The Augustine House Experiment: Final Report

(A JISC Institutional Innovation Benefits Realisation Project, BR1b-10)

Chengzhi Peng

(With contributions from Darren Roberts, Panagiotis Patlakas, and Jenny Chen)

School of Architecture
The University of Sheffield
25 November 2010
Acknowledgements
The Augustine House Experiment (AHE) project was funded under the JISC Institutional Innovation Benefits Realisation Programme (BR1b-10). The author wishes to acknowledge the contributions from Darren Roberts, Pangiotis Patlakas, Binh Nguyen and Jenny Chen while working as technical consultants for the AHE project. Binh built the AH floors, furniture and space function models. The xml2x3d conversion tool kit was designed and implemented by Darren with substantial inputs from Panagiotis in establishing the data flow from the original Excel iBorrow datasets to XML files as inputs to xml2x3d. Following on the ground works delivered by Darren and Panagiotis, Jenny Chen has painstakingly produced the 200+ XML files and X3D models upon which the AHE website and the Final Report are based. Many discussions have been held with Phil Poole, Wayne Barry, Adrian Wheal and Peter Rand at Canterbury, and Richard Jones and Justin Luker at Bucks New, who have helped to shape the key ideas of this project. Finally, thanks to the programme support provided by Paul Bailey, Rhonda Riachi, Josie Fraser and George Roberts of the JISC SSBR team.

1. Introduction
The Augustine House Experiment (AHE) project aims to produce a synthesis of the outcomes from the weCAMP and iBorrow projects to further demonstrate how patterns of spatial uses in technology-rich learning centres could be captured and better understood. Design and construction of this new type of library and learning centres is gaining ever more popular in the UK HE and FE sectors with recent examples including the Information Commons (University of Sheffield), the Augustine House (Canterbury Christ Church University), the Gateway (Buckinghamshire New University), the Hallward Learning Hub (University of Nottingham) just to name a few. There is an increasing demand of effective methods to evaluate these IT-augmented new learning centres and spaces1. A better understanding of how these new learning centres are being designed and used could be valuable to raising our capacities of achieving even more effective planning and design of future learning centres.

As funded by the JISC Institutional Innovation Programme, the weCAMP team and iBorrow team have met on several occasions during the projects’ lifetime and discussed the potential synergy of the two projects. In response to the follow-up Benefits Realisation funding call (Phase 1c), the Augustine House Experiment (AHE) proposal was submitted by the weCAMP team with the iBorrow team and the SMART team (Buckinghamshire New University) as project partners. A funding was allocated by the SSBR team to enable the delivery of (a) development of the software tool kit and production of 3D models of the Augustine House Experiment by the weCAMP team, (b) supplies of architectural drawings, photos of the AH building and one-week iBorrow notebooks tracking datasets by the iBorrow team, (c) joint reviews of the AHE results by all three teams, and (d) dissemination of the AHE outcome through online publications of the AHE Gallery and the project final report.

The weCAMP project undertaken at the University of Sheffield has developed and deployed the uCampus Platform2 for making a large repository of interactive 3D digital models of the campus buildings and spaces accessible over the Web. The uCampus models are created according to the 3D modelling specifications established by the weCAMP project team as accurate 3D documentation of the physical estates of the University.

2 http://wecamp.group.shef.ac.uk
These basic architectural models can be accessed online not only as 3D visual representation of the campus buildings and spaces but also as the underlying spatial contexts for visualising data acquired for domain-specific purposes such as how spaces are used in particular University buildings on a floor-by-floor basis. One of the key software outputs from the project is the design and implementation of a Java-enabled X3D Delivery (JX3DD) framework upon which the uCampus Web application was built [4] [6].

The JX3DD framework can be adapted by other institutions who are interested in creating their own 3D campus applications similar to uCampus. Equally important is the uCampus 3D Estates and Data Modelling Specifications (3D-EDMS) which are essentially the knowledge bases of how the weCAMP team have developed the 3D campus modelling in the X3D open standard. Like the reusable JX3DD framework, we expect that the uCampus 3D-EDMS can also be adopted by other institutions to create their own X3D model and data content to be ported on their own 3D campus modelling platform. The JX3DD framework, 3D-EDMS and the uCampus application have been intensively used and tested by the weCAMP team and a group of participating postgraduate student modellers [5].

An important part of the iBorrow project carried out at the Canterbury Christ Church University (CCCU) concerns with how the Augustine House is performing as the University’s newest learning centre3, which was awarded the UCISA Higher Education Award for Excellence 2010. By overlaying location information with additional data it can provide insights into the way students use electronic and virtual resources at an individual level or within a group context and thus answer the questions that arise when designing new learning spaces [7]. The iBorrow project provided a large-scale demonstrator of the use of tracking software and location-aware technology to aid the configuration of facilities within flexible learning spaces, and eventually an insight into the way students use flexible learning spaces4. Reports of the iBorrow project outcomes can be accessed from a dedicated website5.

2. The iBorrow Notebook Tracking Datasets
Figure 1 shows a snapshot of the iBorrow datasets.

| A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Figure 1. The fields of the iBorrow notebook tracking datasets - a total of 65535 entries of data were collected during the one-week period of 24-Feb to 03-March 2010.

---

3 http://www.canterbury.ac.uk/projects/iborrow/
4 http://www.jisc.ac.uk/whatwedo/programmes/institutionalinnovation/iborrow.aspx
5 http://www.canterbury.ac.uk/projects/iborrow/reports.asp
For the AHE project, the iBorrow notebooks tracking datasets were supplied by the iBorrow team as an Excel spreadsheet of one week's worth of data that incorporates the X and Y co-ordinates. The CCCU Infrastructure Group has provided the following notes on the tracking data and measurements of the floor plans:

1. **X,Y co-ordinates are measurements given in feet;**
2. **The origin (0,0) is in the top left of "each" of the attached screen shots;**
3. **The coordinates should be treated on a per floor basis (to account for any variance in the individual CAD drawing imports);**
4. **The screen shots show a rule scale in metres not feet;**
5. **Floor Numbers will have to be extracted from the Location Data (i.e. extract middle digit from location value); and**
6. **The Confidence Factor relating to each X,Y is in feet and is defined as follows:**

   With every calculated location (say x1, y1), a Confidence Factor (CF) is returned. This is a floating point scalar used to calculate 95% confidence square (Figure 2). The device is estimated to be inside the square cantered at (x1, y1) with sides 2 x CF with 95% confidence. In other words, given that the estimated location is (x1, y1), there is a 95% confidence that the device is within the box defined below. This confidence factor is calculated assuming that the device is located on correct floor.

---

### 3. The Approach to Visualising the iBorrow Datasets

The approach we adopt to visualise the iBorrow dataset can be summarised in three steps:

1. **Architectural and Urban Context Modelling: 3D Augustine House Models built in the X3D format.** An aerial-photo derived 3D urban model with the Augustine House at the centre was sourced and purchased from Zmapping Ltd (Figure 3). The 3D urban model was then used by the weCAMP team as the starting point for producing a Web-based 3D model sets in the X3D format. A user account “AUGUSTINE” was created on

---

6 Chris French of the Infrastructure Group feels the need to emphasize the point that he chose to identify location by Zone because of the inherent difficulty in achieving location accuracy using purely RSSI based calculations. The system has been designed and configured with this in mind and he makes no claims or guarantees about the accuracy of the coordinates gathered.
uCampus to host the X3D models. For each floor of the Augustine House, three X3D models have been built to represent (a) architectural floor, (b) furniture and (c) space functions based on the drawings and information provided by the iBorrow team. The basic 3D modelling produced here is intended to provide an intuitively recognisable architectural and spatial contexts for displaying the iBorrow data models (Figure 4).

![Figure 3. The 3D CAD model purchased from Zmapping Ltd as a starting point for the Web-based 3D modelling of the AHE project.](image1)

(2) **iBorrow Data Modelling: Representation of the data captured by the iBorrow team in the X3D format.** A software package “xml2x3d” was developed to convert the iBorrow datasets into X3D models with location reference to the architectural floor models developed in (1). Each tracked position is represented as a coloured geo-referenced sphere. Various schemes of data visualisation were devised to work with different combinations of data fields such as Male-Female, Times of a Day, PG-UG level of study, Full-Part Time etc. Due to the limited funding, generating the iBorrow X3D data models remains a combined software and manual process: XML files need to be manually created according to a specific format as inputs to xml2x3d. Meaningful viewpoints of the resultant X3D iBorrow data models are inserted manually before uploading onto the uCampus platform.

![Figure 4. The AHE architectural floors and furniture models as 3D spatial contexts created in the X3D open standard.](image2)

(3) **Overlay of iBorrow Data Models on the AHE Floors.** We use the user account facility provided on uCampus to set up a number of accounts for uploading the X3D models created in steps (1) and (2) into different user content folders (Figure 5). Although these accounts are user name and
password controlled, collaborative viewing over the Web can take place easily by sharing the login details. The overlaying of the iBorrow tracking data on the AH floors can be performed simply by selecting relevant data and floor models from the check boxes of the containing accounts, and an assembly of all the X3D models selected will be generated and delivered to the user’s desktop in real-time for direct user 3D navigation (Figure 6).

Figure 5. Overlay of iBorrow data models on the AH Floor and Furniture models on the uCampus platform.

Figure 6. Direct user navigation inside a multi-layered X3D model.

On the basis of the 3D modelling approach described above and the uCampus platform, it is relatively straightforward to construct a dedicate website that makes the Augustine House Experiment results even more easily accessible. The AHE website lists links to 33 pre-assembled X3D model sets in 8 categories of selected iBorrow data fields (Figure 7). The website shows an example of how a user’s viewing and navigating the AHE models can be enhanced with the themes and associated colour keys of the visualisation (Figure 8).
4. A List of the AHE Project Outputs

- AHE Excel to XML Template
- AHE xml2x3d Conversion Tool (Figure 9)
- 16 Augustine House Site, Architectural Floors, Furniture, and Spatial Uses X3D models
- 204 iBorrow tracking XML data files (with “confidence square” fields unfilled)
- 204 iBorrow tracking X3D models
- The AHE website (http://www.wecamp.group.shef.ac.uk/AHE/)
- The Augustine House Experiment Project – Final Report
5. Do the AHE Results answer some of the iBorrow Pedagogic Research Questions?

To support a more holistic visual understanding of the AHE results, screen shots of the six user tracking patterns are assembled floor by floor in Appendix 1 – Appendix 6. Readers of this report are encouraged to access the AHE website to navigate the 3D datascapes.

**Appendix 1**  Part-Full Time, Wednesday 03/03/2010, 11:30, 12:00, 13:00, 14:00, 15:30

**Appendix 2**  Female-Male, Monday 01/03/2010, 10:00, 13:00, 16:00, 19:00, 22:00

**Appendix 3**  Postgraduate-Undergraduate, Monday 01/03/2010, 10:00, 13:00, 16:00, 19:00, 22:00

**Appendix 4**  Disable-Able, Monday 01/03/2010, 10:00, 13:00, 16:00, 19:00, 22:00

**Appendix 5**  Age Ranges, Monday 01/03/2010, 10:00, 13:00, 16:00, 19:00, 22:00

**Appendix 6**  Days of a Week, 25/02/2010 – 03/03/2010, 16:00

**Appendix 7**  Aggregates of all six tracking patterns showing “favoured particular areas”

It should be noted that it was not possible to convert exhaustively the one-week iBorrow tracking datasets as supplied into X3D models within the time frame of the AHE project. The six user tracking patterns assembled above are intended as examples of demonstrating how the visualisation modelling approach has generated results from selected combinations of user characteristics, time and space (AHE architectural floors). Many other combinations are possible but the principle of date visualisation remains the same. However, given the results shown from the AHE website and the snapshots
gathered in the Appendices, some correspondences between the current AHE visualisation results and the previous iBorrow pedagogic study can be made. In *iBorrow Research Report (Pedagogy)* [Lynne Graham-Matheson, 2009], there are a number of observations/comments made and questions raised including:

### Benchmarking: Augustine House pre-iBorrow observations

<table>
<thead>
<tr>
<th>As seen from the 3D visualisation of selected iBorrow tracking datasets in the AHE results</th>
</tr>
</thead>
<tbody>
<tr>
<td>The results from Appendixes 1-6 confirm that</td>
</tr>
<tr>
<td>(1) There is a peak of activity in the building around the lunch time hours;</td>
</tr>
<tr>
<td>(2) The Second Floor has the highest intensity of use across the six patterns, followed by the Third, First and Ground Floor;</td>
</tr>
<tr>
<td>(3) The Aggregates of Appendixes 1-6 compiled in <em>Appendix 7</em> show “favoured particular areas” of each floor.</td>
</tr>
</tbody>
</table>

---

### Location tracking potential

- **To what extent is iBorrow use a snapshot of student use of IT in the library - could you correlate from netbook use to overall use of the learning centre?**

  This is an interesting but challenging question to be addressed adequately. The current AHE results show only a portion of the particular one-week during Feb-Mar 2010, and are limited by the scope of data modelling. For instance, user profiling in terms of the degree programmes has not been including in the visualisation. Given the initial AHE results, it can be said that further work on an improved device-tracking accuracy and more extensive data modelling will reveal a great deal about how AH is used.

- **The mix of IT resources within AH across space and time?**

  When the AH Architectural Floor models overlaid with the Furniture models of each floor, we can see that there appear no mix uses of iBorrow notebooks with fixed desktops. These two IT resources are used separately across space and time. Few iBorrow notebooks are seen around the fixed desktop areas, and the notebooks are predominantly used in the informal flexible areas of the Library and the Group Study Rooms.
• **Student choice – specific groups who make extensive or little use of mobile resources.**

   Clearly, a lot more full-time students used the iBorrow notebooks than part-timers. Part-timers used them more on the 2nd and 3rd floors. More female used them on the Ground and 1st Floors, and increased male students used them on the 2nd and 3rd Floor. A lot more undergraduate uses are seen across the floors and times. The Disable-Able projection shows that the devices were used by disabled students across the floors – the AH seems working well in accessibility. In age ranges, the under 25 group used the devices most, followed by the 30-65 group; few 26-30 were seen on this particular Monday.

• **Do particular ‘groups’ of students gather in certain spaces i.e. near subject resources?**

   This question is yet to be answered, as the current phase of AHE does not including students profiling in terms of what subjects they were studying. But it is possible to carry out such visualisation in future phase of the study.

• **Pattern of use of specific zones – e.g. individual vs group, café, flexible spaces**

   Cafè and the flexible spaces were mostly seen uses of the notebooks. But the Cafè area on the Ground floor saw very little uses of the iBorrow notebooks.

• **Disabilities & gender patterns-use of zones**

   See Appendix 4 for disabilities and Appendix 2 for Gender patterns.

• **Phase of the day - use of zones**

   See Appendices 1-5.

• **Age profile - use of zones**

   See Appendix 5 Age Ranges.

**Direct observation and interview**

<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where, more precisely are netbooks used?</td>
<td>This is what the AHE project has set out to show. Obviously, the precision depends on the level of accuracy afforded by the current iBorrow tracking system. At present, tracking on the 2nd and 3rd floors is more problematic than the other floors surrounding the atrium areas.</td>
</tr>
<tr>
<td>Do groups use a mixed economy of fixed and netbooks?</td>
<td>It does not appear that this was the case – no concentrations of notebooks were seen around the fixed desktops areas. Further in-situ observations can reveal why this could not be the case, for instance, the design of the fixed desktop space does</td>
</tr>
<tr>
<td>Question</td>
<td>Response</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Are particular applications favoured on the different devices?</td>
<td>The current iBorrow-tracking datasets supplied to the AHE project do not reveal what applications were used by the students.</td>
</tr>
<tr>
<td>How do groups use IT resources and the space?</td>
<td>In Appendix 7, the areas seen highest densities of iBorrow notebooks used suggest that these could be the spaces where group working mostly took place. The AHE data visualisation shows the spatial uses distinctly across the four floors.</td>
</tr>
<tr>
<td>How are mobile devices being used in comparison with desktops and own mobiles</td>
<td>As discussed above, the current AHE results do not show a co-locative uses of iBorrow mobile notebooks and fixed desktops. Direct observations need to be made in assessing the uses of students’ own mobile laptops, iPads etc in connection with the AHE results.</td>
</tr>
</tbody>
</table>

**Linking iBorrow data to direct observations**

“As patterns emerge from the data analysis and the observations the gains of cross referencing and correlating the information from these two modes of data collection will be illustrated for the sector.”

The proposed linking will be extremely valuable given the AHE initial results. We can easily develop a dedicated website that will make this linking highly visible by juxtaposing the X3D modelling and direct observations side by side.

**Research into large-scale learning spaces**

“The iBorrow project is a test-bed for exploring the effectiveness of thin-client technology on low cost netbooks and the potential of location-awareness systems to track the use of these. Thus it will provide quantitative data which may support insights into the use of on-line resources in large, technology enhanced learning spaces.

We believe that the initial AHE results are promising in terms of developing and testing the user tracking, data gathering and visualisation approach to researching the design and uses of large-scale learning centres such as the AH. As the JISC JELS Project report and other related studies have pointed out that the current understanding of such complex phenomena is hampered by the lack of accurate...
The resulting information should facilitate both institutional decision-making and intelligent building management.” and relevant empirical data. The AHE project shows that there is a way forward to overcoming such difficulties.

6. Lessons learned from the AHE project
The Excel file of the one-week iBorrow tracking datasets was supplied to the weCAMP team on 04/03/2010, which was taken as the starting point of developing the AHE visualisation approach on the basis of uCampus. Since then, data analyses, specification, design and implementation of a new piece software tool have been carried out with the xml2x3d conversion tool kit delivered on 08/07/2010. The production of more 200 XML files and X3D models was completed towards the end of September 2010, which provides the basis for developing the AHE website and the writing up the AHE project Final Report. There are several lessons learned from the project:

• The collaboration between the iBorrow and weCAMP teams has been ground breaking, which could be a useful exemplar to other HE/FE institutions who share similar research and development interests. The collaboration has taken in various forms through the JISC Assembly Events, WebEX events hosted by Buckingham New University, JISC Institutional Innovation Conferences, iBorrow Conference, and numerous email discussions.

• The iBorrow tracking system is capable of generating an enormous amount of data that correlate users, spaces and times. The AHE project shows how such rich large datasets could be processed and presented in a visual form allowing intuitive reading of any emerging patterns. The AHE 3D modelling approach has generated a new kind of data resource that can be utilised in several ways: (a) direct user 3D navigation into the “datascapes” on the uCampus platform; (b) construction of a dedicated website linked to uCampus supporting a more structural access and navigation of the datascapes; (c) juxtaposition of 2D snapshots of 3D datascapes to inform spatial cross-referencing through the building floors.

• The current AHE results are from a combination of software and manual processes which does not permit extensive data modelling exercises. But the project has shown a possible route to future work on the data flow and system integration that will deliver a very powerful platform for undertaking interdisciplinary empirical researches to large-scale learning and other types of spaces which were not possible before.

7. Some Pointers to Extending the AHE Approach
(a) Optimizing the process via an automatic Excel-to-XML conversion. Such a tool would allow a capable user to implement the XML Schema via the Developer tools of Excel in order to simplify the process. Once given the proper template, and the relevant instructions, a competent Excel user could then generate the XML files in approximately 5 minutes per file, regardless of the number of inputs.

(b) Writing a custom Excel macro to generate the XMLs. This would mean writing a plug-in for Excel. The user would simply have a button on the Excel toolbar that would allow him to select an area, click the button, and automatically generate the XML.
(c) Writing a custom Excel macro that automatically generates the X3Ds. Essentially that would require incorporating the whole X3D Generator application in a single Excel button. The user would simply get the source Excel data, select the area, click, and have the X3D ready for upload.

(d) Animation: The process would require a very large XML (for example, there are about 7,500 data entries just for the day on 24/02/2010). Obviously it would demand prior work on the XML generation process from Excel. However, with this facility built one would be able to see animations of uses of the iBorrow notebooks around the building.

References


Appendix 1    Part-Full Time, Wednesday 03/03/2010, 11:30, 12:00, 13:00, 14:00, 15:30
Appendix 2    Female-Male, Monday 01/03/2010, 10:00, 13:00, 16:00, 19:00, 22:00
Appendix 4  Disable-Able, Monday 01/03/2010, 10:00, 13:00, 16:00, 19:00, 22:00
Appendix 5     Age Ranges, Monday 01/03/2010, 10:00, 13:00, 16:00, 19:00, 22:00
Appendix 6  Days of a Week, 25/02/2010 – 03/03/2010, 16:00