Mobility Monitoring with the Independent LifeStyle Assistant™ (I.L.S.A.)

Liana Kiff, Karen Haigh and Xianghong Sun
Honeywell Laboratories
3660 Technology Drive
Minneapolis, MN 55418

Summary

The Independent LifeStyle Assistant™ (I.L.S.A.) field test was deployed in the first quarter of 2003. We describe the I.L.S.A. function of remote Mobility monitoring and reporting, and discuss the merits and drawbacks of the field test implementation.

Introduction

The I.L.S.A. field test represents the culmination of a three-year NIST ATP program to study how monitoring technology may be used to support the long-term independence of seniors, improve their quality of life, and reduce the cost to care for the burgeoning population of seniors [Haigh *et al* 2002]. General Mobility (general activity level, or lack of activity) was determined to be one of the most significant ADL monitoring needs.

Aims and objectives

General mobility is one early indicator of an impending health crisis. Identifying trends in overall mobility can provide valuable warnings for caregivers. The objective of the mobility monitoring function in I.L.S.A. was to alert caregivers about a complete lack of mobility for some specific time-based threshold, and to identify significant changes in general mobility levels (50% change for three consecutive days). Mobility during sleeping hours was also reported as an indicator of overall quality of sleep (``up-at-night``).

Method

We used pet-immune IR motion sensors positioned throughout the home to record activity. 4-6 of these sensors were deployed depending upon the size of the home. A software agent monitored activity and generated alerts based on the above rules.

Results

Clients quickly overcame any privacy issues related to motion sensor placement, and both clients and caregivers reacted positively to the availability of mobility information.

Several major factors reduced the utility of the mobility reports. The first factor is that sensor placement is critical. For example, sensors aimed too low toward the floor could actually work against the intent of the no-mobility alert by picking up flailing arms or legs associated with a person in distress on the floor. Also, bedroom motion sensors were often activated by normal nighttime motion (e.g. turning over in bed). By filtering these faulty reports from the bedroom motion sensor, we reduced up-at-night alerts by 61%.

The accuracy of up-at-night reports was also compromised by the static nature of the clientís wake/sleep schedule configuration (set at the beginning of the test based on client interview). We discovered that the clients were not accurate in reporting their real schedule by an average of one hour variance. Using Machine Learning techniques to study the clientsí normal living patterns, an adaptive system would have been able to reduce false up-at-night alerts by 72%. These schedule modifications could be reported to clients and caregivers as possible indicators of changes in overall wellness.

A third factor is reliable occupancy detection. We required clients to pro-actively turn I.L.S.A. off when they left to suppress unwarranted lack-of-mobility alarms. Clients were reluctant to do this because they were afraid theyíd forget to turn it on again. One possible solution would be to detect the clientís return and intelligently prompt her to reactivate the system. To report accurate and useful information about mobility, particularly lack-of-mobility, a reliable passive occupancy detection system must be developed. In a limited experiment with two clients we used door sensors and a pressure mat outside the entrance to filter false alarms. Our initial findings indicate some success, but 100% accuracy cannot be obtained using this method.

Finally, without a way to disambiguate the client from visitors and health care providers, all mobility information is questionable. In the single-occupant homes of our field study, there does appear to be some validity to even the inaccurate data when viewed at the macro level over several months. However, correct assessment of long-term trends needs to have reliable occupancy and identity verification.

Conclusion

Mobility monitoring provides valuable information about wellness that is useful to both clients and caregivers. Issues with accuracy and validity of data can be overcome or mitigated with further research or with the balanced use of other assessments and interactions with the client.

References

[Haigh et al 2002] K. Z. Haigh, J. Phelps and C. W. Geib, *An Open Agent Architecture for Assisting Elder Independence*, The First International Joint Conference on Autonomous Agents and MultiAgent Systems (AAMAS), 2002. Pages 578-586.

Acknowledgements

The authors and Honeywell would like to acknowledge the support of the Advanced Technology Program at the National Institute of Science and Technology, U.S. Department of Commerce under agreement #70NANBOH3020. The identification of Minnesota test locations and test subjects was supported by United Health Care, and Presbyterian Homes and Services. The Florida-based field testing managed by the University of Floridaís Department of Occupational Therapy. Honeywell gratefully acknowledges the contributions of Pat Dasler, Michael Justiss, Dr. William Mann, and others who supported the successful deployment to Gainesville test participants. Honeywell ACS Labs thanks LifeLine Systems, Inc. for providing emergency personal response coverage for the Florida-based clients.