Open Home: Approaches to Constructing Sharable Datasets within Smart Homes

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Abstract
In this paper we present our initial efforts to develop approaches for structuring and building openly accessible, scalable, shared home behaviour datasets within smart home communities.

Keywords
Smart home, assistive technology, activity monitoring, data heterogeneity, community sharing

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
Smart homes have emerged as a promising solution to the problems resulting from dramatic demographic changes over recent years. In general, smart homes endeavor to equip living environments with assistive technology to allow “ageing in place”.

Across a variety of disciplines many research efforts have been made towards supporting elderly and disabled people to remain living in their home. Some of the key aims have been to maintain a level of independence and quality of life through the provision of appropriate assistive solutions. At present there are

numerous technical solutions being utilised in smart environments, such as activity tracking and monitoring, environmental control, to name but a few. These solutions are both commercial and proprietary in nature.

As a result of the huge amount of effort which has been directed towards this area we are constantly encountering the challenge to undertake data re-engineering tasks at both data and application levels.

home Series of Standards

Our motivation to design and establish open approaches to manage data within smart environments has been driven through our ongoing research in the area of technologies to support independent living and in particular our involvement in several elderly care related projects. To date we have proposed three open approaches all of which with the primary objective of facilitating the realisation of data sharing, information structuring and knowledge management. Each of the standards is modelled by a series of tree structures and implemented by XML schema.

XML has gained much attention in recent years and of particular relevance has been described as an acceptable means to represent biomedical data. XML has also become a widely established solution for the expressing of a syntax for data and the exchange of data via the Internet. The main benefits of employing XML relate to its platform, vendor and application independence. It is also considered to offer an easy to follow hierarchical data structure. Details of the three approaches adopted are presented below:

homeML: homeML [1] was the first attempt to offer a solution for an open method for the storage and exchange of heterogeneous data that can be collected within smart home environments. Figure 1 shows the model of homeML as a series of hierarchical data trees.

homeRuleML: homeRuleML [2] is a model to standardise the representation of decision support rules for smart environments as shown in Figure 2. The motivation of this standard is to provide a widely and freely accessible set of rules which can be openly used and exchanged within the research domain and beyond.

homeADL: homeADL [3] is a model for representing activities of daily living being monitored in a smart home. It associates undertaking activities with object interactions which can be observed in a smart home setting. Figure 3 shows the hierarchical trees of homeADL.

Semantic Smart Home

In an effort to move towards a new generation of technology infrastructure for assistive living, we have also considered exploiting the Semantic Web (SW) technologies in Smart Home applications. The Semantic Smart Home (SSH) [4] extends the concept of current smart home research with rich semantic information and metadata to solve the problems of data interoperability, integration and semantic/knowledge based intelligent decision making support. At the core of its mechanism is an ontology-based model for smart homes including inhabitants, environments, devices and services. Figure 4 shows the architecture of the SSH and a portion of the SH ontology.

Conclusion

In this work we have demonstrated our efforts in promoting the utility of using XML as a means of data representation and storage. In addition, with the

adaptation of Semantic Web techniques we also developed the Semantic Smart Home concept. What is now required to progress this work further is a consolidation of efforts towards the wide scale deployment of these approaches in a number of experiments to validate the concepts further. In addition a refined suite of APIs is required which can be used for the design of the experiments and the respective schemas along with the visualisation and analysis of the recorded data.

Acknowledgements

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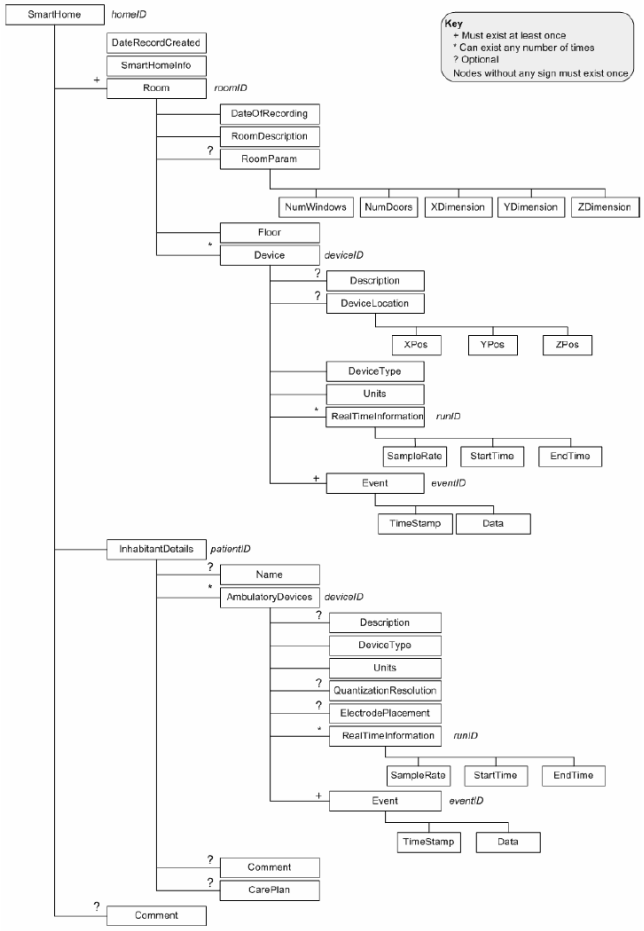


Figure 1: Hierarchical representation of homeML as a series of tree diagrams

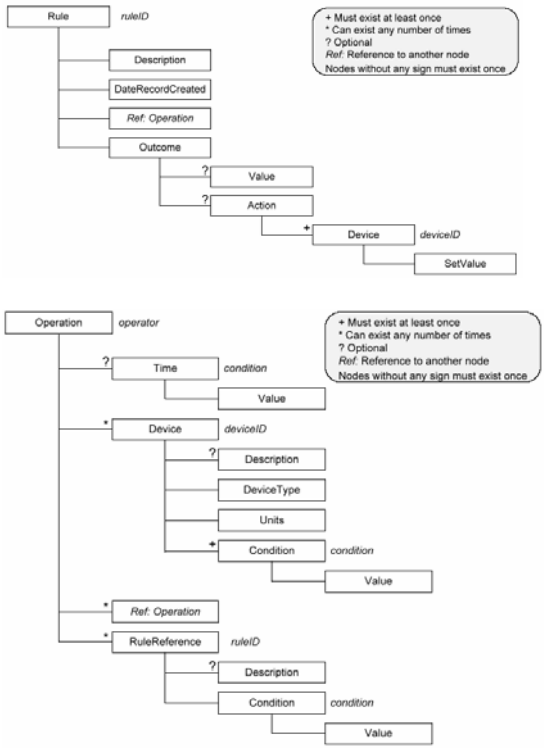
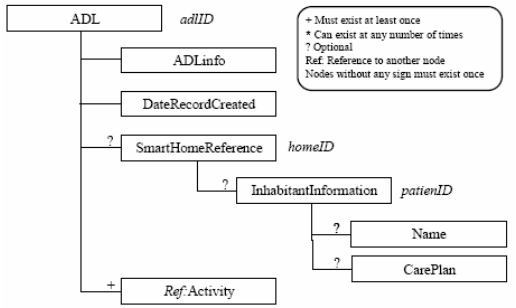


Figure 2: Hierarchical representation of homeRuleML as a series of tree diagrams



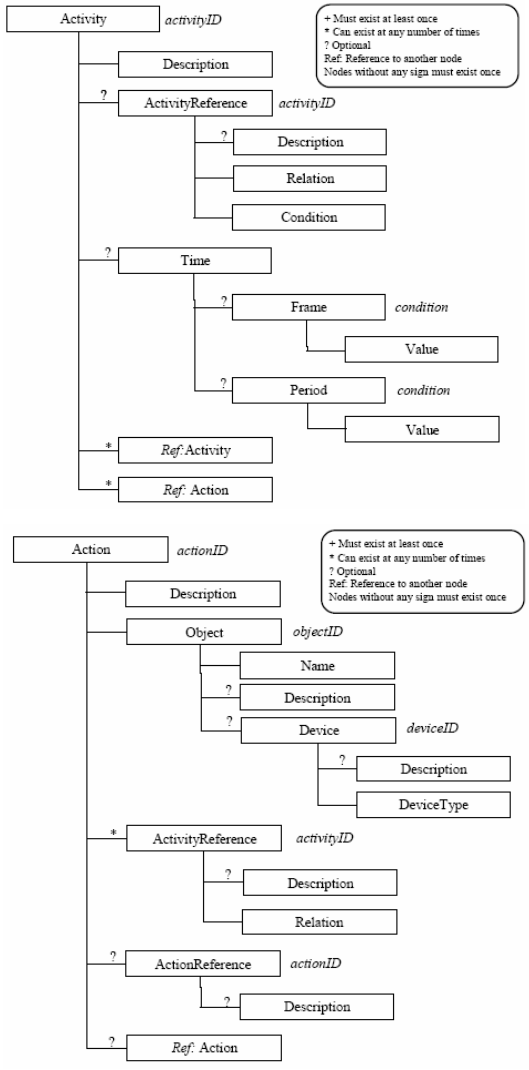


Figure 3: Hierarchical representation of homeADL as a series of tree diagrams

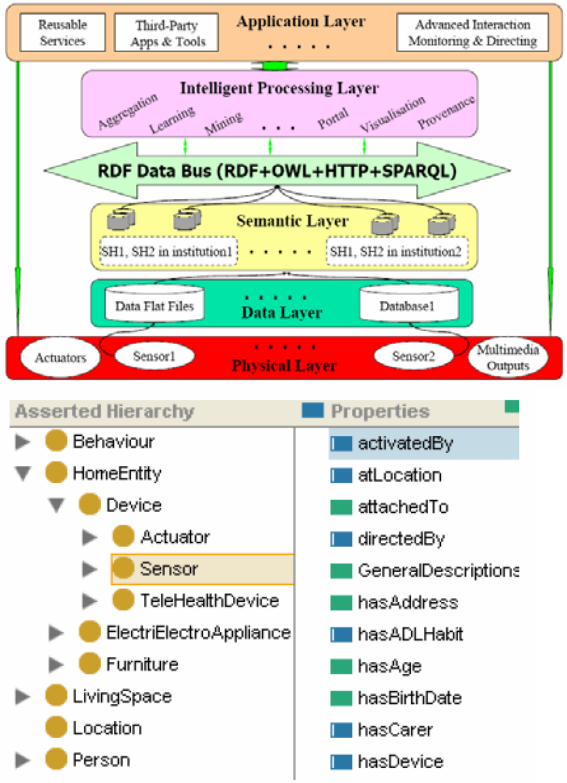


Figure 4: The conceptual architecture of the SSH and example classes and properties of the SH ontology