ProSeniis: multi-parameter remote monitoring system for the elderly

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Abstract and Objective

Prevention and rehabilitation efficiency can greatly benefit from the application of intelligent, 24 hour tele-diagnostics and tele-care information systems. Tele-monitoring also supports a new level of medical supervision over the patient's lifestyle. In this paper we briefly present the aims and first results of the ProSeniis remote monitoring system. The novelty of the system is the unified and flexible processing of various signals retrieved from modern, body-worn devices in an efficient signal abstraction framework. The signals include motion sensors that record patient movement in the home, physiological signals and patient responses in tests performed on the GUI of the central home unit (Home Hub). We are currently testing the prototype system; public experiments will begin early 2010 involving volunteers with neurologic degenerative diseases as well as healthy elderly.

Keywords:

Home monitoring, Intelligent signal processing, Neurologic degenerative diseases, Rehabilitation.

Methods

Home monitoring systems currently available on the market or in the research phase are generally focused on a few physiological signals being measured at the home in an automated or interactive manner, and then transmitted to a medical centre with 24/7 supervision. Signal processing is usually limited to thresholding to generate alerts for supervisors. The Vitalsys VitalCare (http://vitalsys.be) and the Honeywell HomMed (http://hommed.com) are examples of such systems.

The ProSeniis system is being developed by a consortium including academic, healthcare and industrial/sensor manufacturer partners. The system is based on a Home Hub which is a robust laptop category computer with only a touch screen and internet connection, and wireless links to the sensors installed in the home or worn by the patient. Data is collected, from several Home Hubs representing a patient each, by the Data Centre. The centre provides a web GUI for the supervising medical personnel, analysts, and the family. The system is flexible to host any new type of sensor, but we propose a base configuration as follows. Physiological and activity sensors are Bathroom scales, Blood pressure meter, ECG recorder armchair*, Blood glucose meter, Wrist-worn fine motion sensor*, LIG QuietCare activity sensor network including fridge open/close, room temperature and lighting. The items with a * are the consortium's own development. Additionally, some of our scientific novelty comes from the new diagnostic signal processing methods based on these devices (e.g. assessment of Parkinson's tremor based on the wrist-worn motion sensor).

The software components available on the Home Hub GUI are Cognitive and speech therapy software, Personalized dietary log and analysis and Physical exercise coach for post-stroke rehabilitation; all developed by the consortium.

The system uses Lifestyle Support Patterns (LSP) to effectively find and highlight complex events and meaningful, high level physiological states. The LSP governs the monitoring episode. It is composed from a set of sensor configurations, measurement workflow definitions, abstract signal definitions and alerts. Abstract signals, like 'good sleep' or 'overall state', can be composed from processed sensor signals or other abstract signals and they are presented to the medical expert as a special, complex data type. The user can drill down into the 'roots' of an abstract signal or alert to verify the assessment. LSP's are developed for our target patient types, and may be personalized for each concrete episode.

Results and Conclusion

We implemented the ProSeniis prototype using a workflow and a rule engine built into a service-oriented architecture, both on the Hub and the centre. We have also validated our custom devices with respect to commercial alternatives. We have developed a set of LSP's and a full episode configuration GUI is in progress. Living lab experiments with ca. 30 dementia/Alhzeimer/ Parkinson/post-stroke patients will begin early 2010. More information is available on the project website at http://www.proseniis.com

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