Abstract. While schema descriptions are a necessity for large database applications, many current hypermedia applications have been developed without semantic modeling. Addressing these shortcomings several modeling techniques for hypermedia systems have been developed recently, which extend known domain modeling techniques from the database and software engineering field with dedicated constructs for specifying possibilities of navigation.

The current paper presents a more general modeling framework for hyperbooks, which extends previous work by representing all aspects of a hyperbook application in a declarative data model. Domain model, navigational model, user model and visualization model are all captured in a unified meta data model. This explicit, complete model of the application supports a reusable implementation. We finish by presenting a fully generic client/server architecture for displaying the hyperbook from a WWW server to a WWW client.

1 Introduction

Current approaches to systematic hypermedia modeling can be divided into two research directions:

1. Systematic object-oriented modeling techniques developed for generic hypermedia systems like web servers and database frontends. The Hypertext Design Method (HDM) [8], the Relationship Management Methodology (RMM) [11], and the Object-Oriented Hypermedia Design Model (OOHDM) [23], are the most prominent examples. These methods structure a domain into a set of types or classes and their relationships. By classifying the pages into these types, navigation links can be inferred automatically from the relationships.

2. Specific approaches for educational systems investigated by the adaptive hypertext community. Usually the pages of a lecture, which can have an arbitrary structure are indexed by the high level concepts of a user model. The knowledge from the user model can either modify the basic navigation structure of the document, e.g. the system proposes suitable pages for the student; or it can be used to annotate the navigation structure, e.g. links of different color indicate the difficulty of the referenced pages for the student.

As pointed out in [11] the methods described under 1. are best suited for designing front ends to loosely structured data. Therefore, the navigational concepts proposed
in these methods are geared towards indexing a large number of relatively simple information pieces. On the other hand, the methods proposed under 2. which we will discuss in more detail in section 2 usually lack declarative domain models. Indexing book pages with user model concepts has the advantage that the book structure itself is not affected. Any book can be turned into a hyperbook using these techniques. However, these techniques leave the book structure unchanged, while the methods under 1. impose a rigorous structure on the material and define this structure in a domain model, thus making the hypermedia document more maintainable and extendable.

This paper defines a modeling language for building domain models, explicit navigation and visualization models and user models. In this way it combines the advantages of explicit models used by the approaches under 1. with the hyperbook-specific ideas of the approaches presented under 2. All features of the four hyperbook models are defined by the meta model expressed in the conceptual modeling language Telos [19]. The system itself is being implemented as a loosely coupled extension of a WWW server with cgi-bin scripts and Java programs as well as the ConceptBase meta database manager [14]. The paper starts with a survey on previous work in hyperbooks, discussing hypertext and hyperbook systems as well as various definitions for hyperbooks. Section 3 describes our modeling architecture as well as our four hyperbook models in depth. Section 4 discusses the implementation of our hyperbook system.

2 Previous Work

Research in the area of adaptive hypertext theory and systems has concentrated on data models and development of adaptive hypertext systems that reflect their user's interests and preferences. As the definition of a hyperbook is quite ambiguous in current research projects, we will first venture to provide a definition of such a hyperbook (in contrast to simple hypertext). One approach is to characterize hypertext books as a "collection of hypertext documents. In correspondence to real books, these documents are called chapters, sections, subsections, or appendices." [18]. This definition includes "electronic books", which can be characterized as "existing books meant to be read on a computer screen" [10]. Transferring printed books into electronic form is a wide research area [21]. Some of the projects deal with a broad variety of printed books which they translate to simple data formats such as plain text, ascii-text derivates, or the acrobat reader format; the table of contents is translated to a hypertext interface to the book. More sophisticated approaches re-edit the existing printed books by adding pictures, remarks, and annotations as hypertext links [25]. Research has also focused on the design of specialized readers for these electronic books such as Organizers, Portable PCs, and electronic book readers [24]. In contrast to this broad view of a hyperbook we give the following definition for hyperbooks:

Definition 1. A hyperbook is a grouping of electronic texts which can be considered as an entity [16]. Explicit data models describe the basic hypertext system. They are developed to represent the intentions of the author and all aspects of the contents of the hyperbook.

The hyperbook has to follow the guidelines for writing hypertext, e.g. George P. Landow's "Guidelines for Writing Effective Hypertext" [6].