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An Open Hypermedia System Framework for Integrating Information Systems

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Motivation

Incorporating hypermedia functionality into information systems (IS) has become a major thrust in hypermedia research. The current work in integrating third-party applications and information systems has been explored primarily in the context of open hypermedia systems (OHS). We hope to provide a framework for designing OHSs and integrating ISs, in order to provide IS users with supplemental hypermedia functionality.

Information systems (IS) are often implemented as closed, monolithic applications that isolate information and functionality from other applications in computing environments [1]. Open hypermedia systems (OHS) aim to integrate third-party applications with hypermedia functionality.

What benefit do users gain from providing ISs with hypertext? Managing the myriad of interrelationships in an IS's knowledgebase (data, processes, calculated results, reports) is difficult for a user. Hypertext helps by streamlining access to related information, thereby increasing user comprehension of information and its context. Augmenting an IS with hypertext support results in new ways to view and manage the IS's knowledge, by navigating among items of interest and annotating with comments and relationships (links) [2]. In this paper, we focus on integrating hypermedia into computation-oriented information systems (COIS).

Most OHSs support only display-oriented applications (DOA). In DOAs authors create document contents manually. The OHSs integrate with third-party DOAs, enabling authors and readers to manually link existing document contents both within and among applications. OHSs only support manually-crafted hypertext. They cannot fully support COISs [2], which dynamically generate their contents and thus require hypertext constructs to be automatically mapped to the generated content. COISs include MS-Excel, SAS, database management systems (DBMS), geographic information systems (GIS), and decision support systems (DSS). COISs require some kind of mechanism (through schemata or other translation processes) to map COIS objects (e.g., data, models, and variables) to hypermedia components (nodes, links, and link markers). An ideal open hypermedia system would support such a mapping mechanism, and thus integrate with both display-oriented and computation-oriented information systems. This would dynamically provide hypertext features to third party computation-oriented applications, as well as allowing users to create and traverse both manual and generated links among DOAs and COISs.

Our initial research goal is to construct an infrastructure -- a distributed OHS that integrates with COISs. This research brings several challenges, including: 1) building a general process model for coordinating multiple application schemata by mapping application-specific schemata to a general schema; 2) designing identifiers to refer to distributed manually-created and dynamically generated COIS and DOA objects; 3) accessing manually-created and dynamically generated information at remote sites; and 4) recognizing COISs at remote sites. With this infrastructure in place we will be able to study a host of information

systems issues concerning how increased information comprehension through relationship management and streamlined access can improve applications.

Approach

In this paper we propose an OHS framework with three axes: an OHS logical component focus, an application requirement focus and an information system focus (see figure 2). The first specifies a conceptual OHS architecture. The second highlights the functionality an OHS can support for DOAs and COISs. The third encompasses classes of information system support for various management and decision activities. Our framework's purpose is to help us to figure out the requirements for supporting ISs/COISs and the OHS functionality needed to support those requirements. We intend to use our framework first to analyze existing OHSs, and second to design our system. Because we hope to incorporate existing systems as much as possible in our design, the first analysis will help us determine which current OHSs support which aspects of our design requirements. We note that one can analyze OHSs using axis one or two independently or using both together. Besides benefiting our own research, we believe the framework will contribute to OHS and IS research in general. The first axis provides a comprehensive viewpoint for thinking about OHS architectures that integrate COISs. The second axis provides a full set of application requirements which OHS should support. The third axis provides environments that we should consider when integrating OHSs with ISs. Together the axes provide a grid for specifying the logical OHS functionality for supporting application requirements. The framework should help people understand the OHS field and help developers think more fully about OHS design and aspects that we should consider when integrate OHSs with information systems. The axes also provide a way to analyze both existing and proposed OHSs. We currently are conducting a survey of OHS developers for analyzing existing OHSs. We expect to present the results as part of this paper at AIS'96.

Axis 1: OHS Logical Component Focus

In this axis, we propose a conceptual OHS architecture with seven logical components. This architecture emphasizes the integration with both DOAs and COISs, providing hypertext functionality to each. Figure 1 sketches examples of this architecture. Research issues include what functionality each component logically should provide. Note that while actual OHSs will include some or all of this functionality, their architectures may physically implement the functionality in different modules than those shown here.

1. DOAs represent both full display-oriented applications and the front-end portions of COISs. This architecture also allows COIS output to be displayed on DOA interfaces.
2. A DOA Handler translates and routes messages between its DOA and the Hypertext Engine.
3. The Hypertext Engine controls hypertext functionality for both COIS and DOA applications and maps hypertext components to displays of COIS information.
4. The Hyperbase Management System maintains hypertext information stored in the Hypertext Database.
5. The Master Handler coordinates schema mapping among different COIS domains, thus aiding COIS-to-COIS integration.
6. A COIS handler translates and routes messages between its COIS and the Hypertext Engine. It also provides its COIS's mapping schema. A comprehensive COIS handler will allow us to integrate an existing COIS with few or no changes.
7. A COIS is an application system with which users interact to perform some task, which dynamically produces output content for display.

Axis 2: Application Requirement Focus

In this axis, we define and discuss aspects of DOA and COIS applications that must be supported in a distributed, integrated environment [3]. While the OHS field does not agree upon a precise definition of OHS, we believe that integration, distribution, and information access across platforms constitute its most

important requirements. Axis two helps us analyze these, as well as other requirements for our conceptual architecture. Then within the full triple-axis grid (figure 2), we specify the functionality each logical component of our architecture could provide to support application requirements.

1. Integration: integrating DOA and COIS systems and their functionality into an OHS
2. Distribution: distributing all seven logical components across a network
3. Hypertext Functionality over DOA Objects: providing manual hypertext support
4. Hypertext Functionality over COIS objects: providing hypertext support for dynamically generated content
5. Support for Internal Objects: automated hypertext mapping at the object level instead of at the display-value level
6. Multi-user / Collaboration: support for multiple users and support for collaborative environments
7. Across Platform: support for distribution across heterogeneous operating systems

Axis 3: Information System Focus

In this axis, we list broad classes of information systems for various management and decision activities [4]. Axis three helps us consider different aspects of information systems when designing OHSs to support information systems:

1. Transaction Processing
2. Operational Control
3. Management Control
4. Strategic Planning

In other words, what requirements do each of the logical components in axis one have to fulfill to satisfy business software for each class of information system? This axis also helps highlight which application requirements from axis two are necessary for which class of IS.

Conclusion

We believe that integrating hypertext support with ISs/COISs in the business world should be a major thrust for OHS research. We hope this framework would help people understand OHS and IS integration better. It also will help developers think more fully about the requirements for OHS design to support information systems for various management and decision-making activities.

Reference

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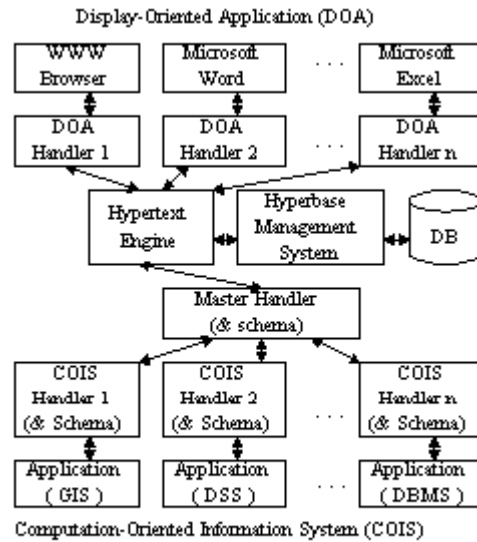


Figure 1. Conceptual OHS Architecture Integrating DOAs and COISs

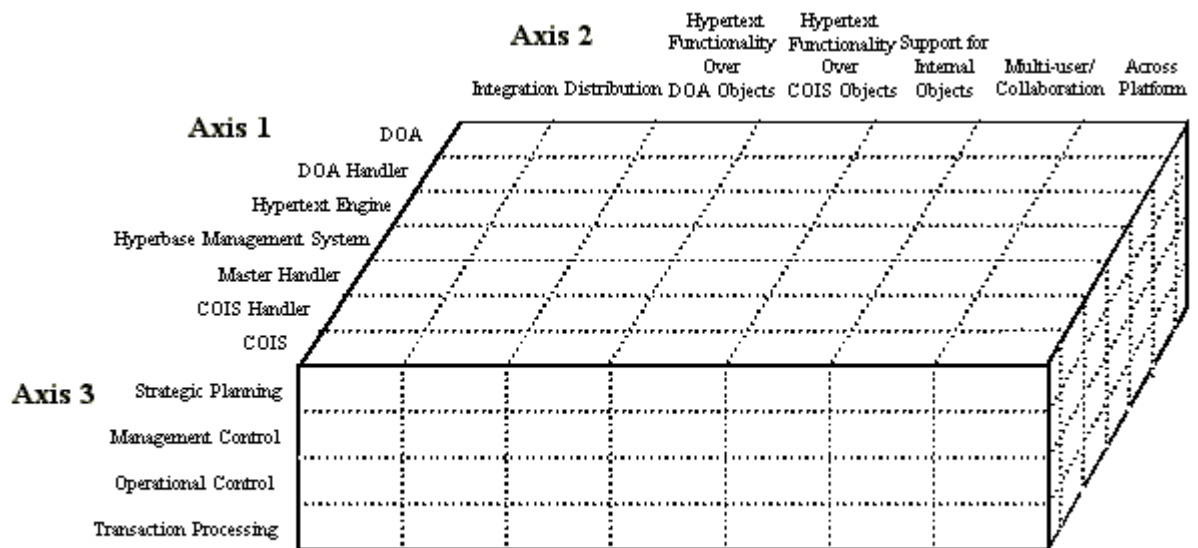


Figure 2. An Open Hypermedia Framework for Integrating Information Systems

