

A comprehensive Remote Monitoring and Feedback Service for People with Dementia living at Home

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Abstract

The increasing worldwide population is accompanied by more and more cases of dementia. Healthcare systems and individuals' families are not able to bear the burden of these costs, so ICT is being used more and more for remote care. Comprehensive monitoring and feedback solutions are being developed to support people with dementia living at home, as well as their caregivers, who can follow their progress and provide them with appropriate feedback almost immediately. Such a service is being created for the FP7 EU Project Dem@Care, where multiple sensors are to be deployed to monitor a person unobtrusively, create a personalized profile of their lifestyle and behavior, and ultimately acquire higher level knowledge about their condition through intelligent processing of the data, which will correctly guide the care provided.

Introduction

Skyrocketing healthcare costs and an increasing ageing population and workforce are making the remote care of people a necessity. Technological solutions are constantly being developed to address this problem and support elderly living alone at home, so they can avoid staying in a nursing home or being hospitalized, while enjoying their autonomy and a good quality of life.

Until now, most solutions involve the use of simple sensors, such as contact sensors placed throughout a person's home. These sensors allow the detection of the frequency of use of certain parts of the home, e.g. how many times windows/doors/cabinets open, how long the person spends sitting on the couch etc. However, a better, more objective picture of the person's situation can be obtained through the deployment of multi-modal sensors, including discreet wearable cameras, ambient cameras, audio recording tools, accelerometers and physiological sensing devices (often in the form of a watch). In efforts like Dem@Care [1] such solutions are being built, always making sure ethical and privacy issues are taken very strictly into account.

Comprehensive Monitoring for Independence at Home

The addition of physiological sensors allows simple, continuous, low cost monitoring of a person's health condition, which can allow their physician have a very clear picture of their progression and detect warning signs early on, so as to provide the appropriate advice. Daily use of physiological sensors allows the creation of a profile of the person's health condition, so as to detect changes in it that are relevant to them alone (e.g. a person who usually walks quickly suddenly walking more slowly).



Figure 1: RGB-D camera and resulting skeleton tracking

The use of ambient video (Fig. 1) is unobtrusive for the elderly person, but allows the recognition of their posture, their mobility status and the detection and recognition of activities of daily living [2]. Such results cannot be obtained through the simple contact or other sensors used until now. Naturally, people participating are fully informed about the project and its goals and capabilities and sign appropriate consent forms, while personal and identifying data is not disseminated. Video data is automatically processed by computer vision algorithms, leading to the recognition of activities and patterns of daily living. The results of the analysis, e.g. "person is eating" may be transmitted in an encrypted form to their caregiver and family members. Use of SoA sensors like RGB-D cameras facilitate person localization, posture recognition and activity recognition.



Figure 2: Wearable GoPro with egocentric point of view that gives clear images of objects, the environment a person interacts with.

Wearable video is becoming more and more popular, with cameras like the GoPro being used in many contexts [3]. Based on previous positive experience from other projects, Dem@Care organizes the parallel monitoring of a person's activities through this camera, whose close-up egocentric point of view improves object recognition results significantly. As a consequence, ambient-camera based activity recognition is improved as well, since the wearable camera lets us detect the objects the person is interacting with. Wearable camera data also leads to the detection of salient points and areas in the scene, from which the person's location can be precisely detected.

Innovative research on the development of new audio-based biomarkers for the early detection of signs of dementia is taking place [4]. The goal is to establish correlations between dementia progression and changes in a person's vocal abilities. The sensors for this are also discreet and do not interfere with a person's daily life.

The integrated system is actually in beta testing mode and pilots are being organized, first in labs and nursing homes, and later on in actual homes of people with dementia. Rigorous testing is expected to lead to new insights about the interactions and relevance of the sensors used, new medical knowledge about the correlation of sensor data with dementia and its co-morbidities. Volunteers in data collection activities so far have expressed great interest in the system and are very willing to use such sensors in their daily life, while they are looking forward to the resulting feedback.

It should be noted that with the advent of miniaturized sensors and improvements in electronics, such as the use of epidermal electronics, systems and services like those provided by Dem@Care

will become even more discreet and easy to completely integrate in a person's life. Significant improvements in the condition of people with dementia are expected, since following correct and holistic treatment programs has been shown to reduce symptoms and issues related to their condition [5].

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