Introduction
It has been a long-lasting interesting in developing in-home based technology to improve the quality of care-giving systems, and in turn, to prolong the ability of older adults to live independently at home and avoid institutionalization. To assist older adults and people with disabilities to live independently, smart environments have become a very popular research area. In order to understand all the information of the smart environments, the goal of the current project is to improve the accessibility of smart environment technology to the public by creating a user-friendly, visualized interface to represent the information gathered from smart home technology.

CASASviz System Architecture

Data Collection in CASAS Smart Environment
As shown in Figure 2, to track people’s mobility, we use motion sensors placed on the ceilings. The circles in the figure stand for the positions of motion sensors. They facilitate the residents who are moving through the space. A simple power meter records the amount of instantaneous power usage and the total amount of power which is used. An in-house sensor network captures all sensor events.

Multi-Platforms Compatibility
CASASviz is a web-based visualization system to represent and explore residents’ behavior patterns in our CASAS smart environment. To implement CASASviz, we make use of Scalable Vector Graphics (SVG), which is an application of XML-format that makes it possible to describe two-dimensional vector graphics. SVG graph is compressible, scalable, and can be zoomed without degradation. To be compatible with different platforms, we use web-based technologies to implement the CASASviz system. Thus, CASASviz can be used on Windows, Linux, and even smart phones without worrying about compatibility. Figure 3 shows the CASASviz interface on an iPhone device.

Visualization Application Module
1. Main Visualizer
Figure 5 shows the interface of our CASASviz main visualizer. As shown in the figure, the red circle represents the location of the resident in our CASAS smart environment. Through XMPP middleware, we can monitor the resident’s mobility in real time. We also provide playback mode from a captured file or SQL database storing the sensor readings for reviewing the mobility history of the resident.

2. Power Usage Visualizer
In smart environments, power usage is also an important factor to represent behavior patterns of the residents. As shown in Figure 6, CASASviz provides an energy usage visualizer to express energy fluctuations that occurred during the time the user defined. This graph can be used to identify trends and abnormalities of power consumption.

Future Plan
1. Long-term and Abnormal Patterns Visualizer
To discover long-term and abnormal behavior patterns of the residents, we are planning to extend a data structure of suffix tree as an efficient sensor event representation to analyze the global structural patterns of sensor events. Intuitively, for a sensor stream S, we consider a sensor pattern p in S to be an anomaly, if the frequency of this pattern does not satisfy a pre-specified threshold. If the frequency of the pattern is one of the highest in all the patterns, we define this pattern will be a long-term behavior pattern for the resident.

2. Activity Feature Extraction
In smart environments, we need to make use of machine learning techniques to do some predictions, such as activity recognition and energy prediction. Before making use of these learning algorithms, another important step is to extract useful features or attributes from the raw annotated data. We have considered some features that would be helpful in prediction and recognition. These features have been generated from the sensor data by our feature extraction module.

3. Need assessments and user-end design evaluation
We are also planning to conduct a pilot study with our focus group of interest. That is, caregivers who have experience using in-home based monitoring systems would be best candidates. We are currently interested to learn more about the desired features/functions, desired interface design, desired platform (e.g., Smartphone, laptop, or desktop) and when, where and how the visualizer system be useful and benefit their everyday caregiving at home or in a distance. We expect such information will be useful for future improvement of our visualizer system.