Entertainment and Ambient: A New OLDES' View

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Abstract. This work introduces a new concept of supporting elderly at their homes. The whole framework is being developed under OLDES project: Older People's e-services at home. OLDES aims at developing a *very low cost and easy to use entertainment and health care platform* designed to ease the life of older people in their homes. The platform is based on a PC corresponding to *Negroponte's paradigm* of a € 100 device, giving the guarantee of an affordable system. OLDES provides: *user entertainment* services, through easy-to-access thematic channels and special interest forums supported by animators; and *health care facilities* based on established Internet and tele-care communication standards. As an example of OLDES platform implementation, two pilot projects are addressed: 100 clients pilot including 10 people with cardiological problems in Bologna, Italy and diabetes pilot in Prague, Czech Republic.

Keywords: Ambient intelligence, entertainment, user interface, diabetes and cardiac disease monitoring.

1 Introduction

Home health care service allows older persons to live as much as possible in their own ambient, with the members of their family, when clinical state and family consent that. Several projects, e.g. [3], [5], have studied and tested various approaches how ICT can improve this service addressed to not self-sufficient patients suffering with chronic diseases, to children with chronic diseases, to people suffering from serious handicap. It is integrated into the health network including hospital and territorial services to guarantee the continuity of the cure. The service is assured by a team of various operators: doctors, nurses, social workers that collaborate with the general practitioner. Sometimes it involves voluntary associations. Home health care service is carried out according to a personalized treatment plan, based on the assessment of the functional state of the patient and care problems oriented. Over three-quarters of the patients that utilize the home health care service is over 75 years old.

It is necessary to produce improvements as regards the actual home health care delivery [5] whether promoting healthy life style through an adequate scheduling of

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thematic radio channels, or through the constant monitoring of vital parameters and health state, that allows a more adequate and well-timed treatment of possible diseases. Moreover opportunity of extending the service to a wider number of users and having a great number of available data, relevant to monitor and analyse the patient behaviour and clinical state, is not negligible.

1.1 Current Landscape

Up to date the community centres offering recreational and cultural services have been running by senior citizens themselves (volunteers) in full autonomy and open to all citizens, providing facilities such as bars and recreation centres, reading and TV rooms, organising exercise courses, leisure activities and social events. These centres are fully aware that, although the organisation and activities offered should be geared towards the current situation, they should also think ahead to future strategies regarding bringing people together and fighting isolation. The term **"isolation"** is used as it communicates the feeling of suffering, whereas "being alone" can be a choice.

The presented concept represents a step forward to use tools for exchange of information between humans on the web in order to reduce the loneliness and isolation of older people. In this context we aim to provide a complete lifestyle monitoring of the patient and to provide the huge (logistic, emotional and psychological) advantage to allow the old persons to stay home, in a less "hostile" and "unknown" environment than the hospital or health care housing. The low cost of the proposed device (around € 100) can be affordable by a Municipality like Bologna considering its advantages and the possibility for instance to save money by reducing, and in some case removing, long term institutionalisation of elderly people. So far local government has limited or rejected a large-scale adoption of new technologies because their high costs that were not affordable by the public funding resources. The scope of the project is to overcome this critical issue by developing a service accessible to the municipal budget and that can be delivered on a systematic basis to every old person of the town. The system can of course be extended to offer and manage many other services like booking services, transportation, etc.

1.2 Concept Vision

In order to explain how the project advances beyond the present state-of-the-art a brief representation of the vision is explained.

The goal of computer-aided gerontology is to maintain up-to-date information about the condition of thousand of aged people across a given region. This is the problem municipalities face today and that will increase dramatically. The current solution is to call them individually from a contact centre. This situation is critical: many European cities have more than thirty thousand of inhabitants aged 75 or more. An employee of a contact centre can contact at most 35 people a day. So, it is impossible to deal with such a situation. Moreover, if it is not possible to contact all these people, it is certainly not possible to gather them in a given place, so that they meet friends or participate to activities.

The suggested concept gives aged people living at home a digital companion, in the form of a low cost PC [2, 8, 10]. This device will implement various popular communication means, but in a way that makes them transparent and easy to use for the old and disabled people [11]. Without knowing it, they will be able to use the most recent communication technologies to communicate between each other, with their relatives and care services. In addition to this, their experiences will grow and improve the more they use the system. High quality experiences are characterised by the proactive and reactive targeting with highly relevant content, by the personalised proactive and reactive assistance and by the intelligent social networking features offered.

2 Method

The approach proposed is an integrated web-based system able to manage information and "knowledge" regarding the domestic environment and the biological conditions [9]. The system interfaces all home and vital devices by collecting information from automatic signals [1] and manages the entrainment channels. The technological system is composed of two parts: software and hardware.

2.1 Basic Concept

The main stakeholders are shown in Fig. 1. Different groups connected to the proposed system: thousands of elderly people (*clients*) and several animators and professionals. *Central system* refers to a place where the information about all the users is known. A direct connection between *doctor/social services* and elderly people can also take place but usually, it can be only done on the explicit request by the patient.

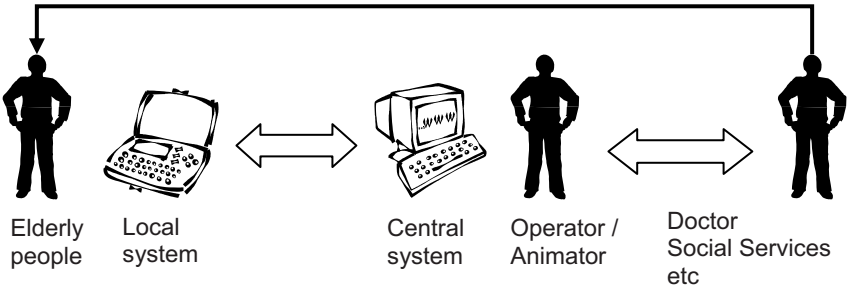

Fig. 1. Agents

Elderly people can get the needed feedback in various ways: through the bi-directional communication characterising the functioning of the entertainment services, by communication with the operators of the contact centre or directly with their GP. GPs (and/or clinicians) take part of the proposed system as well. Moreover,

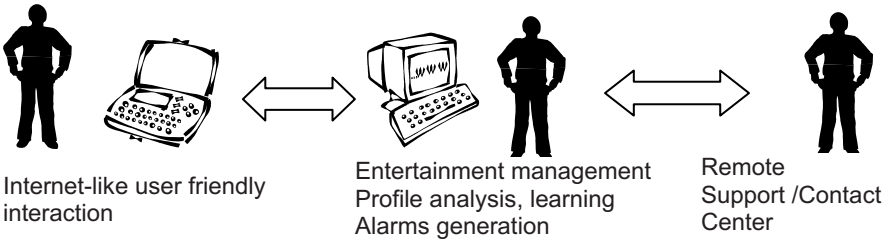

Fig. 2. Roles

the on-line analysis of the client's behaviour and health status allows health and social operators to give each client specific support if needed through the above-mentioned means.

The goal of the system is to provide both entertainment and communication services as shown in Fig. 2.

The **local system,** based on the low cost PC, runs the following services:

- Forums, thematic channels
- User-friendly feedback of the sensor data, health diagnostic, warnings or alarms.

The **central system** consists of:

- tools for the animators to manage the virtual communities;
- stores, retrieves and updates the user profile like a socio-sanitary dossier;
- tools for the management of the interactions with the elderly people and for the analysis of signals coming from home devices.

The **remote support** allows access for the doctors, social services, nurses, etc. This access can be given through

- a direct access to the central system;
- messages send by the central system, given the result of the analysis;
- or the animators.

2.2 SW Infrastructure

All developed SW is intended to be open source (Linux) and all HD used is low cost [7] with plug-in capability. The processing SW module consists of a decision support system using an integrated approach involving a rule-based expert system and machine learning based system. The goal of decision support is to supply the best recommendation under all circumstances.

2.3 Local Infrastructure

Central to the software is the "communication system" that facilitates communication between the user and Contact Centre concerning tele-accompany service, while monitoring system facilitates communication between Central Node and the installed domestic and personal devices and related sensors concerning social medical support.

The services are based on Internet technologies. The platform reuses existing established and new communication standards: e-mail, instant messaging, voice-over-ip as Skype - see Fig. 3.

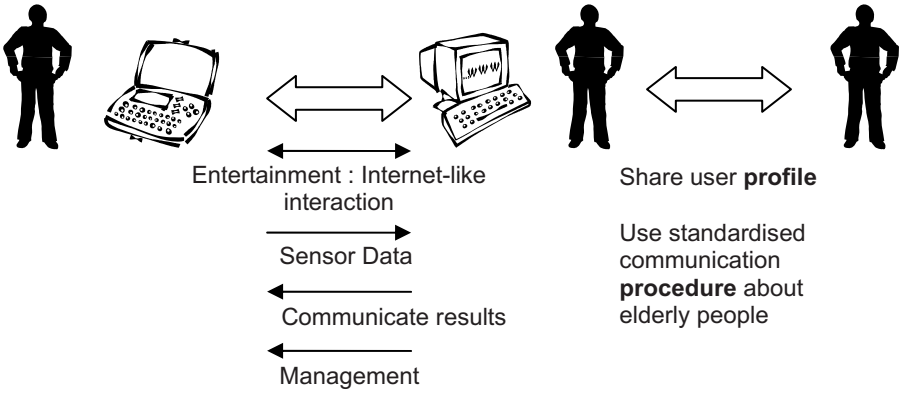

Fig. 3. Communications

The local sensors use a standard communication layer, such as BlueTooth, or Zigbee. Only one communication layer is used. It must be cost effective, low power and reliable – see Fig. 4.

2.4 Pilots Project

The system is being tested at two different locations: in Italy over a group of 100 elderly (including 10 suffering with cardio disease) and in Czech Republic over a group of 10 diabetic patients.

- Italy, where the user entertainment feature is extensively tested over a group of 100 elderly (in their homes) in conjunction with health monitoring (through specific sensors connected to the communication device) of a sub group of about 10 people with cardio problems.
- Czech Republic, where the communication feature is used in conjunction with the health monitoring (through specific connected to the communication device) to put in direct connection a hospital with a group of 10 diabetic patients staying at home.

These two pilots allow to prove the systems flexibility, easiness to use and transferability to different countries. The different approaches adopted in the two pilots test:

- the modularity of the system – the possibility to use it for different purposes with simple plug and play devices and sensors being everything managed centrally;
- its easiness to use – the users just have to wear the sensors or interact with the services via a simple user interface;

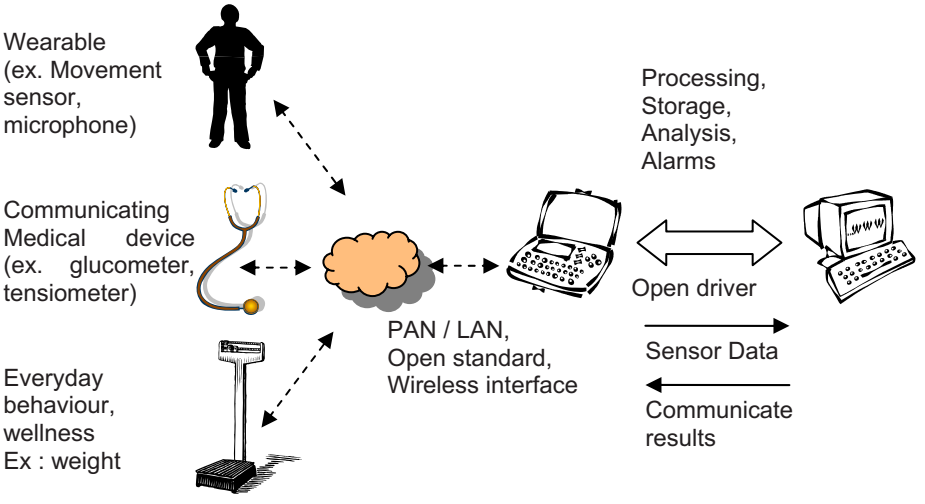

Fig. 4. Sensors

- its exploitation potential – the different characteristics of the two countries where the system is proven will provide the confidence (if the pilots will be successful) for the replication potential of the overall approach and technology.

2.5 Infrastructure Integration

The PC device is used to provide user entertainment (tele-accompany) and care facilities through a series of easy-to-access thematic channels. The PC mounts easy to use SW that can be utilised by the old person or his/her family [11]. The PC is integrated with multiple wearable and ambient sensors and devices that gather the information to be sent to a remote Central Node (CN).

The CN manages all the potential functions of the single local devices and facilitates communication both with the user and, as appropriate, with entertainer centres, remote call centre, relatives, social services providers, health care providers etc.

Sensors and devices consist of sensors for vital functions (as for instance ECG, respiration, skin and ambient temperature, heart rate, pulse oximetry SpO2, and diastolic and systolic blood pressure) monitoring and movement detection.

At the CN level, algorithms analyse the data received by the local PCs and manage automatic warnings to alert remote call centre if user behaviours and health parameters change suddenly (i.e. a person who has been not participating for a long time to e-conference sessions or a person having a very low skin temperature).

3 Results and Discussion

The Municipality of Bologna aims at offering the whole system to the elderly over 75 of the town (about 30.000 persons could be involved in the medium period) and at

setting up a centre for monitoring and analysing the needs and parameters of elderly in order to allow communication among different communities (elderly themselves, entertainer centres, health and care professionals). The municipality of Prague investigates the specific implementation of the project on group of diabetes patients.

3.1 Diabetes Case Study

Elderly population commonly suffers from multiple diseases/co-morbidities and requires treatment by a combination of different medicaments. This population therefore carries the most significant risk of acute worsening of the diseases themselves and/or side effects of the medicaments and their combination, respectively. It is estimated that more than 15% of population older than 65 years suffer from diabetes mellitus. Clustering of diabetes with arterial hypertension, obesity, dyslipidemia and other pathologies is commonly referred to as metabolic syndrome. The presence of this syndrome markedly increases the risk of cardiovascular morbidity and mortality of diabetic population.

Concerning diabetes pilot project, a preliminary study has been carried out using blood pressure monitoring of 250 patients aged over 60. The system consists of blood pressure monitor equipment, which automatically reports results of up-to-date patient's measurements to the doctor's monitoring and decision support system using wireless communication. The following sensors have been used: Finapres system, standard electronic tonometer OMRON M4I, classical mercury tonometry and electronic tonometer OSCIOO [6] measuring directly oscilometrical pulsations. Significant differences (even over 30%) in blood pressure measurements between classical tonometer based on mercury and electronic ones have been found. That is why further physiological signals as SpO_2 must be added to the final alerting system following thus the OLDES concept. The results will be compared to those obtained in another project considering the same diseases using different technologies [4].

3.2 OLDES' Benefits

The main innovation in the OLDES proposal is that by using a low cost platform for delivering interactive services and monitoring:

- the elderly maintain contact with the carer and each other via interactive services;
- the solution is low cost both in software and hardware terms because of the low cost PC and the ASP model;
- it is easy to use for the elderly: you just turn on the device to access the interactive services provided by the carer;
- the services can be personalised to the needs of the elderly. The animator knows the profiles and names of the people he is interacting with;
- the server keeps the history of measurements from sensors for analysis and raising health related alarms;
- measurements are made at the client's location and monitored centrally at the call centre. This allows the doctors to spend less time visiting patients who don't need it and provides better supervision of patients (each patient has a health agenda that is monitored by the call centre);

- the client technical infrastructure is very simple. The PC acts as a communication gateway and doesn't manage sensor data locally;
- the carer can monitor more patients that before because of the monitoring assistance and the raising of alarms by the monitoring software;
- the proposed platform supports a modular approach to services: services can evolve and be provided as needed without much work on the client side. It can be done centrally by the application service provider;
- it promotes social life for the elderly by supplying them with interactive services. Some of the services allow the isolated elderly to talk to each other;
- the approach is sustainable because of the low cost of the proposed platform. It is easy to add new services and new sensors;
- by monitoring patients you can avoid going to the hospital when it is not necessary;
- the platform makes some of the most popular internet services available in an easy to use form for the elderly;
- it supports mobility by allowing the elderly to be anywhere in their home and still interact with the contact centre thanks to the wireless communication. For example if the patient is sick he/she can still interact with the call centre as long as the wireless communication is working.

For the municipalities and their contact centres, the project provides a number of solutions for improving the efficiency and effectiveness of assistance and support processes dedicated to elderly and disabled people. Based on *automatically generated Content Intelligence* (what topics are consumed, which are the popular ones, which are missing / content gaps, emerging topics), *Customer Intelligence* (user demographics, user thematic preferences, user social relationships, user behavioural patterns, user health status) and *Context*, the system generates relevant messages and alarms and trigger the appropriate workflow(s) / process(es). This dramatically improves the scalability of the present systems, decrease personnel costs (operational and schematisation) and enhance the quality of the services. With such a system, the municipalities, health-care service providers and other related service-providers are able to better know their target audiences and to offer them better services at lower costs.

4 Conclusion

To sum up, at the end of the project there will be an easy to use, plug and play system with a different costing level based on the profiling of the person to which it will be provided:

- a base level (offered to all) which includes the communication and tele-accompany and which is simply based on the low cost PC and the open source SW with a target price of around € 100 per person.
- an intermediate level with the addition of simple sensors (like for example the ambient temperature) for the management of generic monitoring situations (i.e. hot summer periods management)
- an upper and tailored level with an addition of health monitoring sensors depending on the health profile of the user.

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References

1. Cook, D., Das, S.: Smart Environments: Technology, Protocols and Application. Wiley-Interscience (November 2004)
2. Cammaerts, B., Van Audenhove, L., Nulens, G., Pauwels, C.: Beyond the digital divide: reducing exclusion, fostering inclusion. VUB Brussels University Press (2004)
3. CONFIDENT http://www.etw.org/2003/case_studies/soc_inc_confident.htm
4. Doc@home http://fp6uk.ost.gov.uk/Page.aspx?SP=2034
5. eInclusion@EU http://www.einclusion-eu.org/default.asp?MenuID=8
6. Fabián, V., Fejtová, M.: Telemedical system for monitoring of blood pressure. Advances in Electrical and Electronic Engineering, pp. 213–215 (2005)
7. ink-media.com
8. Kubitschke, L., Stroetmann, V.N., Hüsing, T., Stroetmann, K.A.: Older People and Information Society Technology: Results from the European SeniorWatch Survey. In: ICAT – International Conference on Assitive SeniorWatch (2002), published by British Computer Society (2002)
9. Nussbaum, G., Miesenberger, K.: The Assistive Home – More than Just Another Approach to Independent Living. In: ICCHP 2004. LNCS, vol. 3118, pp. 891–897. Springer, Heidelberg (2004)
10. http://www.seniorwatch.de
11. Stephanidis, C.: User Interfaces for All - Concepts, Methods, and Tools. Lawrence Erlbaum Associates, Mahwah, NJ (2001)