
Visualizing Your Ward: Bringing Smart Home Data to Caregivers

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Abstract

Health care visualization is a quickly evolving field. With a significant increase in the data available, care providers are continually being bombarded with increasingly complex information about their patients.

Smart home technologies used to monitor older adults are no exception to this proliferation of information. Little work has been done to discern what pieces of data are most important to care providers and how to best deliver it. The Center for Advanced Studies in Adaptive Systems (CASAS) at Washington State University has launched a series of evaluations to derive a concrete understanding of which interfaces and data are most useful to nurses in a continuing care retirement center environment.

This work will be used to guide how future smart environments are designed and presented to users. Research will also address how these same systems should be shown to residents and various kinds of care givers. The outstanding questions surrounding acceptance, usability and privacy are all open issues to be addressed.

Keywords

smart environments, health care, gerontechnology, acceptance, visualization

ACM Classification Keywords

H.5.2 Information Interfaces and Presentation: User interfaces – Evaluation/ methodology

Introduction

Smart environments have a place in the future of elder care. The renewed focus on aging in place as a means to blunt the impact of our rapidly aging population has left the health care community seeking new approaches to monitoring their wards at home. Smart environments provide a tool to monitor older adults in an unobtrusive, but comprehensive manner. These technologies have already been established in both the research [4] and commercial worlds.

A key issue when bringing any technology into the health care community is determining its efficacy. Discovering what data is needed by care providers, such as nurses, doctors, family members, and the residents themselves is an open issue. The CASAS engineering and psychology researchers have begun the process of exploring how health care professionals perceive and can make use of smart environments to better help their wards.

Data and Environment

The research for this work is based on the latest CASAS testbeds at a Continuing Care Retirement Center (CCRC) called Horizon House. These 16 smart environments have been installed as part of a longitudinal elder care project. The primary goal is to build and evaluate tools for supporting aging in place approaches to elder care. Other goals include testing new sensor technologies, algorithms development for activity detection, transfer learning and visualization.

At Horizon House the residents mostly live in individual apartments with their own facilities for daily living. Sixteen residents between the ages of 70 and 90 have had the CASAS

smart home sensors installed in their homes and over 7 months of data have been gathered.

The smart home testbeds used at Horizon House are based off of previous CASAS projects [2]. They utilize ceiling and wall mounted motion detectors, door sensors, light meters, and room temperature sensors to monitor the space. The resulting data sets from the residents can then be used to drive automatic classification of activities or other behaviors. Visualizing these large and complex data sets for the nursing staff is a keystone of making these tools successful

Visualization

The work at CASAS has begun investigating methods of providing information to the caregiver. There are a handful of key factors that the CASAS research has decided to focus on (Table 1). These have been selected to give a caregiver a clear view of how their ward is doing, both in the long and short terms. Several prototype visualization interfaces have been developed to present this complex information in an understandable medium.

Sleep Patterns	Activity Density
Activity Occurrences	Socialization
Ambient Environment (light, temp, etc.)	

Table 1: Key resident monitoring factors

The long term chart (Figure 1) is based on earlier work about occupancy density [5], and extended to show an individual's activities of daily living behavior over time. As the researchers worked with care providers, it was determined that more immediate information about the wards was desired, as well as trend analysis. These newer tools (Figures 2, 3) are geared to be more interesting to care providers on a day to day basis, and will be the basis for the upcoming surveys in the field.

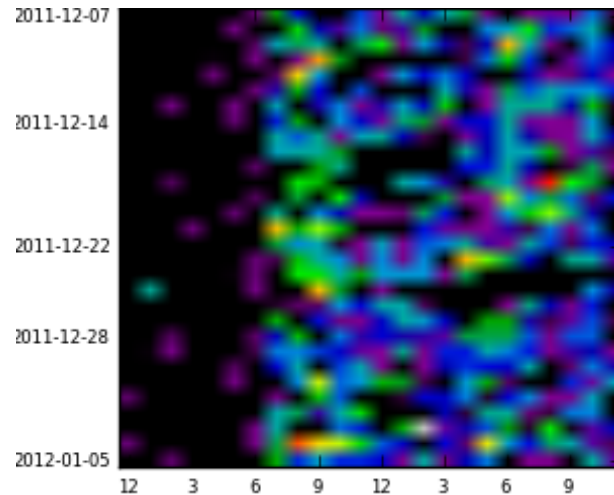


Figure 1: Prototype monthly Activity Density visualization

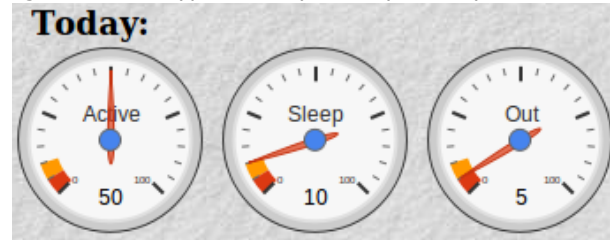


Figure 2: Resident weekly activity performance

Usability Study

Research into how to best visualize smart home data is a relatively untapped field. While some researchers have done studies on what the elder clients think about the system as a whole [3] and the perception of health care providers about technologies [6], a rigorous evaluation of visualization techniques of the data is a new venture.

The research done at University of Missouri's Tiger Place suggests that elder clients do have some privacy concerns about how their data is handled and where it goes, which is a key factor in what can be included in data shown to others. The researchers there have found that elderly clients desire a system that is unobtrusive, but one that would be helpful to them in an emergency situation. Therefore, it's clear that when creating tools to visualize the smart home data, it is important to make the data from the clients as secure as possible and to ensure that emergency alerts are carefully engineered.

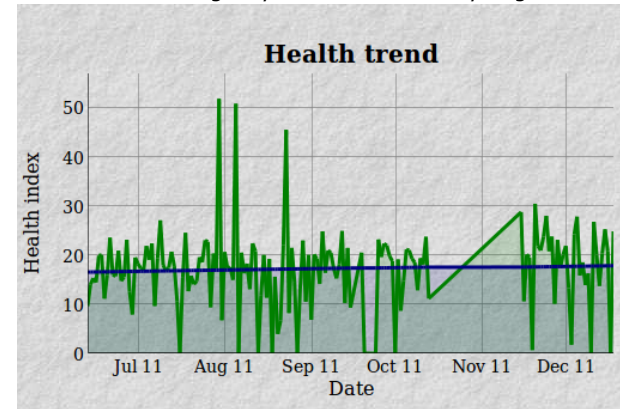


Figure 3: Health trend over six months

The CASAS lab is conducting a Usability Study to investigate effective techniques for visualizing assistive smart home data. The study consists of a set of interviews and questionnaires for caregivers. The main research questions on this project assess what the caregivers feel are the most important pieces of data to have access to, the ease of use of the current prototypes, and what future changes they would like to see.

The interview will consist of four parts. The first phase of the interview includes questions to assess the interviewee's technical skill. The second phase includes questions such as:

"Name three things that you would like technology to be able to do the most to help you do your job," to get an unbiased view of their desires from technology. The third phase is demonstrating the current visualization prototypes and using the System Usability Scale [1] to evaluate the current interfaces. Lastly, the fourth part uses questions like "What do you think are some of the most important data points that you could receive from the current system?" to determine their perceptions and desires for future tools. These interviews would be encapsulated in 30 minute one on one sessions with at least 8–10 health care professionals. After the first round of interviews, a short 2 page questionnaire will be generated for wider and repeated use. This questionnaire would then be used with a 6–12 month cycle to iteratively improve the smart home technologies in use. The results of this process should provide new insights and directions for visualization and aging in place technologies.

Conclusion

With the ever growing body of smart technology and the increasing elder population, it is important to know how this specialized population will relate to assistive technologies. CASAS is one of many labs working to better understand the assistive smart home user and their caregivers. It is important to know how to best link the caregiver to the most relevant pieces of data available.

In the future, questions about how best to communicate with those residents living in the home, how best to detect and relay emergencies, and how to help the caregiver by assisting older individuals in their everyday activities will need to be explored. Creating useful and usable assistive smart homes will provide means to support aging in place approaches to elder care. Delving into how to best present and visualize the

data from the technology is a key aspect of achieving these goals.

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