Development of a Socio-technical System for an Age-Appropriate Domestic Environment

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Abstract. Being part of the social community is for many people a crucial part of their life. Unfortunately, many of the elder generation are not able to participate due to physical condition and lack of will power. These people often suffer from loneliness and depression. In order to overcome these issues a system is being developed with its main goal to be a motivator for these people. Closely related to this is the term of *primary prevention*.

Within an AAL living room scenario an armchair with integrated sensors monitors several vital signs and offers the possibility to perform exercises which both are displayed on a TV screen. In addition, by using a tablet the user is able to communicate with medical experts as well as social group members, relatives and friends.

The acquisition of vital data in combination with elements of (virtual) social networks prevents isolation, motivates to be (more) active and supports healthy aging with a high *joie de vivre*.

Keywords: AAL, vital signs monitoring, social connectivity, motivation.

1 Introduction

Within the context of the demographic evolution and the fact that physical activities have manifold positive effects on the elderly, the part who is doing sport regularly is dramatically low [1]. Furthermore, the discrepancy between the percentage of the population keen on doing sports and those being indeed sufficiently active shows the impact of one's weaker self. Especially elderly people suffer from this. As a consequence, it is crucial to identify the target group and how motivation concerning physical and even social activities occurs and targeted promotion can be given [2], [3].

A lot of people think that depression is part of the aging process. Loneliness coupled with depression among the elderly decreases the quality of their lives extremely. Frustration with the loss of memory and physical ability (e.g., the

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loss of hearing makes phone calls difficult, trouble by walking means no driving and exercise, vision problems mean no reading), death of a loved one and even financial problems are the main causes for depression and loneliness [4]. But these symptoms often remain misdiagnosed and untreated.

Several existing platforms support health monitoring, but they are lacking of interconnection with vital signs monitoring and activity incitation [5]. Especially the combination of daily used technologies and end devices (e.g., TV, tablets, etc.) with these platforms as well as the integration of sensor technologies for monitoring vital signs are missing.

Consequently, the main target is to find solutions and strategies to overcome the lack of will power - motivate the elderly to be more active, stay in contact with friends and relatives, and find groups of the same interests.

2 Concept and Vision

The system presented in this paper is one approach for *primary prevention* [6] where the elderly is encouraged and motivated to be more active. The complete system comprises of two main parts. On the on hand the *interactive* arm chair, which provides a variety of exercises to improve the users health status. Whereas, on the other hand the virtual coach covers the social aspects, like coordination of group activities or maintaining social connectivity with friends and relatives.

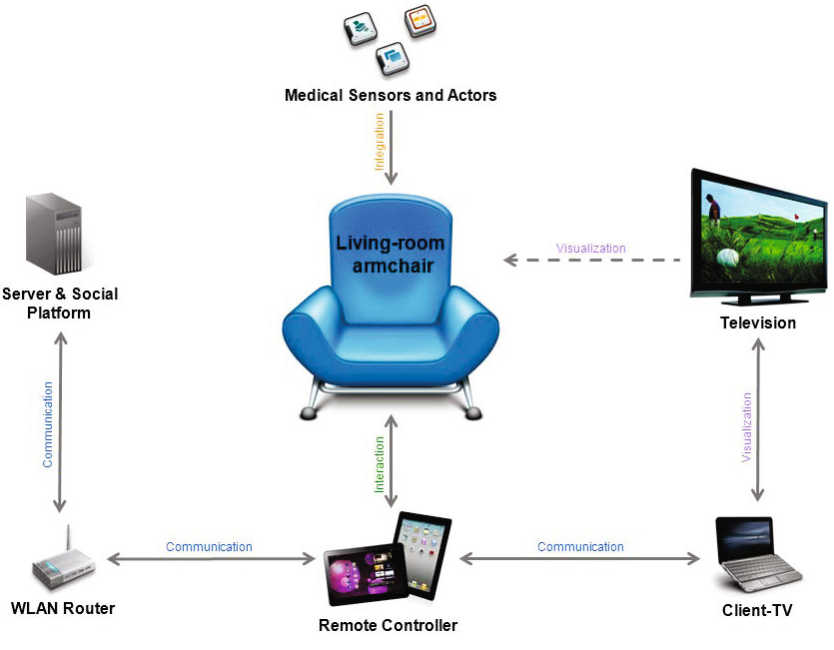

Fig. 1. Schematic representation of the overall concept

Both are means to motivate the user in a physical as well as in a social way. The system offers promising strategies and solutions for the motivation and activation of lonely and/or sport-passive elder people, even in their living room.

The concept shown in Fig. 1 consists of two core elements - a platform and a comfortable armchair. With the armchair (mounted on a carrier plate) it is possible to get passive and active feedback of the users. First, the elderly can perform exercises by using the chair (e.g., rowing or crunches) and second, vital signs can be measured on a voluntary basis. An important aspect is the inconspicuous integration of the armchair into the ambience of the living room design. Thus a high acceptance of the elderly concerning technical devices could be achieved. Beyond that, the user should not be aware of the measurements which should run automatically without any action of the user. Nevertheless, a comprehensive evaluation of the health status has to be ensured. In addition, the following (vital) parameters are acquired:

- Heart rate and single-channel ECG
- Oxygen saturation (SpO_2)
- Weight
- Respiratory rate

Hence, it is required to integrate the sensors in an unobtrusive way. For instance, in order to detect the weight distribution, four strain gauges were integrated into the carrier plate. Therefore, the detection and, ideally, the correction of the person's posture during the performance of different exercises (e.g., sit-ups, rowing, etc.) are possible (see Fig. 2).

Whereas the armchair is indeed part of the familiar environment of the user, the platform is rather the *invisible* core element of this system. The platform provides the health-related knowledge in order to process the vital signs recorded by the sensors integrated in the armchair. As a consequence, the system can provide useful hints for the elderly to improve his or her health condition.

This is realized by a *virtual coach* who acts as mediator and friend for the user and guides him or her through the system. The main function of this assistant is to motivate the elderly to be more active. This means that he suggests exercises according to a schedule set up by a physician and/or by the user himself.

At the same time, he acts as a mediator for existing and potential social relationships. He initiates communication with other users of the social network and encourages social activities (e.g., visiting a concert or going to the theater). In this context the assistant is a mediator of the user's social network, connecting to different groups of the same interests (e.g., playing chess or Nordic walking) and updating the user regularly with incoming news, appointments and requests. The *virtual coach* will manage the assets of the user and enable communication with friends, relatives and even health care services and professionals. As a consequence, this assistant motivates the elderly to be more active both, in a physical and a social manner.

The above mentioned data, vital signs and activity profile, are stored on the server (under persistence, data security and privacy aspects) and can be displayed on the TV screen. For this interaction a mobile device (e.g., tablet PC) is

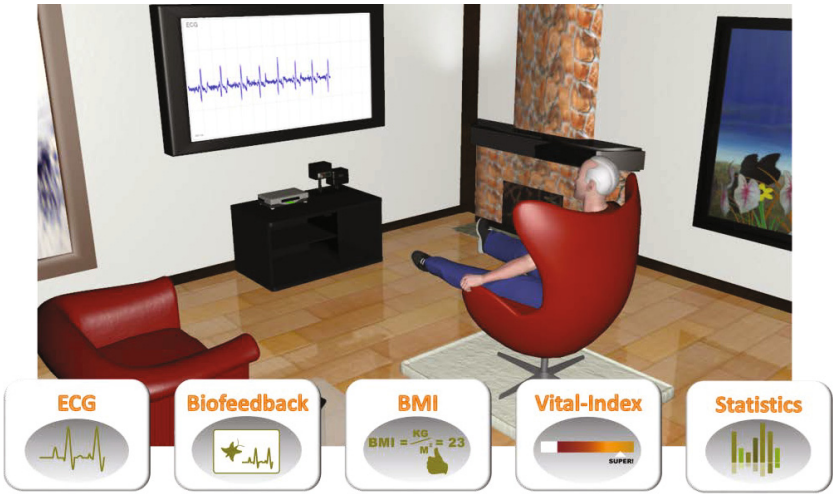

Fig. 2. System integration in the home environment

used as a remote control. This device offers the possibility to navigate through the application - selecting an exercise, get in contact with friends, display the measurements and the vital signs.

In addition, the data can be transmitted via the platform to medical experts or other service providers of the health care sector in order to maintain medical care.

Within this system standardized components and communication also have to be accounted and thus standards, like WLAN (IEEE 802.11) or W3C standards for Internet applications, have to be considered.

3 Conclusion and Outlook

In this work the overall concept was pointed out and the technical approach was presented. The term of *primary prevention* was described and on its basis the principal purpose, increasing the motivation of the older population to do more exercises, was specified. Hence, the social connection will be made possible again over physical and social components. But what is even more achievable: the technology should prevent to loose this connection. This is to be achieved with a system, which disturbs the domestic environment in no way and thus as technical aid reaches a broad acceptance by the elderly.

The upcoming steps - after the integration of the sensor technology into the armchair - consist of comprehensive laboratory tests and user evaluation during pilots. On the one hand this serves the iterative optimization of the system. On the other hand target-oriented evaluation of the armchair and the measuring system both, from user and medical view, is enabled.

Finally, this assistant enriches the user's life and increases the social and physical activities. As a result, an attractive living environment for elderly people is being created.

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