Years

In contrast to the only audio-based home emergency call systems, video-based systems are still in a nascent state with a small number of subscribers. Some of the video-based systems are promoted by public or private housing enterprises. These enterprises are confronted with the fact that the tenants of their flats are growing older. Although

[4]http://www.helptheaged.org.uk/en-gb/AdviceSupport/HomeSafety/PersonalAlarms/as_peralarm_040106_4.htm

increasing age does not nessescarily mean increasing demand for social and medical support, older people in general have to cope with a an increasing number of age-specific health problems and impediments (Kruse et al. 2005).

As each housing enterprise is interested in minimizing the vacancy rate, they have to offer specific services for older tenants to keep them as customers as long as possible. One example for the combination of housing and (ICT-based) elderly specific services is SOPHIA (Pfeuffer 2006). The acronym SOPHIA stands for "SOziale Personenbetreuung - Hilfen Im Alltag – Personal Social Services - Help in everyday Life". Its ICT-components have been developed by the University of Bamberg[5] , the social and economic components by "SOPHIA Wohn- und Lebensqualität GmbH & Co. KG"[6] . The core component of SOPHIA is the service centre, which is ready to serve day and night.

Current components of SOPHIA are:

- communication with the neighborhood and the kin
- services: houskeeping, shopping, ambulant nursing, arranged by the service centre
- personal Security by a home emergency call system

Planned components of SOPHIA are:

- telecare by cooperation with telemedical centres to monitor patients after stroke, cardiac insufficiency, management of chronic wounds
- telehealth: virtual consultation of doctors

In 2005 about 100 households had a SOPHIA-installation[7]. The "SOPHIA Wohn- und Lebensqualität GmbH & Co. KG" is a firm located in Bavaria. Partners are several Bavarian housing enterprises and several social welfare organizations. In Northrhine-Westphalia meanwhile the SOPHIA NRW GmbH[8] has been founded; Bavaria and North-Rhine-Westphalia (NRW) are the two largest states in the

[5]http://www.uni-bamberg.de/wissenschaftl_einrichtungen/zentren/centrum_fuer_betriebliche_informationssysteme/news_ce_bis/sophia_hilfe_fuer_senioren/

[6]www.sophia-tv.de

[7]http://www.senivita.de/sophia/presse.htm

[8]"SOPHIA Wohn- und Lebensqualität GmbH & Co. KG"

Federal Republic of Germany. Owner of SOPHIA NRW is THS[9] , one of NRW' s biggest housing enterprises. THS plans to establish further SOPHIAs in some other federal states of Germany.

Another example for the activities of housing enterprises in combination with ICT for housing is the project DOGEWO21[10] . This is a project of "Dortmunder gemeinnützige Wohnungsgesellschaft mbH" in cooperation with several Fraunhofer Institutes[11], which deliver the research and development capacities.

3.3 Interim Conclusions

On the whole the degree of utilisation of Information and Communication Technologies for active ageing at home is rather disappointing in Germany:

- the traditional telephone based home emergency call systems indeed record a continuous growth over the last 25 years. However in comparison with the United Kingdom and Scandinavia the number of subscribers in Germany is astonishingly low.
- in the development of the video conference technology for innovative emergency call and service systems German providers started early. But to date were not successful to establish them as a mainstream application. This is all the more surprising as the majority of the users appreciated the video based systems.

4 The Next Generation: Telehealth Monitoring and Ambient Assisted Living

As outlined in the previous chapter in Germany it is difficult to adopt and implement advanced ICT for active ageing. Yet these circumstances have not deterred German researchers and developers to devise even farther reaching concepts. Hence the next generation of (model) ICT for active ageing will be shaped by telehealth monitoring and ambient assisted living.

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[9]http://www.ths.de/presse/index_presse.php?
CONTENT=PRESSEINFODETAIL&AKTNEWS=510&TSID=ababf7737870e5d81
65f0537a39ae38f

[10]"SOPHIA Wohn- und Lebensqualität GmbH & Co. KG"

[11]http://www.iuk.fraunhofer.de/index2.html? Dok_ID=70&Sp=1&MID=977

4.1 Telehealth Monitoring as an Application of ICT for Housing

Home emergency call systems enable users to call helpers to their apartments in cases of emergency. Telehealth Monitoring Systems enable users to carry out diagnostic and monitoring actions by themselves in their apartments, which formerly had been carried out by medical professionals in hospitals or doctors' practices.

An example for telehealth monitoring in the area of cardiac diseases is AUTARK (Körtke et al. 2006). The acronym AUTARK stands for "ambulant and telemedical based follow-up rehabilitation after cardiac interventions". The AUTARK-project was devised and conducted at the Institute for Applied Telemedicine (IFAT), founded in 2003 and attached to the "Heart and Diabetes Centre North-Rhine-Westphalia", which in turn belongs to medical faculty of the Ruhr-University Bochum. Participiants in AUTARK during their treatment in hospital were trained in the application of a mobile electrocardiograph (ECG), which is shaped more or less like a cell phone and which they took home when they left the hospital. In cases of cardiac problems the patients record an ECG and the result is immediately transmitted via an integrated telecommunication device to the respective hospital unit. The actual progress is that rather easily and without asking too much of the patient "Patient data, i.e. so-called vital parameters such as ECG, INR values, blood sugar levels, weight, blood pressure, heart sounds, as well as up-to-the-minute cardiovascular and metabolic data, can be sent directly by patients from their homes to our hospital for evaluation. This system is especially effective in detecting acute coronary syndrome, an imminent apoplectic fit, facilitating prompt and appropriate diagnosis and therapy. Telemedical controls (or telemedical consultations) are also especially well suited to all other cardiac and diabetic diseases." resumes IFAT' s director Heinrich Körtke[12] .

Similar services to those delivered by IFAT are meanwhile offered by a growing number of further providers. One example for such a firm is the "Personal HealthCare Telemedicine Services GmbH"[13] .

At the moment telehealth monitoring for housing is dominated by applications for cardiac and diabetic diseases. But other diseases can be monitored in this way, too. One of these diseases is traumatology, the study of wounds and injuries and their treatment.

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[12]http://www.hdz-nrw.de/en/centre/institutes/telemedicine.php
[13]http://www.phts.de/ueberblick.html

The firm Teltra (Telematic Traumatology) offers a "tele ward-round"[14]. In hospital the patient is equipped with an electronic camera and is trained to make pictures of his/her wound. Back in his apartment, he/she regularly takes pictures of the wound, which are transmitted to the hospital, where doctors can monitor the process of healing.

In spite of several encouraging developments, telehealth monitoring as an application of ICT for housing is far away from being a standard procedure in medical treatment. As far as we know at the moment there are no studies which systematically compile, describe and analyse the use and effects of telehealth monitoring in Germany.

4.2 Ambient Assisted Living, Ambient Intelligence, and Intelligent Houses

Video-based home emergency call systems are being prepared for rollout since 15 years - but rollout is still being waited for. Nevertheless the next innovation of ICT for housing has arrived: Ambient Assisted Living (AAL) and Ambient Intelligence (AmI).

"In a short way Ambient Assisted Living may be defined as the use of AmI in everyday life. Assisted means assistance, by technical devices as well as by technical or human services". (Giesecke et al. 2005, p. 44). The most important technical devices of AAI are small computers, most of them invisible for users. These computers are frequently wireless networked and have numbers of sensors to collect information about their environment. Additionally they have actors to manipulate their environment. The concept of AAL and AmI is based on considerations of Mark Weiser on "Ubiquitous computing" (Weiser 1991)[15].

The systems of ICT for housing described in the previous chapters needed no or only little additional dedicated hardware. ICT for Housing with the label Ambient Assisted Living, however, implies the use of much additional hardware and networking. The promotors of AAL for housing intend to construct "a flat or a house, that cares for its inhabitants, monitors and shelters them. "[16]

Main components of AAL-centred ICT for housing are sensors, actors, (body area, local area, wide area) networking, and (invisible) computers. Monitored by sensors are kitchenware, windows and doors

[14]http://www.teltra.org/cms/site/index.php? id=24
[15]http://www.ubiq.com/hypertext/weiser/SciAmDraft3.html
[16]http://mn.offis.de/smarthomes/
20070628_SmartHomeWorkshop_OFFIS_Brucke.pdf

(open/close), temperature, heating etc. The actors can manipulate the monitored devices. The kitchen stove is switched off automatically, if the cook forgot to do it. The heating is switched off as well, if a window is opened in winter. Additionally monitored are vital parameters of the inhabitants of the "intelligent" house. Either the monitoring of the vital parameters is done the way described in the chapter above, or it is done by a wearable. A wearable is a garment, that contains sensors, which continuously monitor vital parameters of its bearer[17] .

The wearable' s sensor is part of a Body Area Network (BAN)[18] . The BAN transmits the data collected to the Local Area Network (LAN) of the "Intelligent" House. The LAN transmits the data via a connection to Wide Area Networks to a remote medical centre.

One important player in the field of AAL is the Massachusetts Institute of Technology's (MIT) Department of Architecture. It's "house_n research" "is focused on how the design of the home and its related technologies, products, and services should evolve to better meet the opportunities and challenges of the future. Massachusetts Institute of Technology researchers are investigating methods for merging new technologies with person-centred design. They are generating new ideas, technologies, and methodologies that support the creation of innovative products and services that satisfy the emerging and future needs of people as they live in their homes."[19]

In Germany the counterpart to MIT is the Fraunhofer-Gesellschaft (FhG), "the largest organization for applied research in Europe"[20]. The FhG has set up the "inHaus-Innovation-Centre"[21], which consists of two components:

- inHaus1: residential properties, opened in 2001
- inHaus2: commercial properties, in 2007 still under construction

The goals of MIT' s house_n and the Fraunhofer's Inhaus are very similar.

Meanwhile the European Union has discovered its interest in Ambient Assisted Living, too. This interest ended up in the preparation of a new European technology and innovation funding programme: "The

[17]http://www.wearable.ethz.ch/tps.0.html
[18]http://www.ban.fraunhofer.de/index_e.html
[19]http://architecture.mit.edu/house_n/intro.html
[20].http://www.fraunhofer.de/fhg/EN/company/index.jsp
[21]http://www.inhaus-zentrum.de/site_en/

programme is intended to address the needs of the ageing population, to reduce innovation barriers of forthcoming promising markets, but also to lower future social security costs. AAL aims - by the use of intelligent products and the provision of remote services including care services - at extending the time older people can live in their home environment by increasing their autonomy and assisting them in carrying out activities of daily living"[22]. The start of the funding is expected for 2008.

"Europe Is Facing a Demographic Challenge. Ambient Assisted Living Offers Solutions" is the title of a country report, which was compiled in preparation of the funding programme described above (Steg et al. 2006). This is a very optimistic view, when you take into consideration that AAL has still remained in the phase of research and development. Both German and international experiences in the field of video-based home emergency call and service systems teach the lesson that the way from research and development to a working application and business model more often than not is much longer and stonier than anticipated.

5 Summarising Interpretations and Recommendations

Many research and development projects have demonstrated that ICT for housing offers opportunities to support living (comfortably) at home in age. Yet in spite of these results especially Germany has difficulties to use the potential of ICT for housing:

- home emergency call systems needed 25 years to find 350.000 subscribers
- video-conferencing-based systems have not left the state of pilot installations since 15 years
- telehealth monitoring is struggling for future prospects
- ambient assisted living for the time being is only a topic for insiders in the research and development business.

To date there are no scientific studies which would explain the reasons why ICT for housing in Germany is so difficult to implement. One most beloved by politicians is an alleged "German technophobia"; however, in most cases this has proved to be rather nonsensical. More

[22]http://www.aal-europe.eu/

serious arguments worth to be followed up might be found along the following, though still speculative, assumptions:

- in Germany many social workers, gerontologists and caregivers perceive technical support and enabling systems as inhuman; instead they see face to face contact as essential. They believe the quality of help would suffer if it is technically supported or even substituted.
- under the influence of the above argument social and health politicians are reluctant to provide financing of services discussed in this article or to put them on the list of accepted treatments of statutory insurances respectively. Hence, as long as politics, industry and insurances play the game of log-rolling any more encompassing concepts will be moving beyond reach
- many engineers have little understanding and little knowledge of the world of social work and care for the elderly and they have a certain reluctance towards "participative" strategies of development and design. Therefore they have difficulties to design systems which would fit real life conditions of larger numbers of elderly and working conditions and concepts of social workers
- many pilot projects can only be started with the aid of public funding. The public financiers expect "successful" developments. Under this constraint pilots are more promising than large scale applications which always involve risks – particularly in the intersections where technology and "traditional"social services meet
- though large numbers of pilot projects, working groups, professional circles and societies exist in the field, there is no systematic development of technical norms nor coordination and communication about results and outcomes, so that many projects necessarily end up in the archives.

As has been shown in this article the bottleneck for the implementation of ICT to support living at home in age is not technology – rather it is the "philosophy" of development strategies, design and fit with the circumstances of everyday life of the elderly and caregivers. Technology is no end in itself. It makes sense only when it really "supports" people to fully utilize their options. From this point of view the present patchwork of pilot projects, model applications and aims definitely need more streamlining, structure and direction, if investments, both past and future, are expected to return profits. Hence the current debate (in Germany) whether it makes sense to compile and to adopt a “Masterplan Telehealth Monitoring” is more than overdue.

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