Automatically Assessing Movement Capabilities through a Sensor-Based Telemonitoring System

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ABSTRACT

Telemonitoring makes possible to remotely assess health status and quality of life of individuals. By acquiring heterogeneous data coming from sensors (physiological, biometric, environmental; non-invasive, adaptive and transparent to user) and data coming from other sources to become aware of user context; by inferring user behaviour and detecting anomalies from this data; and by providing elaborated and smart knowledge to clinicians, therapists, carers, families, and the patients themselves, we will be able to foster preventive, predictive and personalized care actions, decisions and support. In this paper, by relying on a novel sensor-based telemonitoring and home support system, the authors are focused on monitoring mobility activities; the ultimate goal being to automatically assess quality of life of people. In particular, the authors are aimed at answering to an item of a quality-of-life questionnaire, namely “Mobility”. Although the authors are interested in assisting disabled people, they performed preliminary experiments with a healthy user, as a proof of concept. Results show that the approach is promising. Thus, the authors are now in the process to install the final system in a number of disabled people’s homes under the umbrella of the BackHome project.

Keywords: Ambient Assisted Living, Assistive Technology, Home Support, Mobility, Quality of Life, Sensor-Based Telemonitoring

DOI: 10.4018/IJEHMC.2015100103
INTRODUCTION

How to improve Quality of Life (QoL) of people is one major challenge of modern health. Thus, several solutions have been proposed, especially for disabled people (Celler et al., 2003). Among the many kinds of proposed solutions, let us focus here on those that provide telemonitoring and home support (Carneiro et al., 2008; Corchado et al., 2010; Mitchell et al., 2011).

TeleMonitoring and Home Support Systems (TMHSSs) help users (e.g., disabled or elderly people) to live normally at their own home keeping (or returning to) their life roles and daily life activities. On the other end, they support care providers in the task of being aware of the status of their patients. In particular, for disabled people, telemonitoring enables care providers to get feedback consisting of health status parameters which provide a measure of an individual’s QoL and level of disability and dependence; taking into account not only functional and cognitive factors, but also psychological, social, and participation ones. In so doing, care providers benefit from telemonitoring because preventive and proactive actions can be triggered while clinicians, therapists and caregivers are getting smarter and more precise data. More interestingly, the end user /patient will become empowered and her/his QoL improved.

Assessing QoL is currently performed by relying on off-the-shelf questionnaires (Murphy et al., 2000; Euroqol, 1990; Hays & Morales, 2001; Ware et al., 2001; O’ Sullivan & Schmitz, 2007). In particular, users are asked to answer to a predefined set of questions about their mental and psychological status and feelings. In fact, as noted in (Vargiu et al., 2013a), answering them could become tedious and annoying for users and could even be impossible in cases of severe impairment of the user.

In (Vargiu et al., 2014), we proposed a generic methodology aimed at automatically assessing QoL of users. In this paper, we present how the generic methodology has been applied to assess “Mobility”, one of the items of an administered QoL questionnaire. The paper extends and improves our previous work (Miralles et al., 2014). In particular, after providing an overview of the corresponding background, we illustrate more deeply the proposed approach and present results concerning recognizing activities.

The rest of the paper is organized as follows: first, relevant related works on QoL assessment and activity and behaviour recognition have been recalled. Subsequently, we illustrate the proposed approach following the generic methodology, presenting the newly implemented TMHSS as well as how it allows assessing mobility. Then, the first installation of the system together with preliminary experimental results is presented. Finally, we end the paper with a discussion on the main results and the lessons learnt as well as summarizing future research directions.

BACKGROUND

Although several works study how to recognize activities (Tapia et al., 2004) and behaviour (Ogawa et al., 2002), to our best knowledge, this is the first attempt to use that information to automatically assess a (part of a) QoL questionnaire.

Quality of Life Assessment

The World Health Organization (WHO) defines QoL as the individuals’ perception on their position in life within the cultural context and the value system in which the individuals live and with respect to their goals, expectations, norms and worries (WHO, 2007). It is a multidimensional and complex concept that includes personal aspects, like health, autonomy, independence, satisfaction with life and environmental aspects such as support networks and social services, among others.
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