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Assessing the Impact of the homeML Format and the homeML Suite within the Research Community

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Abstract: The lack of a standard format to store data generated within the smart environments research domain is limiting the opportunity for researchers to share and reuse datasets. The opportunity to exchange datasets is further hampered due to the lack of an online resource to facilitate this. In our current work we have attempted to resolve these issues through the development of homeML, a proposed format to support the storage and exchange of data generated within a smart environment and the homeML suite, an online tool to support data exchange and reuse. A usability and functionality study performed by 8 unbiased members of the research community is presented and discussed. All participants in the study agreed that the homeML format could address the need for a standard format within this domain. Participants also agreed that the homeML suite would be a useful tool to be available to researchers as they perform experiments in the area of smart environments.

Keywords: Heterogeneous Data, Smart Environments, homeML, Standard Format, Repository and XML
Categories: E.1, E.2

1 Introduction

The global population is transitioning from a predominately younger population to one with a much higher percentage of older adults [Coughlin, 08]. Coupled with population growth is the prevalence of increasing numbers of people suffering from age related impairments and chronic diseases such as dementia, stroke and diabetes [Lutz, 08].

There has been a considerable amount of research in the area assistive technologies in the realm of home based support and healthcare provision, particularly in the direction of smart environments [Chan, 09].

Smart environment are residences equipped with technologies and devices that allow the monitoring of its inhabitants; whilst encouraging independence and the maintenance of health and well being [Chan, 09]. They can be used to support people suffering from cognitive or physical impairments, as well as people who may live alone and require assistance performing day-to-day activities or should an emergency situation arise. In addition, people who receive healthcare at a distance or people who suffer long term chronic diseases and require continuous monitoring may also benefit.

As a direct result of this level of research there has been an abundance of data generated. The data itself is of a largely heterogeneous nature, given that it is generated by a variety of devices and systems. It is therefore stored in an array of differing formats. The major issue with the heterogeneity of data generated within this research domain is its lack of interoperability; creating difficulties when data is stored, exchanged and processed. It also limits the opportunity to share and reuse datasets amongst researchers.

Another issue is that generating such datasets to validate and test developments and theories can be expensive and time consuming and may not always be possible. There is therefore a recognised need to develop a means by which researchers within this domain can share and reuse the datasets they have generated. Ye et al. state "Data sets are essential to activity recognition research, since they provide a basis for assessing activity recognition algorithms. ... The ability of researchers to share and reuse data sets is therefore of paramount importance." [Ye, 10].

To the best of the authors' knowledge, there does not exist a standard format specifying how data generated within a smart environment should be stored. Neither is there a resource available to support the storage of datasets generated within a smart environment within one central location where they can be shared and reused. There is, therefore, a growing need to develop such a standard format and supporting suite of tools to address these issues. Specifically, the work presented within this paper discusses the homeML format and the homeML suite. These are approaches which offer a proposed standard format for the storage and exchange of data generated within a smart environment and an online application that supports the use of the homeML format whilst promoting data reuse and exchange, respectively. In particular the paper focuses on the need for an unbiased evaluation of the proposed format and suite, the methods used when performing the external evaluation and finally the results of the external evaluation.

The remainder of this paper is organised as follows: Section 2 will discuss related work while Section 3 will discuss the homeML format and the supporting homeML suite. This Section will also discuss the previous evaluations performed on both the format and the suite of tools. Section 4 discusses in detail the external evaluation performed including the methods used to recruit and profile participants. The results of the external evaluation documented within Section 5. The observations made during the external evaluation are also discussed in Section 5 and finally Section 6 concludes the paper.

2 Related Work

Sensory Dataset Description Language (SDDL) has been developed within the Department of Computer and Information Science and Engineering at the University of Florida. SDDL is an XML-encoded description language for sensor data generated within pervasive spaces. It is proposed as a standard for characterising sensor datasets to improve interoperability and the ability to share datasets among members of the research community [SDDL, 02]. The description language specifies collective information including sensors/actuators, dataset parameters and sensor events, however, it does not specify any physical properties of the sensors/actuators. A complimentary tool is also being developed to be used alongside SDDL, as a "mechanism to repurpose and customise a shared dataset" [SDDL, 02].

SensorML is an Open Geospatial Consortium (OGC) approved international, open technical specification; providing standard models and XML encoding to describe sensors and measurement processes [OGC, 12]. SensorML defines processes as inputs, outputs, methods and parameters. In its simplest application, SensorML provides a standard digital means of creating sensor components and system specification sheets.

During a workshop within CHI'09 [CHI, 09] the issues surrounding the development of shared home behaviour datasets were discussed to advance home-computer interaction and ubiquitous computing research [Intille, 12]. Intille [WSU, 12] has continued this research and outlines a problem within an area he is currently working, 'Developing Shared Home Behaviour Datasets to Advance HCI and Ubiquitous Computing Research'; whereby work related to context-awareness within the home is being limited due to the lack of large datasets available to researchers to test their developments and discoveries. Intille has proposed the development of a community resource, containing datasets consisting of high quality, synchronised data streams from most sensor types currently being used within smart home environments. Whenever possible, the datasets available are stored using easy-to-read file formats such as XML and CSV (Comma-Separated Values). This resource will enable researchers to focus on development and testing without being stalled by the need for data collection. The Boxlab Visualizer [BoxLab, 12] is a tool designed to accept multiple data types and create visual representations of ambient environmental conditions, as well as 3D mapping of sensor activations and timeline plotting of accelerometer data, along with many other visualisation options.

In summary, the literature would suggest that although a number of standards exist within the healthcare and technology domain, there is no standard, widely adopted format existing within the research domain specifying how data generated within a smart home environment should be stored. It is the authors opinion that this may be due to smart environments being a relatively new and emerging research area with research focused towards technology developments. As a result there has been an abundance of heterogeneous data produced within this domain; creating a growing need to develop such a standard format.

3 The homeML Format and Suite of Tools

homeML [Nugent, 07] is an XML-based format, proposed as a means of resolving the issues caused by the heterogeneous nature of data generated within a smart environment. The homeML suite has been designed to support the use of the homeML format and to assist researchers as they perform experiments within this domain. The remainder of this Section focuses on the description of these two components in detail, including the two main elements of the homeML suite, the homeML toolkit and the homeML repository. The preliminary evaluations performed on both components are also documented within this Section.

3.1 homeML Format

The homeML Format has been designed to support the storage and exchange of data generated by any device used to monitor and support an inhabitant both inside and outside of their home environment. Following an iterative design process, the homeML schema has evolved from version 1.0 in 2007 [Nugent, 07] to version 2.2 in 2012. This is illustrated in Figure 1.

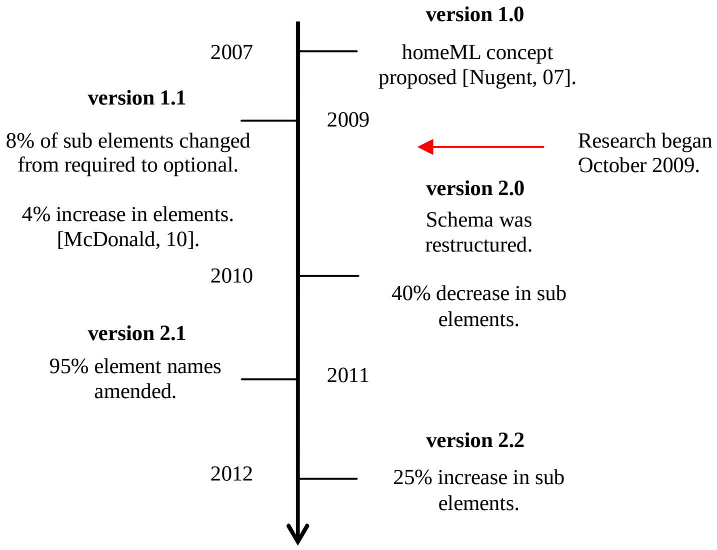

*Figure 1: Timeline documenting the evolution of homeML from version 1.0 [*Nugent, 07*] to version 2.2.*

3.1.1 Internal Evaluation

At the time of its original proposal homeML was neither validated nor reviewed. Subsequently, an initial review was performed to ensure the homeML schema was capable of storing data recorded by a range of sensors and devices typical deployed within a smart environment. To undertake the evaluation, 6 open source datasets from 5 research institutions were accessed. Each dataset structure was compared to homeML in order to identify any inaccuracies and unsupported data. A number of inaccuracies were identified and the homeML schema was amended accordingly. A detailed description of this evaluation has been previously reported in [McDonald, 10].

homeML version 1.0 was limited to the storage of data generated by location specific devices. Nevertheless, with the continued technological advances within this domain, it is now possible to monitor a person outside of the home environment using mobile devices. It was therefore decided that the homeML format should be extended further to support the storage of data generated by mobile devices. Changes made to the format based on this premise have been reported in [McDonald, 11].

homeML has since undergone two additional evaluations performed by members of the Smart Environments Research Group (SERG) which is based at the University of Ulster[1]. homeML version 2.2 is the most recent version and can be viewed in the hierarchical data tree illustrated in Figure 2.

As Figure 2 illustrates, the root element homeML consists of three required attributes called inhabitantDetails, location and annotationDetails which must occur at least once, as well as a forth optional attribute called mobileDevice. A brief description of each can be viewed in Table 1.

The inhabitantDetails attribute stores an inhabitant's personal details and can have up to four sub elements (inhabitantID, Name, carePlan and Comment). The second attribute location will store up to three sub-elements (locationID, locationDescription and locationDevice) providing descriptive details of the inhabitant's location. The locationDevice element stores up to six sub elements (ldeviceID, deviceDescription, deviceLocation, units, realTimeInformation and event) providing descriptive details of any device integrated into that location and the data produced by that device through the inhabitant's interactions with it. The only optional attribute mobileDevice stores descriptive details of any mobile devices used by the inhabitant such as a mobile phone, as they move between environments, as well as any data generated through the inhabitant's interaction with that environment or data generated by an inhabitants movements between environments. The mobileDevice attribute can consist of up to 7 sub elements (mdeviceID, deviceDescription, units, devicePlacement, quantizationResolution, realTimeInformation and event). Finally, the final attribute annotationDetails stores experimental details and can consist of up to six sub elements (annotationID, experimentType, lDeviceID, mDeviceID, startTimeStamp and endTimeStamp).

homeML	**The root element for XML based smart home data**		
Element/ Attribute	**Description**	**Required/ Optional**	**Data Type**
inhabitantDetails	Inhabitant personal information	Required	Requires element description
location	Location definition and the devices within that location	Required	Requires element description
mobileDevice	Definition of mobile devices	Optional	Requires element description
annotationDetails	Experiment Information	Required	Requires element description

Table 1: A description of the four attributes of homeML version 2.2.

[1] Access to the Smart Environments Research Group (SERG) website can be obtained using the following link: http://scm.ulster.ac.uk/~scmresearch/SERG/

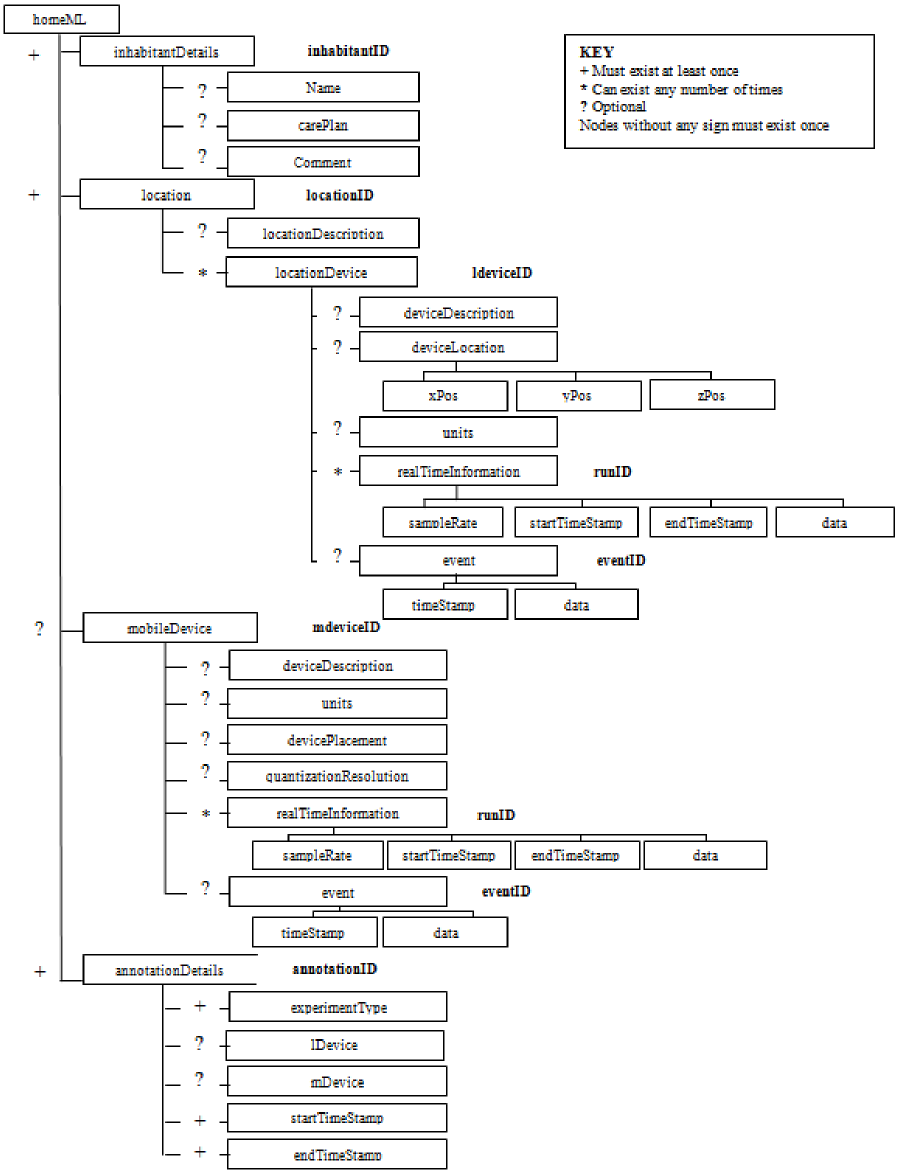

Figure 2: The homeML version 2.2 tree structure.

3.2 homeML Suite

The homeML suite has been developed to facilitate the use of homeML within the smart environments research domain. Users have access to an intuitive end-to-end system that will assist them as they perform experiments. Each registered user has access to an online repository and suite of tools. The following Sections describe the tools available in further detail.

3.2.1 homeML Repository

In order to promote data sharing and reuse the homeML repository was developed. Functionality of the repository allows a registered user to upload and store data generated from experiments, as shown in Figure 3.

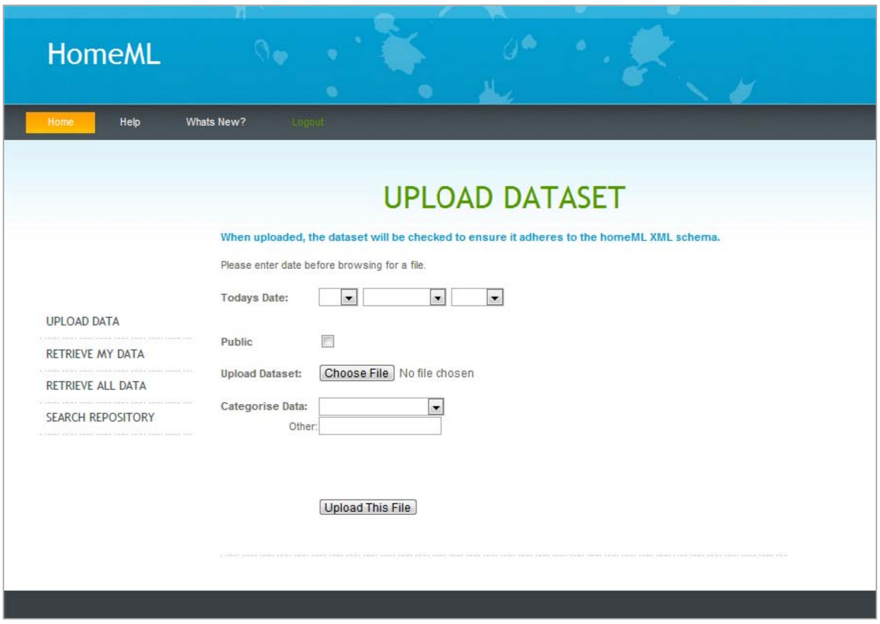

Figure 3: Screenshot illustrating the tool available to upload datasets to the homeML repository.

Prior to being published within the homeML repository all datasets will be validated to ensure they adhere to the homeML version 2.2 format. The user will also be asked to confirm that they would like to make the dataset publically available, i.e. viewable and downloadable by all registered users. Figure 4 illustrates a validated extract of data uploaded to the homeML Repository. All publically available data files can be viewed and downloaded by any registered user. A facility is available, allowing users to search for data according to author or data category, i.e. single occupancy, multiple occupancy, fall detection, to name but a few.

3.2.2 homeML Toolkit

The homeML toolkit is a suite of tools designed to facilitate the use of the homeML format. A tool is available allowing researchers to design an experiment prior to performing it, as shown in Figure 5.

```
▼<homeML>
  ▼<inhabitantDetails>
      <inhabitantID>1</inhabitantID>
      <Name>SMART 2</Name>
    </inhabitantDetails>
  ▼<location>
      <locationID>1</locationID>
      <locationDescription>Labs 16J26/27</locationDescription>
    ▶<locationDevice>...</locationDevice>
    ▶<locationDevice>...</locationDevice>
    ▶<locationDevice>...</locationDevice>
    ▼<locationDevice>
        <ldeviceID>34035498</ldeviceID>
        <deviceDescription>Kitchen Cupboard</deviceDescription>
      </locationDevice>
    ▼<locationDevice>
        <ldeviceID>34035452</ldeviceID>
        <deviceDescription>Fridge</deviceDescription>
      </locationDevice>
    ▼<locationDevice>
        <ldeviceID>34035426</ldeviceID>
        <deviceDescription>Microwave</deviceDescription>
      </locationDevice>
    ▼<locationDevice>
        <ldeviceID>34035493</ldeviceID>
        <deviceDescription>Kettle</deviceDescription>
      </locationDevice>
```


Figure 4: Extract of data taken from a validated dataset uploaded to the homeML Repository.

A partially populated XML file will be produced including all inhabitant details and annotation details, in addition to any descriptive details of any device the inhabitant will potentially interact with during the experiment. The partially populated XML file can then be populated with the data generated during ensuing experiments. A similar tool is also available allowing researchers to populate the schema and upload raw data into it, after an experiment has been completed. Both methods produce an XML file, adhering to the homeML version 2.2 format, which can then be uploaded to the homeML repository.

3.2.3 Internal Evaluation

The homeML suite has been evaluated twice by members of SERG, including a usability study and a functionality study [McDonald, 12]. The usability study was completed by ten participants, who were asked to complete 4 tasks using the homeML suite. Each participant was then asked to complete a questionnaire rating the design, intuitiveness and layout of the application. The results of the usability study identified only minor design issues which have since been rectified [McDonald, 12].

The functionality study involved 5 participants recruited from within the SERG [SERG, 12]. Prior to engaging with the homeML suite each participant was asked to complete a questionnaire, which consisted of both quantitative and qualitative questions. The purpose of which was to profile each participant in relation to their area of research and experience. Following completion of the questionnaire the participants were asked to use the homeML suite as an end-to-end system, i.e. design an experiment, populate the schema and upload the completed XML file to the repository. Participants were then asked to complete a questionnaire, again consisting of both quantitative and qualitative questions; the purpose of which was to allow the participants to rate their experience using the homeML suite, in addition to providing them with an opportunity to suggest recommendations for future developments of the homeML suite. The results of this questionnaire were positive with no technical or design issues being identified [McDonald, 12].

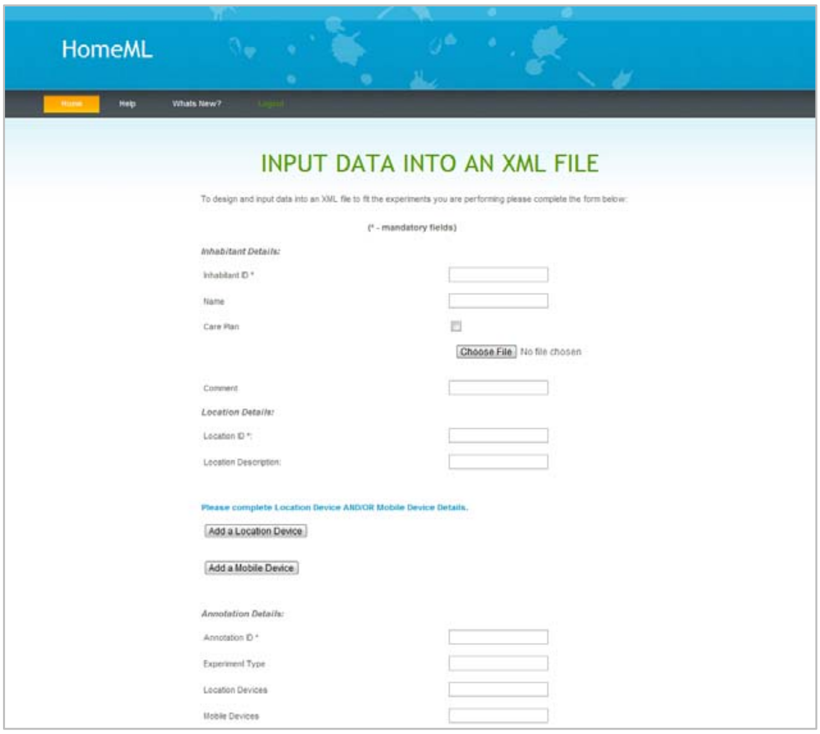

Figure 5: Screenshot illustrating the tool available to design an experiment and create a partially populated XML File.

4 Methods

As discussed in the previous Section, both the homeML format and suite have undergone a number of evaluation studies performed by members of SERG. Nevertheless, in order to achieve an unbiased review of this work it was essential to perform both acceptance and usability testing by truly objective researchers, who have no affiliation with SERG. This Section describes how the participants involved in the external evaluation of the homeML format and the homeML suite were recruited and profiled. The experimental set-up for evaluation purposes is also discussed including a detailed description of the pre-test and post-test questionnaires.

4.1 Recruiting Participants

The International Conference on Smart homes and health Telematics (ICOST) is considered to be a "premier venue for the presentation and discussion of research in the design, development, deployment and evaluation of Smart Environments, Assistive Technologies and Health Telematics" [ICOST, 12]. This conference was therefore deemed an appropriate forum to recruit participants to perform the evaluation of an emerging smart environments data format and corresponding suite of tools.

During the 2012 meeting of ICOST, an information sheet advertising the homeML format and homeML suite was inserted into the delegate packs of each delegate attending the conference. An announcement was also made requesting that those willing to participate in the study should approach one of the researchers involved in the study. This along with ad hoc solicitation of delegates, resulted in a total of eleven delegates being recruited to take part in the study.

4.2 Pre-test Questionnaire

Prior to performing the evaluation, all participants completed a pre-test questionnaire which was available online [Questionnaire ICOST 2012, 12]]. This questionnaire consisted of ten questions, which were used to profile the participants. It was used to obtain the participant's research area, the challenges they face when performing research within this area, their working knowledge of various technologies and which data formatting standards they were aware of. Participants could select multiple options when asked: What is your research area? What are the current challenges you face when conducting experiments in a smart environment?, What technologies do you currently use as part of your research?, and Which standards are you aware of?. All participant responses obtained from this questionnaire are summarised in Table 2.

One particularly interesting statistic from the pre-test questionnaire was that five out of eleven participants were aware of the homeML concept. This was in contrast to two other standards within this area, SensorML [OGC, 12] and SDDL [SDDL, 02], that were less well known by the group of participants. Another interesting statistic to note was that the most common challenges faced by the participants when performing research was reported to be the availability of datasets and participants, in addition to technology installation. This suggests there is a need for publically available datasets within the smart environments research domain.

As the results show, participants were involved in many research areas simultaneously, however, it should be noted that five out of eleven participants were involved in the area of data collection and processing. Ten out of eleven participants stated that they performed experiments that produced heterogeneous data on a regular basis, with the same ten participants stating that they used environmental sensors as part of their research. Ten out of eleven participants also considered themselves to have a working knowledge of XML, databases and ontologies. Finally, nine out of eleven participants agreed that the current methods for data sharing and data interoperability within this research domain were insufficient.

	Participants who completed the pre-test questionnaire (n=11)
Research Area:	4 Requirements Analysis, 5 Data Collection and Processing, 2 Data Analysis, 6 Information Modeling, 4 Middleware support, 4 Technology Assessment, 5 Impact Analysis, 1 Context Awareness, 1 System Modeling, 1 Machine Learning and 1 Formal Methods.
Frequency of Experiments:	3 Daily, 1 Weekly, 6 monthly and 1 never.
Current challenges:	5 Availability of Datasets, 3 Sharing and Comparing Datasets, 6 Availability of Participants, 6 Technology Installation.
Technologies currently using:	10 Environmental Sensors, 4 Wearable Technologies, 3 Camera Technologies, 7 Ontologies and 1 Mobile Devices.
Production of heterogeneous data:	10 Yes and 1 No.
Working knowledge of XML:	10 Yes and 1 No.
XML Knowledge Rating (between 1-5)	4 - 5/5, 3 - 4/5, 1 - 3/5, 1 - 1-5 and 2 - 0/5.
Working knowledge of Ontologies:	10 Yes and 1 No.
Ontologies Knowledge Rating (between 1-5)	2 - 5/5, 5 - 4/5, 1 - 3/5, 1 - 1/5 and 2 - 0/5.
Working knowledge of Databases:	10 Yes and 1 No.
Database Knowledge Rating (between 1-5)	1 - 5/5, 2 - 4/5, 4 - 3/5, 2 - 2/5 and 2 - 0/5.
Standards currently aware of:	5 homeML, 2 SDDL, 1 SensorML and 7 HL7.
Sufficiency of current data sharing methods:	2 Yes and 9 No.
Sufficiency of current data interoperability methods:	2 Yes and 9 No.

Table 2: The pre-test questionnaire results from all eleven participants.

4.3 Experimental Set-up

Following the initial study, all participants who were interested in reviewing the homeML format and suite were contacted after the conference. Of the eleven participants who were contacted eight agreed to be involved in a further acceptance and usability study. Prior to the study beginning each person was given an information sheet and asked to complete a consent form both of which are available online [Participant Information Sheet, 12] [Consent Form, 12].

Once consent was given the participant was provided with a username and password allowing them to access the homeML suite [HomeML, 12]. When logged in each participant was able to view and download the homeML format in addition to use the homeML toolkit and homeML repository.

Participants were not given specific tasks to complete. They were simply asked to use the suite for a period of seven days and provide feedback regarding the homeML format and homeML suite through the completion of a questionnaire, as shown in Figure 6.

What will I have to do?
Participants will be first asked to review the homeML version 2.2 format as a means of storing data generated within a smart home environment. They will then be asked to use the supporting homeML Suite. Upon completion participants will be asked to complete a short questionnaire consisting of both quantitative and qualitative questions. No personal data will be transmitted and any information that identifies the participant will be removed prior to publication of any results related to the study.

Figure 6: A description of what each participant was asked to do, as written in the participant information sheet [Participant Information Sheet, 12]].

No specific hardware or software was required to complete the study. Participants merely required access to an internet browser. The only stipulation was that the participant enabled cookies before attempting to login to homeML suite.

4.4 Post-test Questionnaire

After each participant had used the homeML suite for seven days they were asked to complete a post-test questionnaire which was available online [Questionnaire, 12]. The post-test questionnaire allowed participants to evaluate both the homeML Format and corresponding suite of tools. Web based questionnaires were used. The questionnaire consisted of two sections containing both quantitative and qualitative questions. The first section was concerned with the usefulness and usability of the homeML format whilst the second focused on the usability and aesthetics of the homeML suite.

5 Results

It has been the aim of this work to perform an unbiased review of both the homeML format and the homeML suite. In order to do so 8 participants from various research institutions were approached and asked to interact with the homeML format and homeML suite. They were then asked to complete a post-test questionnaire to assess both the usefulness and usability of both the homeML suite and homeML format.

When assessing the usability of both the homeML format and homeML suite, no technical errors were reported by any of the eight participants undertaking the study. When asked to rate how understandable the homeML format structure was on a scale of one to five, one being easy and five being difficult (mode: 1, mean: 1.75).

In addition to assessing the usability of both it was also essential to evaluate usefulness, learnability and user satisfaction. The results of which have been reported within the following sections.

5.1 Usefulness

The 'usefulness' of both the homeML format and homeML suite were evaluated using the post-test questionnaire.

To assess the usefulness of the homeML format, participants were asked four questions, the results of which can be viewed in Figure 7. The questions asked were:

- Would homeML 2.2 meet your smart home data storage requirements?
- Would you consider using homeML 2.2 to store your smart home data?
- Would you recommend the homeML format to other members of the smart homes' research domain?
- Could homeML 2.2 address the need for a standard smart home data storage format?

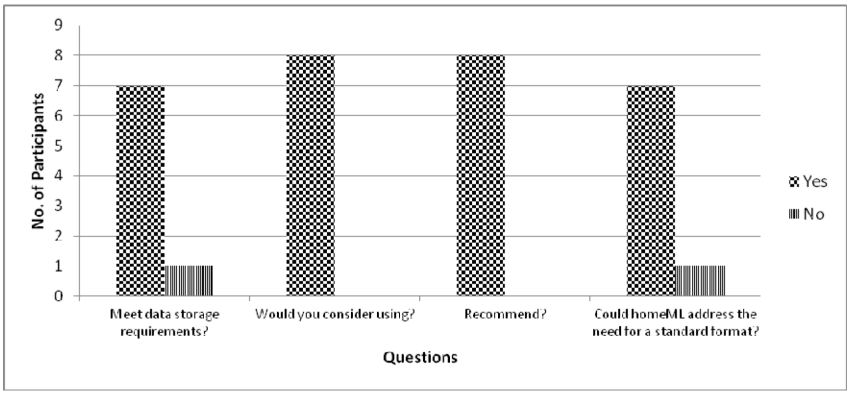

Figure 7: Results from a series of questions from the post-test questionnaire, assessing the usefulness of the homeML format.

To assess the usefulness of the homeML suite, participants were again asked four questions. Participants were asked to rate the usefulness of the homeML suite within the smart home research domain on a scale of one to five, one being not very useful and five being useful (mode: 4.5, mean: 4.5). The participants were also asked three further questions to assess the usefulness of the homeML suite, the results of which can be viewed in Figure 8. The questions asked were:

- Would you consider using the homeML suite in the future?
- Would you recommend the homeML suite to other members of the research domain?
- Do you think the homeML suite would be useful to further research in the area of smart homes?

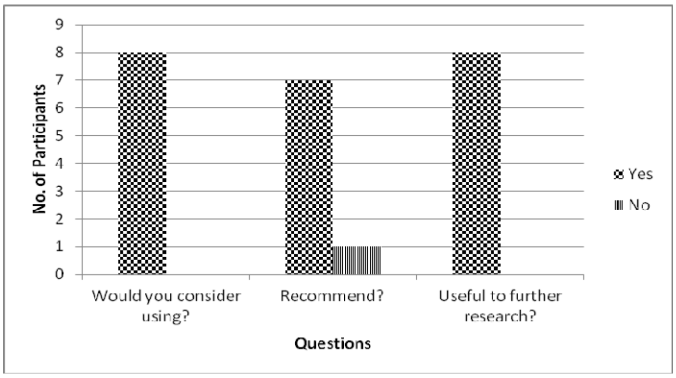

Figure 8: Results from a series of questions from the post-test questionnaire, assessing the usefulness of the homeML suite.

5.2 Learnability

The 'learnability' of the homeML suite was assessed through a series of questions in the post-test questionnaire. After using the suite for seven days, each participant was asked to estimate how long they thought it would take for a researcher to become familiar with the homeML suite, the results of which can be viewed in Figure 9. As the graph shows 50% of participants estimated that it would take a researcher a matter of hours to become familiar with the homeML suite.

Participants were also asked whether they thought a person could use the homeML suite without training.

5.3 User satisfaction and Aesthetics

User satisfaction was again assessed in the post-test questionnaire. Participants were asked to rate how they found interacting with the homeML on a scale of one to five, one being easy and five being difficult (mode: 2, mean: 2). Participants were then asked to rate how they found interacting with both the homeML toolkit and homeML repository separately using the same scale, (mode: 2, mean: 2.25) and (mode: 3, mean: 2.25) respectively.

Participants were then asked to rate the 'look and feel' of the homeML suite, on a scale of one to five, one being poor and five being excellent (mode: 4, mean: 4.25). Finally, all participants agreed that the homeML suite had an intuitive layout.

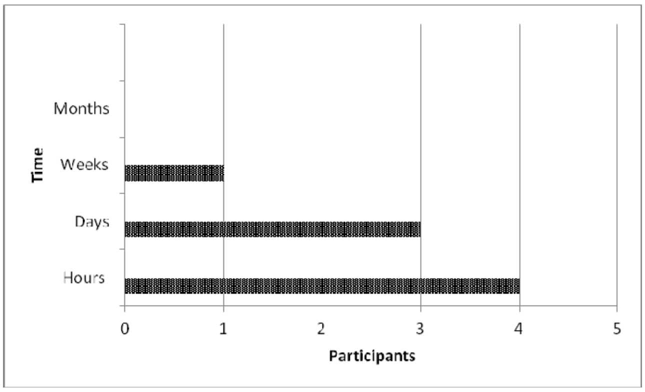

Figure 9: Results from the post-test questionnaire when all participants were asked how long they would estimate for a person to become familiar with using the homeML suite.

5.4 Experiment Observations

During the study a number of observations were made with regards to the methods used to conduct the evaluation. Upon completion of the study a number of advantages and drawbacks were identified in regard to the methods used to recruit participants at ICOST 2012, as presented in Table 3.

Although the disadvantages of using this method of participant recruitment have been identified, the investigators feel that the advantages far out way the negatives. The most considerable advantage of using this method is that each participant was from a different institute or organisation and no participants involved had any affiliation with SERG. Therefore, a completely unbiased and objective evaluation could be produced.

6 Conclusion

It is a well-known fact that the global population is growing older and therefore a higher percentage of people are experiencing age related impairments and suffering from chronic diseases [Coughlin, 08] [Lutz, 08]. There is also a large number of older adults suffering from either cognitive or physical impairments who may require assistance and support whilst performing ADL. One solution to these issues that has seen a considerable amount of effort is the area of assistive technologies and in particular smart environments.

As a direct result of the considerable amount of research in this area, a large amount of heterogeneous data is being generated. The major issue with the heterogeneous nature of this data is its lack of interoperability, causing difficulties when data is being exchanged and reused. homeML has been presented within this paper as a solution to this issue through the development of a standard format to store data generated within a smart environment.

Advantages	Disadvantages
• Effective advertising of the study through inclusion of an information sheet placed in every delegate pack. • Potential participants could be better informed through a demonstration of the homeML Format and Suite as opposed to reading literature. • High concentration of experts in the field of smart environments. • Expert feedback can be obtained. • The conference is a convenient setting for participants. • An international representation of participants can be obtained.	• High cost of conference attendance. • Conferences can be a busy environment, with a limited amount of time that can be spent with each participant. • Participants could feel pressure to provide a positive review in the presence of the researcher.

Table 3: The advantages and disadvantages of recruiting participants to complete the study at a conference.

Data that can be used to test and validate theories and developments within this domain can be difficult and time consuming to produce. The homeML suite is also presented within this paper as a means of resolving this issue, through the creation of a central repository where researchers can upload and share datasets they produce.

Previous evaluations of both the homeML format and homeML suite could be considered biased as they have been performed by members of SERG. The aim of this study has therefore been to perform an unbiased evaluation though the recruitment of participants from various research institutes who have no affiliation with SERG. An external evaluation has been performed by eight researchers. Each participant was provided with both a username and password allowing them to access the homeML suite [HomeML, 12]. When logged in to the homeML Suite each participant was able to view and download the homeML format in addition to use the homeML toolkit and homeML repository.

Participants were not given specific tasks to complete. They were simply asked to use the suite for a period of seven days as they would do should they decide to use the format and tools during their future research activities. After the seven days they were then asked to provide feedback regarding the homeML format and homeML suite through the completion of a questionnaire.

The results of this study have been considered positive. All participants agreed that the homeML format could address the need for a standard format within this research domain and that the homeML suite would be a useful tool to support people as they perform research within this domain.

Ideally, more participants could have been recruited; potentially providing a more conclusive set of results, as well as providing additional feedback and suggestions for improvement.

Finally, in the future it is hoped that through their continued promotion within the research domain that an increasing number of researchers will use the homeML Format and the homeML suite as they perform their research. In the short term, homeML version 2.2 will be used within SERG within ongoing projects, which will be used as an additional review process.

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