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Conceptual modelling of web information systems

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Abstract

This paper presents the conceptual modelling parts of a methodology for the design of large-scale data-intensive web information systems (WISs) that is based on an abstract abstraction layer model (ALM). It concentrates on the two most important layers in this model: a business layer and a conceptual layer.

The major activities on the business layer deal with user profiling and storyboarding, which addresses the design of an underlying application story. The core of such a story can be expressed by a directed multigraph, in which the vertices represent scenes and the edges actions by the users including navigation. This leads to story algebras which can then be used to personalise the WIS to the needs of a user with a particular profile.

The major activities on the conceptual layer address the support of scenes by modelling media types, which combine links to databases via extended views with the generation of navigation structures, operations supporting the activities in the storyboard, hierarchical presentations, and adaptivity to users, end-devices and channels.

Keywords: Web information systems; Conceptual modelling; Storyboarding; Personalisation; Media types; Adaptivity

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1. Introduction

A *web information system* (WIS) is a database-backed information system that is realized and distributed over the web with user access via web browsers. Information is made available via pages including a navigation structure between them and to sites outside the system. Furthermore, there should also be operations to retrieve data from the system or to update the underlying database(s).

Various approaches to develop design methods for WISs have been proposed so far. Many of them such as the ARANEUS framework [1], the OOHDM framework [2] and the WebML work in [3] focus on a problem triplet consisting of content, navigation and presentation. This leads to modelling databases, hypertext structures and page layout. In addition, the personalisation of a WIS to the particular needs of users is still a hot research topic. We will give a more detailed overview on the related literature in Section 2.

Our own work in [4] emphasises a methodology oriented at abstraction layers and the co-design of structure, operations and interfaces. As WISs are open systems in the sense that everyone who has access to the web may turn up as a user, their design requires a clear picture of the intended users and their behaviour. This includes knowledge about the used access channels and end-devices. At a high level of abstraction this first leads to *storyboarding*, an activity that addresses the design of an underlying application story [5,6]. As soon as WISs become large, it becomes decisive that such an underlying application story is well designed.

Inspired by approaches in theater and film storyboarding first describes a *story space* by scenes and actions on these scenes. Furthermore, we have to describe the *actors* in these scenes, i.e. groups of users of the WIS. Actor modelling leads to roles, profiles, goals, preferences, obligations and rights. Finally, the actors are linked to the story space by the means of *tasks*.

Further on in the development process the scenes in the story space have to be adequately supported. For this our work focusses on the integration of traditional methods for the design of data-intensive information systems with new methods addressing the challenges arising from the web-presentation and the open access. This leads to *media types*, which cover extended views, adaptivity and hierarchies.

In a nutshell, a media type is an extended view on some underlying database schema. Which data model is used for the underlying database is of minor importance, as long as views can be built that capture the complex content and navigation structure that is to be presented to a user. Adaptivity to users, channels and end-devices mainly concerns the question, whether all information or only the most important part of it is to be presented to a user. By specifying on a conceptual level what these ''most important'' parts are and which parts have to be kept together we may then leave the technical realisation of adaptivity to an algorithmic solution. Hierachies enable the presentation of information at different levels of granularity allowing a user to switch between these levels. Such hierarchies are common in OLAP systems [7], and the principles can be borrowed from there.

In this paper we bring together various pieces of our work on conceptual modelling and design of WISs. The purpose is to give a comprehensive picture of our methodology. In addition, we extend our previous work by focussing on the aspect of reasoning about conceptual WIS models. For this purpose, all ingredients of our methodology will be based on solid formal grounds.