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Microsystem Technology for Ambient Assisted Living (AAL)

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Abstract

AAL is certainly an application area with sensor as well as actuator needs. Some of the requirements can be fulfilled by state of the art technology; some areas however still need a lot of R&D efforts for potential applications in homes. The contribution describes two areas of interest and actual development: One is the topic of robust fire detection; the other domain is fall detection. For both application areas one has to understand both the state of the art and the drawbacks of the current solutions. One can state clearly that there is a huge potential for the development of new microsystems. Still one has to keep in mind that usage in elderly homes also requires consent and cooperation of the users which is the focus of the user centered design principle.

Keywords :Ambient Assited Living (AAL), User centred Design (UCD),firedetection, fall detection, acceloremeter, 3D position detector

1. Introduction

The demographic evolution in Europe and beyond (basically all industrialized countries are following the same trend) with a (relative) reduced number of younger people and an increasing number of an aged population fraction is not a problem per se. The increased life expectancy is seen very positive; still it is one of the main challenges for the following generations. The current care paradigm with professional as well as informal caregivers (i.e. family, neighbours and friends) is just by numbers difficult to maintain. More than that there is also an underlying ethical issue since more than 80% of the primary users (older people in need of care and support) are willing to stay at home as long as possible and are not willing to enter professional nursing homes etc [1]. Consequently one has to think about technologies which can help and support the primary as well as secondary users (professional as well as

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informal caregivers) to keep the balance between the amount of work able to perform and the requirements resulting out of the situation in the home.

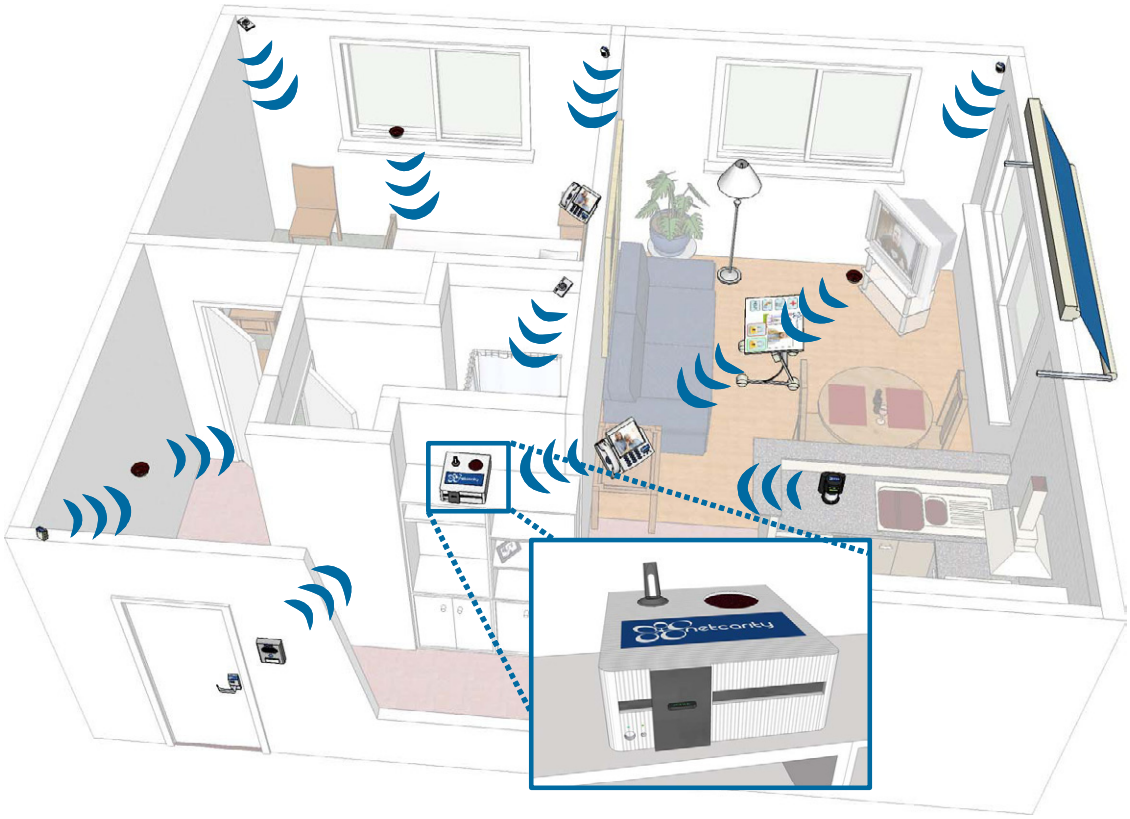

Figure 1: Sensors and actuators placed in a flat. Communication to and from a central gateway predominantly by wireless connections.

A typical sketch of such a home is shown in Fig 1. Several sensors and actuators are placed there, amongst others also the ones which will be presented for robust fire and fall detection. For obvious reasons the technology installed in the flats has to be designed in such a way that it can be retrofitted and therefore as much as possible has to use wireless technology for communication. A very important boundary condition (even if it might be very obvious) is to follow the path of user centred design. This means to involve the primary users right from the beginning in the design process in order to check in an early stage the acceptance level of technology which will enter their homes. Respecting the approach will rule out certain technologies. The important consequence is that one cannot invest in a technological development without having the chance of a follow up exploitation. It is very important to realize that technology always has to be embedded in real services for the users. These kinds of services are the incentives for the older people as well as the caregivers to accept or even welcome technology in their surroundings (Fig. 2). A large number of these aspects are currently under investigation in the European Integrated Project (IP) “Netcarity” [2].

2. Overview

This report allows only describing two specific areas of application, namely the robust fire and fall detection. In the first case a combined approach using optical detectors and gas sensors is used, in the latter case 3D detectors based upon laser interferometers are tested together with accelerometer based detectors which have to be attached to the person. This however can only be accepted for test and training procedures and can be ideally removed when the fall detection with the 3D system(s) mounted in the rooms of the flat / home is applied successfully. In the following two sections the status of both technologies are shortly summarized.

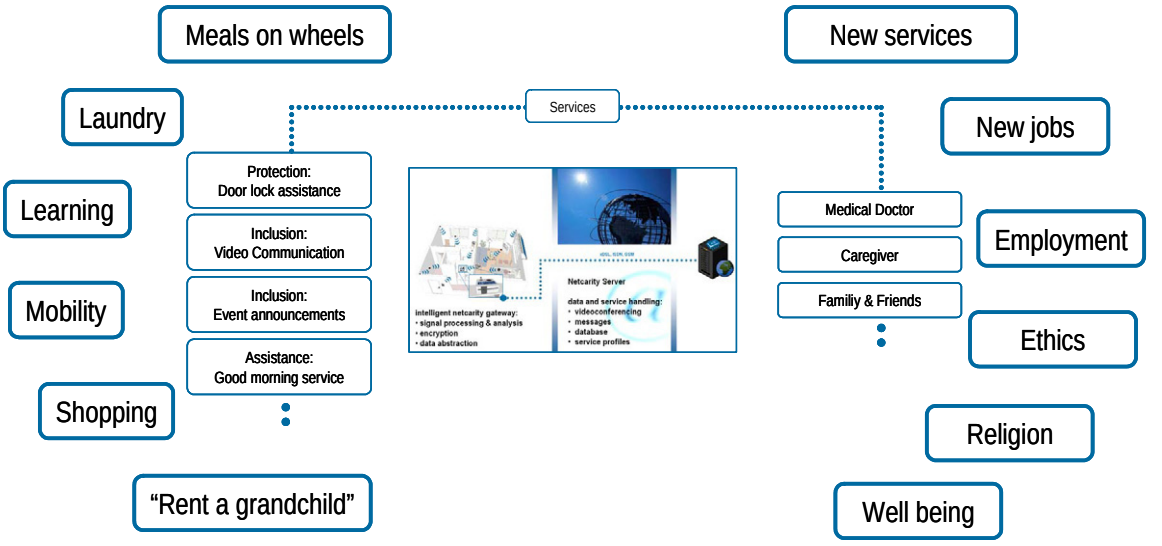

Fig. 2: AAL home and server technology embedded in real life services for the primary users (i.e. older people)

3. Fire detection

Conventional fire detection as it is currently applied is using in almost all cases an optical detection system which causes an alarm when a certain amount of light is scattered out of the optical pathway. This works well in the case of smoke but also causes an alarm while frying something in a pan or getting the steam in form of aerosols out of the kitchen or bathroom while taking a hot shower. These false alarms are relatively rare in commercial buildings (e.g. offices) but not acceptable in the application field of AAL in homes and flats. The approach is to combine conventional optical detectors with gas sensors of different nature in order to get to a higher robustness and a drastically reduced false alarm rate. Fig. 3 is illustrating the concept.

Fig. 3: Illustration of the concept of combination between smoke detectors and gas sensors for false alarm elimination

Using the different kind of detectors / sensors requires fusing the data out of the different sources and experiments. The ongoing work is clearly indicating the advantage of using such a combination both in speed of response as well as robustness.

4. Fall detection

Actual fall detection systems are typically wearable systems in a way “body attached”. Their performance when worn is good and the false alarm rate system immanent. The problem with the current systems is the need for active cooperation of the user (intentional and un-intentional). There are many cases reported when users are getting up during night visiting the bathroom and are simply forgetting to put on the fall detector (e.g. accelerometer mounted in a wrist watch or used like a necklace). In case of a falling event the detector cannot initiate the alarm sequence. Consequently the idea is to use instead of body worn technology, systems able to be mounted in the flat allowing a constant screening of the rooms and starting the alarm sequence when a critical situation has arrived. The 3D imaging system under development is based on a custom designed optical sensor, an illuminator and all the specific interface blocks (Electronic readout, A/D converter, FPGA, etc.) necessary for the data pre-processing and connection with the home gateway, as shown in Fig. 4.

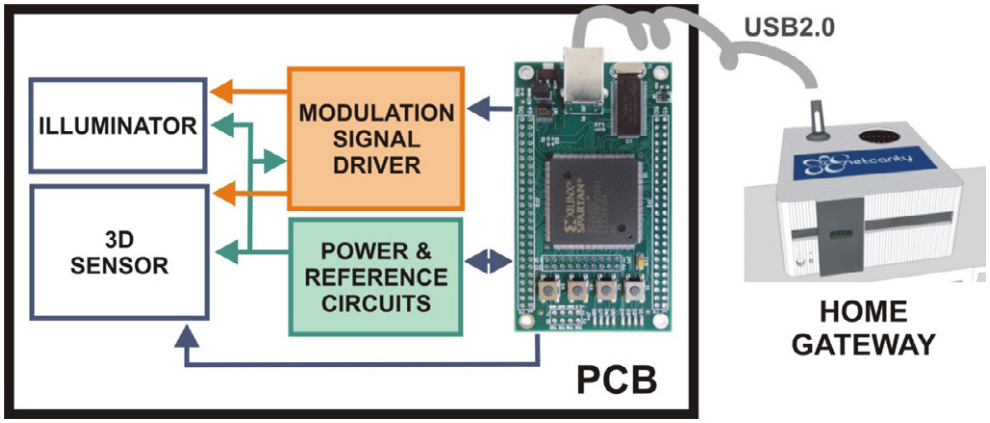

Fig. 4: 3D position detector system architecture

5. Summary

The development of technology for AAL in the frame of user centered design is still very much at the beginning since the chasm between the real user needs and the level of understanding on the technology side is large. This chasm can only be bridged if inter- and trans-disciplinary teams with different professional background and interest are cooperating paving the road for a successful demonstration and exploitation of technology.

Acknowledgements

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