American Journal of Geriatric Psychiatry 2010 Annual Meeting

Abstract for Poster Number: NR 47

Discovering and Tracking Activities of Daily Living Using Smart Environment Technologies

Maureen Schmitter-Edgecombe; Parisa Rashidi; Diane Cook; Lawrence Holder
Washington State University, Pullman, WA

Introduction: We utilize pervasive sensing technologies in a smart apartment to determine whether software algorithms can recognize and track everyday activities of daily living (ADLs). We introduce and validate a new data mining method, called discontinuous varied-order mining method, which is able to find frequent patterns in data that may be discontinuous and might have variability in the ordering. This is important because interruptions may occur during everyday ADL completion or substeps of ADLs may be accomplished in slightly different orderings.

Methods: In Experiment 1, 20 undergraduate students performed scripted ADLs in a smart apartment that involved telephone use, hand washing, meal preparation, eating and medication use, and cleaning. Sensor readings were obtained from motion, temperature, water, burner, and phone usage sensors. In Experiment 2, we complicated the situation by having 20 participants complete eight everyday activities interwoven with the goal of completing the tasks quickly and efficiently. The activities included filling a medication dispenser, watching a DVD, watering plants, conversing on the phone, writing a birthday card, preparing a meal, cleaning and selecting an outfit. In Experiment 3, we applied our activity discovery method to 3 months of daily activity data collected from the smart apartment while two residents lived there and performed their normal daily routines.

Results: Experiment 1 showed that our multi-hidden Markov model was able to recognize 73.8% of the original activities compared to 95.2% of the activities discovered by our activity discovery method. Experiment 2 revealed that our multi-hidden Markov model was able to recognize 77.3% of the original activities and 94.9% of the activities discovered by our activity discovery method. In Experiment 3, we then used our activity discovery method model to discover activity patterns for our smart home residents and our multi-hidden Markov model to track the activities that had been identified. To verify the discovered activities, we presented the discovered activities to the residents to see if they could recognize any of the activities as their daily routine. Identified patterns included preparing a meal, using the bathroom, watching TV/getting snack, and resting in the bedroom (after working on computer).

Conclusions: These findings show that our activity discovery method is able to discover frequent activities that belong to known sets of ADLs. The findings also indicate that this new data mining method can be used to track when activities are performed on a continual basis in a smart home and can be applied to large datasets collected over a long period of time. Ultimately, we want to use our algorithm design as a component of a complete system that performs functional assessment of older individuals in their everyday environments. This type of automated assessment could also provide a mechanism for evaluating the effectiveness of treatment interventions on everyday functioning.

This research was funded by: Life Sciences Discovery Fund