Hypertext in the Semantic Web

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ABSTRACT

The Semantic Web extends the current state of the Web with well-defined meaning. We advocate the use of *ontological hypertext* as an application of the Semantic Web to provide a principled and structured approach to navigating the resources on the Web. This paper demonstrates how we have applied this concept to two real-world scenarios.

KEYWORDS: Semantic Web, Ontological Hypertext, Navigation, Ontologies

INTRODUCTION

Ontology is the study of "things that exist". A formal model that allows reasoning over concepts and objects that appear in the real world.

Hypermedia is the study of "what can be said" using computer media, databases and links. Hypermedia provides computer mediated extensions to familiar textual communication. This is important because real-world objects, or the "things that exist", have complex relationships, and so complex structures are required for expressing and exploring these relations when we make hypermedia statements about them.

Ontological hypertext is then the kind of hypertext whose structure and links are derived from the relationships between objects in the real world. It enables us to effectively answer queries using a "query by linking" approach (as opposed to the more traditional "query by searching"), using facts that we are able to assert in order to discover new knowledge through exploration.

SCENARIO: USING THE WEB FOR RESEARCH

The Web has become a popular publishing medium for scholars in many fields [3] and is gradually turning us into e-Scholars. The reasons for this transformation can be attributed to the actions of primary and secondary publishers placing their archives online and adapting to e-commerce opportunities, as well as the actions of researchers themselves in using

the Web to extend public access to their work. Indeed, the potential advantages the Web has to offer the scholar are easy to enumerate: instantaneous and interlinked access to the entire research literature and its surrounding resources.

E-scholars not only publish their research results on the Web, increasingly they also use the Web for research, a process of systematic investigation and collection of information relevant to their research speciality. Currently, this process requires detective work (*What did the author of this paper go on to write? What other papers describe this project? Did this work influence any standards or other software?*) because the literature is disconnected from itself and from the records and reports of the research activities which produced it. In fact, the Web seldom exhibits associatively connected hypermedia to its maximum potential [1]. Even within digital libraries the ability to locate scholarly information requires an efficient search engine that provides comprehensive results, but remains flexible enough to satisfy a researcher's request.

Ideally, what is required is a semantic hyper-web of scholarly information that encapsulates the knowledge required to become thoroughly immersed in one's research field.

EXAMPLE

We applied the ontological hypertext principle to two scholarly scenarios. OntoPortal [5], a project funded by the Defense Evaluation and Research Agency (DERA), UK, and the E-Scholar Knowledge Inference Model (ESKIMO) [4] project based at the IAM Research Lab, Southampton, UK.

OntoPortal projects intelligently interlinked hypertext over a research domain, and has been applied to modelling the latest research in metadata. An ontology identifies the concepts (e.g. literature, organisation, standard) and relations (e.g. literature discusses a standard) within this domain. The OntoPortal system then enforces this ontological structure over this domain to provide principled and intelligent navigation of the knowledge.

Figure 1 illustrates how a researcher can realize the query, *Which researchers are based in the same team as this project?*, quickly and effectively by exploring the now *explicit* link that exists between projects and research teams. In Figure 1 the scholar brings up a list of all projects (1) and selects a relevant one (2). To learn more about the team responsible for
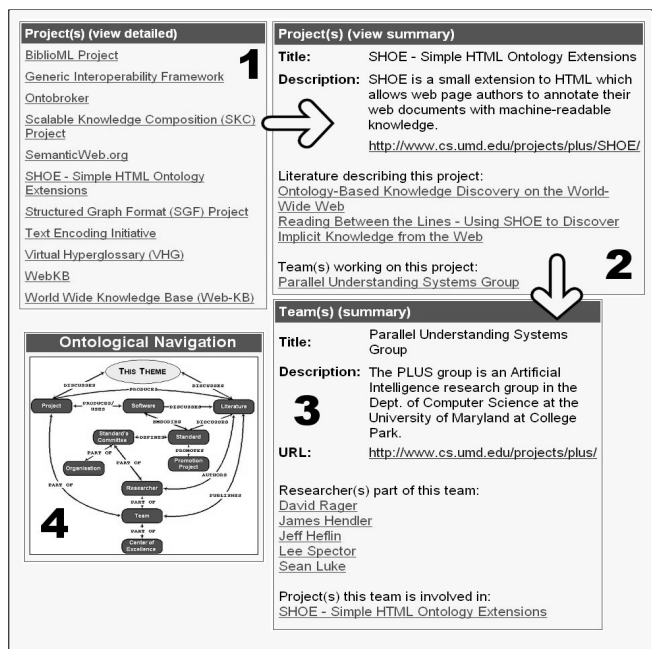
Figure 1: OntoPortal Screenshot

Figure 2: ESKIMO Screenshot

the project, the link to the research team is selected. Among other related concepts, all researchers based at that research team are presented (3). A graphical representation (4) of the ontology is always provided to act as a navigational cue.

While OntoPortal illustrates the concept of "query by linking", ESKIMO fully utilises the primary advantage of the Semantic Web: analysing ontological knowledge to infer new facts. The ontology used in ESKIMO models the general academic community and represents an evolution of the OntoPortal ontology, being more literature-oriented with a greater emphasis on producing and analysing research. ESKIMO also augments traditional scholarly analysis tools (e.g. bibliometrics, citation analysis) by drawing on this ontological knowledge. The combination of ontological hypertext as seen in OntoPortal and the inferencing mechanism enables intricate research queries, such as the following, to be formulated.

- What other adaptive hypermedia papers has this research team produced?
- Who are the experts in hypertext?
- What are the seminal papers in metadata research?
- Which papers discuss the application of theoretical models and hypertext?
- What impact has this project had?
- What trends can be identified in agent systems from 1990 to 1995?

Figure 2 demonstrates a researcher viewing information about a particular literature, and then requesting a list of (inferred) experts within the research field that the literature addresses. Further work is being undertaken to identify the most useful knowledge inferences to encapsulate as links and the most
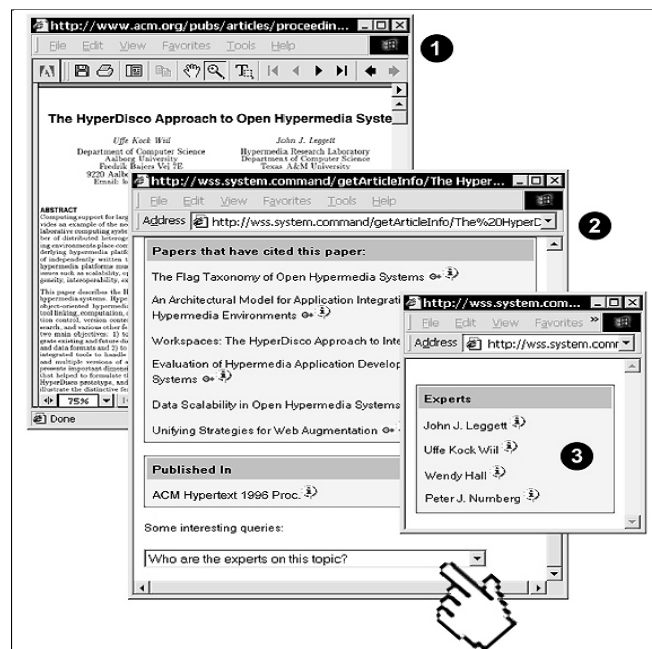
useful source anchors on which to site those links [2].

CONCLUDING REMARKS

We have used two example scenarios to demonstrate how using ontologies together with hypertext as an application of the Semantic Web can enhance the Web and provide a principled and structured approach to navigating and uncovering related information.

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