Discreet In-Home Monitoring of Activities of Daily Living of Dementia Patients Based on Embedded Sensors

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Background The steady increase of the average life expectancy gives rise to an higher prevalence of age-associated disorders such as Alzheimer Disease (AD) and other forms of dementia. With the progression of AD, the need for institutional care intensifies, which contrasts with the desire of most patients to live independently. In that respect, the occurrence, performance and duration of different activities of daily living (ADL) are important indicators of functional ability. To provide good and effective care and to support independent aging, caregivers need to know how well patients cope with ADL, particularly when left without supervision.

Objective In contrast to other commercial products available on the market, our aim was to develop a passive, unobtrusive, embedded sensor network to capture ambient environmental data from the participant's home and to develop necessary algorithms to subsequently distinguish multiple ADL.

Methods The components of the embedded system are a number of wireless sensors that were distributed in key locations throughout the participant's home. The system was set up in the homes of healthy control subjects (N=10) and dementia patients (N=10) and environmental data were accumulated over a period of 20 days. The data were categorized using an in-house classification algorithm. Thereafter, ADL activity maps were calculated to compare the behavioral patterns of healthy controls and dementia patients.

Results Ten healthy participants (6 women, 4 men; mean age = 76.7 years; SD = 8.2 years; age range 64-94 years) and ten dementia patients (6 women, 4 men; mean age = 73.9 years; SD = 6.7 years; age range 63-87 years) were included in the study. From the retrieved environmental data, specific behavioral patterns were determined and allotted to eight ADL. The behavioral patterns of the two groups exhibit significant differences, particularly in regularity of patterns and in overall daily structure.

Discussion The wireless sensor system is able to identify data patterns and assign these to eight specific ADL. Owing to its discrete approach, the system maintains a high level of participant privacy while providing detailed information about the person's cognitive status and capability to cope with ADL. Current and future clinical trials of new drug interventions in dementia patients will need to prove their effects on ADL and we believe that our approach offers an excellent solution.

Keywords ADL classifier, forward chaining inference engine, rule-based, wireless sensor system, dementia, Alzheimer, behavior pattern, activity monitoring, assistive technology, smart homes