Computational case-based redesign for people with ability impairment: Rethinking, reuse and redesign learning for home modification practice

by

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Except where otherwise indicated, this thesis is my own original work.

Catherine Bridge

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Abstract

Home modification practice for people with impairments of ability involves redesigning existing residential environments as distinct from the creation of a new dwelling. A redesigner alters existing structures, fittings and fixtures to better meet the occupant’s ability requirements. While research on case-based design reasoning and healthcare informatics are well documented, the reasoning and process of redesign and its integration with individual human functional abilities remains poorly understood. Developing a means of capturing redesign knowledge in the form of case documentation online provides a means for integrating and learning from individual case-based redesign episodes where assessment and interventions are naturally linked.

A key aim of the research outlined in this thesis was to gain a better understanding of the redesign of spaces for individual human ability with the view to computational modelling. Consequently, the foundational knowledge underpinning the model development includes design, redesign, case-based building design and human functional ability. Case-based redesign as proposed within the thesis, is a method for capturing the redesign context, the residential environment, the modification and the transformational knowledge involved in the redesign.

Computational simulation methods are traditionally field dependent. Consequently, part of the research undertaken within this thesis involved the development of a framework for analysing cases within an online case-studies library to validate redesign for individuals and a method of acquiring reuse information so as to be able to estimate the redesign needs of a given population based on either their environment or ability profile.

As home modification for people with functional impairments was a novel application field, an explorative action-based methodological approach using computational modelling was needed to underpin a case-based reasoning method. The action-based method involved a process of articulating and examining existing knowledge, suggesting new case-based computational practices, and evaluating the results. This cyclic process led to an improvement cycle that included theory, computational tool development and practical application.

The rapid explosion of protocols and online redesign communities that utilise Web technologies meant that a web-based prototype capable of acquiring cases directly from home modification practitioners online and in context was both desirable and achievable.

The first online version in 1998-99, encoded home modification redesigns using static WebPages and hyperlinks. This motivated the full-scale more dynamic and robust HMMinfo case-studies prototype whose action-based development is detailed within this thesis. The home modification case-studies library results from the development and integration of a novel case-based redesign model in combination with a Human-Activity-Space computational ontology. These two models are then integrated into a relational database design to enable online case acquisition, browsing, case reuse and redesign learning.

The application of the redesign ontology illustrates case reuse and learning, and presents some of the implementation issues and their resolution. Original contributions resulting from this work include: extending case-based design theory to encompass redesign and redesign models, distinguishing the importance of human ability in redesign and the development of the Human-Activity-Space ontology. Additionally all data models were combined and their associated inter-relationships evaluated within a prototype made available to redesign practitioners.
Reflective and practitioner based evaluation contributed enhanced understanding of redesign case contribution dynamics in an online environment. Feedback from redesign practitioners indicated that gaining informed consent to share cases from consumers of home modification and maintenance services, in combination with the additional time required to document a case online, and reticence to go public for fear of critical feedback, all contributed to a less than expected case library growth. This is despite considerable interest in the HMMinfo casestudies website as evidenced by web usage statistics. Additionally the redesign model described in this thesis has practical implications for all design practitioners and educators who seek to create new work by reinterpreting, reconstructing and redesigning spaces.
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</thead>
<tbody>
<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
</tr>
<tr>
<td>AIP</td>
<td>Ageing In Place</td>
</tr>
<tr>
<td>A-V pair</td>
<td>Attribute–Value pair</td>
</tr>
<tr>
<td>CBR</td>
<td>Case-Based Reasoning</td>
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<td>DACS</td>
<td>Disability, Ageing and Carers Survey</td>
</tr>
<tr>
<td>DBMS</td>
<td>Database Management System</td>
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<tr>
<td>DDA</td>
<td>Disability Discrimination Act</td>
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<td>DNT</td>
<td>Data Networking Technologies</td>
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<td>DVA</td>
<td>Department of Veterans Affairs</td>
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<tr>
<td>E-R diagram</td>
<td>Entity Relation diagram</td>
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<tr>
<td>EMR</td>
<td>Electronic Medical Records</td>
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<td>HACC</td>
<td>Home and Community Care Program</td>
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<tr>
<td>H-A-S</td>
<td>Human-Activity-Space model</td>
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<tr>
<td>HMM</td>
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<tr>
<td>HTML</td>
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<tr>
<td>HTTP</td>
<td>HyperText Transfer Protocol</td>
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<tr>
<td>ICD</td>
<td>International Classification of Diseases</td>
</tr>
<tr>
<td>ICF</td>
<td>International Classification of Function</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>LISP</td>
<td>List processing language (a computational language for list manipulation)</td>
</tr>
<tr>
<td>KBS</td>
<td>Knowledge Based System</td>
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<tr>
<td>NSW</td>
<td>New South Wales</td>
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<td>PADP</td>
<td>Program of Aids for Disabled People</td>
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<tr>
<td>POMR</td>
<td>Problem Oriented Medical Record</td>
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<tr>
<td>SBF</td>
<td>Structure-Behaviour-Function model</td>
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<td>Server Side Includes</td>
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<td>WHO</td>
<td>World Health Organisation</td>
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