ABSTRACT

Monitoring the activities of daily living is a common form of assessing the progression of dementia. Yet so far, this mostly can only be done by visual observations, which is time and cost expensive and therefore only done on a short scale. Even though the technology for automatic monitoring exists, it is still seldom used in real life environments. Key problems are the effort involved in sensor deployment and the extraction of relevant activity information from simple sensor data. In the following article the authors describe a long-term real-life monitoring of dementia patients using an easy to deploy UWB-location system. The authors describe the system-concept, discuss practical deployment and maintenance experience, and present monitoring results.

Keywords: Challenges, Dementia, Indoor Location, Monitoring, Real-Life Deployment, State Recognition, Study Perception

1. INTRODUCTION

It is an achievement of modern medicine that life expectancy increases. Yet, with people living longer age-related diseases gain more and more importance. One of those diseases is dementia. Broadly speaking, dementia is a summary term for a set of mostly neuro-degenerative diseases, which progressively lead to a loss of cognitive abilities and in course of it to the loss of the ability to deal with basic everyday situations. Alzheimer, which is caused by deposits (plaque) in the brain and/or changes in nerve cells, and vascular dementia, which is caused by disturbed blood flow in the brain are the most common forms of dementia (see Froestl & Schweiger, 2003; Kastner & Loebach, 2007; Schroeder, 2006) for more information).
Next to scaling tests, assessing the state and the progress of dementia is mainly done by monitoring a person dealing with common activities of daily living (ADLs) (Information and work about monitoring of daily activities is presented by Wilson et al (2005), Chen et al (2005), Huynh et al (2007), Lester et al (2006), Tapia et al (2004), and Kasten et al (2004)).

Hitherto, constantly monitoring of dementia patients is aligned with a certain expense and furthermore very intruding for the patients. Hence, a system, which allows monitoring the progress of dementia invisibly, would obviously be desirable for the health system and care takers as well as for relatives and the patients themselves.

From the medical point of view, many common dementia symptoms (e.g. dis-orientation, erratic behavior, aimless pacing or reduced social interactions) are related to how a user moves around the house and how much time he/she spends where (Schroeder, 2006). Even though, from the sensing point of view, tracking a user within coarse areas can be achieved relatively reliably with non-obtrusive sensors (Ni, 2004 and Ubisens, 2013 provide specific examples for such technologies), so far little experience exists with practical deployments of such systems for dementia monitoring as the one which is presented in this article.

2. OBJECTIVES AND CONTRIBUTIONS

The main objective of the work presented here was to investigate the potential of pervasive sensing technology to monitor and assess the progress of dementia with the focus on the feasibility of deploying and operating a system over a long period of time in a real nursing environment. Thus, the main contributions of this article are:

1. Analysis of the suitability of different sensing modalities.
2. Deployment of a system in a real-world nursing environment. In this article we discuss a collection of practical issues we have encountered from which future work could significantly benefit.
3. The collection of a large-scale data set.
4. Analysis of the data that demonstrates the potential of the system for reliable state assessment.
5. Analysis of the perception of the system by the stuff as a way to understand factors that need to be considered in successful real life deployments of pervasive technology in nursing environments.

3. RELATED WORK

The research field of pervasive healthcare is novel. Nevertheless, a reasonable amount of work has already been done in this field. Overviews of the potential of pervasive computing in healthcare are presented by Lukowicz (2008), Teng (2008), Bonato (2009) and Orwat et al (2008).

In the area of pervasive computing in mental health Pollack (2005) and Yang (1997) are good examples for approaches to assist elderly people with cognitive impairment.

A specific part of pervasive computing in mental health is the monitoring of patients suffering from dementia and its most common shape Alzheimer. Megret et al (2008) describe their work of monitoring dementia patients using wearable video cameras including a video-browsing interface so dementia-specialists could give continuous feedback. Possible techniques and set-ups needed to develop assessment, monitoring, and intervention systems are presented by Rebenitsch et al (2010) where the authors analyze the feasibility of different approaches and introduce a sample environment established in a lab.

Very little work has been done so far in monitoring dementia patients using wearable sensors as problems are expected if they are not hidden from the patients (Allin et al., 2003).

In terms of deploying pervasive systems in nursing homes for analyzing dementia patients in their daily life, Chen et al. (2004) introduce
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