AmIE
Towards Ambient Intelligence for the Ageing Citizens

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Abstract: This research presents a system, currently under development, which aims at providing an intelligent ambient able to improve the quality of life and delivering customized support to elderly people in need of assistance, according to their own specific situation, and in a non-intrusive and respectful way.

1 INTRODUCTION

Celebrating a 100th birthday is a privilege only reserved for a happy few. However through modern technology and medical progress, these 'few' have grown to a bigger group than ever before. People older than 64 in the euro area are about 18% of the total population in 2005 and it's supposed to grow up to 30% by 2050 (Eurostat Yearbook, 2008). Thus this situation has favoured the need to exploit technologies that address the issues posed by demographic ageing and trying to decrease the costs of health-care systems because so far it seems very high. Technologies that can support independent living at home rather than being institutionalized are envisaged as one of the main solutions for a significant reduction of health-care costs.

The research described in this paper has addressed these needs developing a comprehensive reliable adaptive distributed service system that can serve multiple categories of elderly people, assisting them in their everyday life, helping them to stay independently at home as long as possible and moreover, increasing their comfort and safety and social wellbeing. In following, the related research addressing aging citizen's needs (with position of our research in the field) are discussed in chapter 2. The intelligent distributed service system and targeted applications are presented in Chapter 3. Market opportunities are discussed in Chapter 4. Finally, Chapter 5 concludes the paper identifying further R&D challenges still faced by researchers.

2 RELATED RESEARCH

The use of information technologies for assisting people with medical needs and for enabling ageing citizens to manage their well-being and safety has been considered in the recent past. Various existing initiatives can be divided in four big groups:

- Robots
- PERS-systems
- Domotics and sensor networks
- Video telephony and iTV

With the rise of more advanced robots, their usage for elderly care has increased slowly. In many of the projects however, the robots, which were created for a more generally purpose, are being reused for the elderly (Shinozaki et al., 2005), which may cause the problem. The main advantages are that a robot can give the elderly an immediate feedback on his or her actions, reacting on the spot of external stimuli. Furthermore, a robot can also be used to execute physical work of which the elderly is

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not capable anymore. On the other hand, robots can not replace human touch in everyday life assistance.

PERS (Personal Emergency Response Services) are the best-known elderly assistance systems at the moment (Porteus and Brownsell, 2000, Kenchiku, 2005). The system acts as an emergency button for elderly to press when they are in trouble. Also more automated solutions with activity monitoring features are available. The great advantage of the PERS systems is that they are a relatively easy to deploy as use.

Domotics and sensor networks have started its uptake about a decade ago (Fellbaum and Hampicke, 2002, Van Berlo and Fellbaum, 1999., Van Berlo, 2005, MOBILALARM, 2005), but because of its high purchase price only recently more and more elderly homes are including it in their buildings. One example is the Besta-flats in Norway. But domotics, as some robots, are made for a broader public and only later repurposed for the elderly. However they also offer big advantages: they are passive and non-intrusive technologies which make them very comfortable and safe for the elderly.

iTV (interactive Television) was originally represented as a means of linking individuals together by providing each with an electronically mediated representation of the other's voice and visual presence (Wellens, 1979), providing a way of deploying video telephony service. This type of user interaction based on "social television" concept, is nowadays being exploited into many other different new services for all the inhabitants at home, thanks to the development of the Internet, broadband communications and specific devices such as STBs (Set-Top-Boxes) and mobile phones.

Obviously, four groups are complementary, meaning that only a combination of technologies could be positive and really profitable for the elderly. Moreover, through these complementarities and their own progresses, these technologies and services for users at home seem to trend to a seamless integration. For example, some domotic systems include teleassistance service (PERS) -even a step ahead with a telemedicine service-, and can be controlled by a TV set with a remote control or even a touch screen. Thus presented research, referred here as AmIE (AmIE, 2008), tries to observe the best practices from technologies discussed above, emphasising unique features of non-intrusiveness and versatile adaptability of the offered services.

3 AmIE SERVICE SYSTEM

The main building blocks of AmIE service system are presented in Fig.1. The heart of the systems is the Intelligent Rule Engine. The AmIE system operation is based on the rules which are defined by means of interactions with health care professionals. Rules define when and how to provide help, compensate some behaviours, uplift the person, keep track of the behaviour and send alarm signals. The system also monitors vital parameters such as pulsioximetry, electrocardiography, temperature, blood pressure, heart rhythm, breathing and glucose level. In this case rules enable the system to understand for example when those medical parameters are low or high and consequently generate an alarm, when and how the system should interact with the user in case of behavioural disturbances, emotional or memory problems and to support the user during activities of daily living.

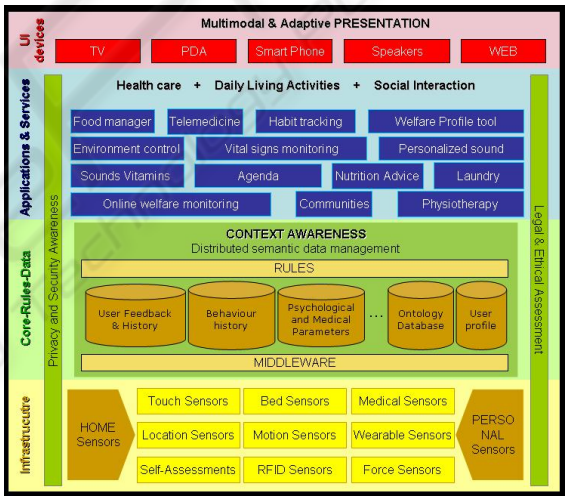

Figure 1: AmIE service system – building blocks.

An environment equipped with an infrastructure of sensors and actuators, including body sensors, medical devices, domotics equipment, RFID tags, as well as sensors of various kinds (temperature, humidity, pressure, movement and presence detectors, etc.) monitors what happens in the space and collects data of various kinds and log behaviours. Data collected by the sensors are processed, interpreted, stored, correlated, and ultimately mapped into decisions and decision rules. AmIE will be able to discover hidden information applying Data Mining techniques over collected data, identifying, in some cases, patterns and correlations between these data that could reveal trends and future users' behaviour, making in this

way predictions based in the medical and behavioural history of each user. Key components of service system are context-awareness and databases whose task is to digest all the raw data and to learn and act based upon it. Such system intelligence is partly centralized (i.e. home server) and partly distributed.

The adaptive system intelligence enabled by innovative developments and technologies in the domain of sensors data fusion, semantic modelling and automatic reasoning of information coming from different sources (sensors, user profiles, calendars, home agenda) will insure the reliable personalised on demand service delivery.

Security and privacy implications are concerned particularly when employing sensing technology and recording/monitoring behaviour of people. Furthermore, the issue of personalization involves storing and using an embedded user model for the purposes of automatically selecting and adapting functionality and services offered. It is important to keep the user informed about the data that will be collected and how it will be used. Obviously, this is all related to legal and ethical issues too, managed by an Ethical Committee.

3.1 Applications and Services

The scenarios below give an idea about applications and services provided by AmIE system.

Wellness Evaluation. Anna is a 75-year-old woman who lives in her own apartment. AmIE system gathers automatically online information about her current wellness status. An online wellness profile is estimated by combining data from several sources. The system collects sensor data from wearable sensors, environment sensors, wellness self-evaluations, social proximity (nurse, family, friends,…), health record information, etc. The online profile can be utilized by Anna herself, relatives and health care professionals to personalize the services offered to Anna. Anna has several wearable sensors, such as a motion detector in her wrist watch. The system notices when Anna is active and performing her exercises, and also when Anna is passive and not doing much. The AmIE system stores also some information from bed sensors about the sleep quality, about how many times certain electrical appliances are used or different doors opened during the day, how many phone calls or visitors Anna has had today, etc. Anna's mental wellbeing is analysed through interactive games, such as memory games. In addition, information from possible medical measurement devices, such as blood pressure meter, is collected by the system. Anna can give her own assessment on her current condition to the system by touching a corresponding smiley face. A nurse or a family member visiting Anna can give their opinion on Anna's condition using the same method or by using a web or mobile phone service. This information together with sensor information described above is combined to indicate Anna's current condition with e.g. "traffic light indicator".

Supporting Independent Living. Dealing with the activities of the daily living, Anna is assisted in doing the laundry, cooking and shopping. A washing machine equipped with RFID tags may warn about incompatibilities among the clothes being entered into the machine. A refrigerator keeping track of the foodstuff available may refresh the shopping list or advice some alternative food recipes based on user preferences, diets or health recommendations. Using a simple device with several buttons for communication, Anna may contact a call center for further assistance in reserving time to barber or ask for any other home assistance like cleaning or shopping. Easy to use video TV communication is available in Anna's home to communicate with friends, family, or share photos and gaming, but also to communicate with medical staff if she feels some need for this.

4 MARKET OPPORTUNITIES

Nowadays, various systems for home assistance are already being commercialised. Companies such as Tunstall, Mextal, Philips and Siemens Communications and Tadiran Spectralink Ltd in Europe or Telehealth Broadband in the US, commercialise teleassistance and telemedicine systems.

AmIE offers several innovations that constitute strengths also in the market. AmIE does not only perform a diagnosis but also predicts future problems and helps the user improve his/her daily habits to remain healthy for a longer time. The system is expected to have a highly degree of acceptance by the elderly users since the interaction is not a roughly configured one, but adapted to each user and situation (multimodal interaction). Moreover, its design is based on the principle of non-intrusiveness so that the user's daily life is not affected by the system elements. AmIE is positioned at the boundary between self-monitoring and life-style applications on one side and professional monitoring and elderly care at the other side (see Fig.2). This positioning has the advantage of evolving along with the user from comfort services and life style applications to assisted living in a natural way.

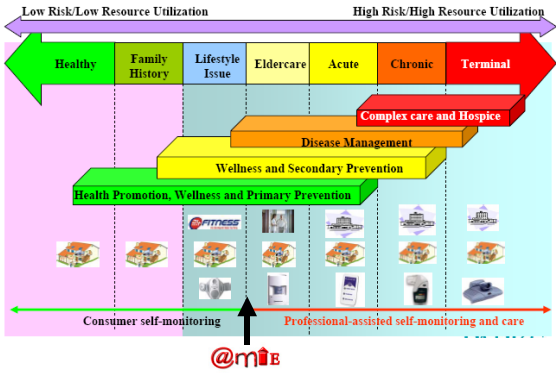

Figure 2: The position of AmIE in the market. *Source: Parks Associates 2008.*

The above discussions show that there is a good possibility to address market and add-value service delivery for elder. However, there are some substantial challenges that still have to be dealt with:

- Health is such a delicate matter, that it can not be left in an automatic system's hands.
- Skills to interact with a computer: the elderly are quite reluctant to technology and are not usually accustomed to interacting with it.
- Who is our customer? It is found that in different areas Age Care is organized with different model (Scandinavia vs. South Europe). Payer and end-user is not always the same person.
- Do we know the real needs/resources of the elderly to solve our task in a proper way? Old people are not just one target group based on age, instead a huge group of individuals with different needs and ever changing mental, physical and perceptual capabilities.

5 CONCLUSIONS

In comparison to other available solutions, AmIE will act as a preventing and assisting intelligent system. Still several R&D challenges need to be addressed to achieve its ambitious goals:

Reasoning and Intelligence. In order to add intelligence to the system, technologies related with Artificial Intelligence are applied. However there is still a challenge to build a reliable usage and context models from low-level sensors. Thus the health care professional help will be involved to ensure that collected data covers wide range of situations.

Living Ontologies. Ontologies are indispensable elements of the AmIE rule definition module. However grounding of ontologies in evolving, real-world communities and service activation process is still an open issue.

User Information. One key issue for AmIE is the acquisition of information about the user, its processing and analysis to derive predictions and intelligent interaction with the user. Personal up-to-date data access is a risen challenge concerned with architectural, regulator and commercial issues.

REFERENCES

Shinozaki, R., at al., 2005. Communication and Control of a Home Robot Using a Mobile Phone. *6th Pacific Rim Conference on Multimedia, Jeju Island, Korea, November 13-16*

Porteus, J. and Brownsell, S., 2000. Using Telecare. Exploring Technologies for Independent Living for Older People. Brighton: Anchor Trust, Pavilion. Publishing

Kenchiku, K., 2005. Introducing New PC emergency Call Systems. *Presentation at the IAHSA Symposium in Norway, June 27-29.*

Fellbaum, K. and M. Hampicke, 2002. Human-Computer Interaction in a Smart Home Environment. *Symposium "Domotics and Networking", Miami, Nov 11-12.*

Van Berlo, A., 2005. Smart Houses and smart living for senior citizens: chances and markets. *Silver Economy in Europe Conference in Bonn, Germany Feb 16-17.*

Van Berlo, A. and Fellbaum, K., 1999. Smart Home Technology: Useful Applications for older people. Assistive technology Research Series 6, pp.508-512. Amsterdam.

MOBILALARM, 2005. Validating European Mobile Alarm Services for Inclusion and Independent Living. D 2.1 Market Analysis.

Finkelstein, S.M. Speedie, S., Potthoff, S., and Ratner, E., 2005. Home Telehealth Provides an Independent Living Option for the Elderly, *In proceedings TELEHEALTH 2005 Banff Canada July 17-19*

Eurostat Publications Office, 2008. EUROPE IN FIGURES, Eurostat Yearbook 2008

AmIE project home, http://www.amieproject.com/, 2008