Knowledge management system for the Saint-Petersburg Museum of Optics

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Abstract

In this paper we introduce OntolingeWiki, the system aimed to resolve problems of content management including consistency control and site navigation. We also present the extension of the system to be developed especially for the Optics museum. This extension will operate on mobile devices used by visitors to the exhibition and provide extra services as track planning and additional information context presentation.

Index Terms: Semantic web, Ontology development, Knowledge management, Smart Spaces, Mobile devices.

I. Introduction

Developers of the large information systems, like a web-portal of virtual museum exhibition, sooner or later face with the following typical problems of the information resources growth:

1. Inconsistency of data.
2. Incompleteness of data.
3. Lack of the common data model.

We see the solution of these problems in a formal approach to the information resources development: using strict knowledge model as a core for the given information system.

Here we would like to present a project called Ontolinge-wiki that makes it possible for domain experts, knowledge engineers and non-expert end users to create well-structured, high quality content based on the ontological schema [2]. The project consists of two main parts: a web application which provides a representation of content bound to ontological metadata and a mobile application which supports attendees of the museum. At the moment we have working prototype of the web application and well-defined vision of the mobile app.

This paper has the following structure: in the first part we try to figure out who our users are, in the second part we build main use cases of our system concerning users, and explain core concepts related to them, in the third part we quickly overview proposed solution in the field of content management. In conclusion our ideas about project's future are presented.

II. Users of the system

In this section the target users of the web-application are described.

1. Content managers and domain experts are people who are in charge of producing the content and filling an informational resource with it. They know the scope of the

problem domain and understand the structure of concepts and relationships between concepts in the domain. They can express their knowledge in form of texts and media materials simply interlinked in classical www-manner.

2. Knowledge managers, systems analysts and ontology developers are people who help organizing knowledge. Their job is to interact with domain experts and formalize an expert knowledge. As a result they build an ontology of domain problem consisting with concepts and relationships.
3. Content consumers are people who want to learn about various things in the problem domain. They are mainly concerned about usability questions, navigation simpleness, quality of search and recommendation systems.

In the real world these groups of users cannot be divided distinctively. In a Web 2.0 era content consumers can be also content producers; some experts can have strong analytical skills and are able to organize information without any additional support.

III. USE CASES

The main usage scenario is described below:

1. Knowledge managers develop initial version of an ontology. They use text analysis as a knowledge source and communicate with experts.
2. Ontolinge-Wiki generates portal's structure and provides tools for online content editing in a wiki style. Nowadays OntolingeWiki generates one wiki-page for each ontology concept.
3. Content managers make content such as hypertexts and media corresponding to ontology concepts. They use wiki-like user interface of OntolingeWiki for adding and editing data.
4. Content managers continue development process and now consistency and completeness are guaranteed.
5. Content consumers get a well-structured content together with context services provided by OntolingeWiki. Usage of a common data model for data in the portal provides great opportunity for realization of services like: context help ('See also' lists that are generated automatically), improvement of search capabilities, etc.

By completeness of content we mean all facts about concepts, presented in ontology, to be fully described. For example, an expert can tell knowledge manager that Michelson is the inventor of an interferometer. Knowledge manager adds this fact to the ontology. From now on we can provide suggestions to content managers that they can use this fact during the content editing process, i.e. suggest adding a named link from the page Interferometer to the page Mickelson. We'll explain a named link structure further on the paper.

By consistency of content we mean that there are no conflicted facts in our data. Continuing previous example if content manager adds the fact that an interferometer was invented by Newton, than we provide him warning about content-model inconsistency

IV. CONTENT MANAGEMENT TECHNOLOGY

After the use case declaration we can clarify how to realize this schema regarding to existing solutions.

Wikis are powerful collaboration tools that use simple wiki-markup instead of plain HTML. One can find the introduction into wiki-technologies in Wikipedia. There is free online wiki engine for comparison different wikis called WikiMatrix.

There are wiki systems where it is possible to assign names to links between pages. Using this mechanism one can represent portal structure as depicted on Figure 1:

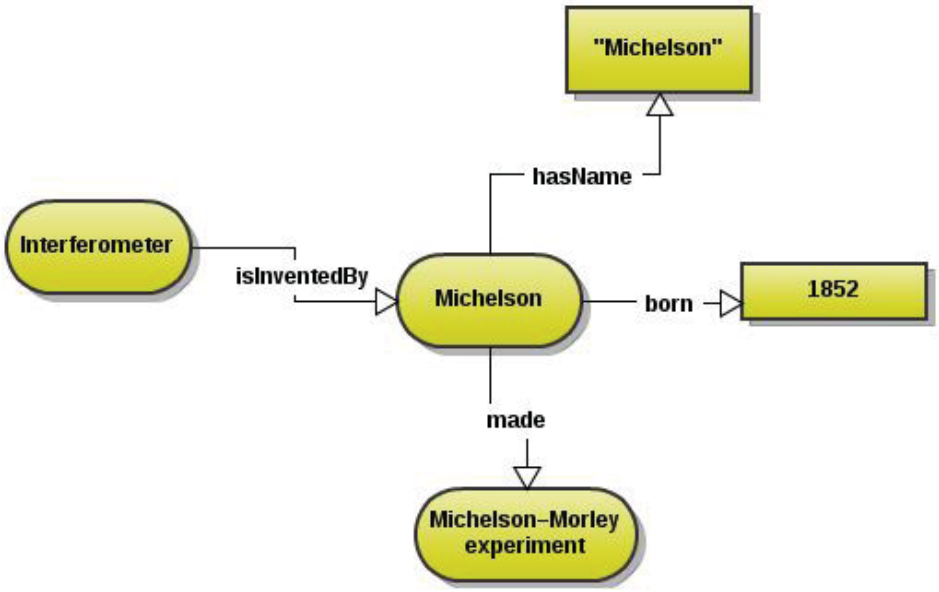

Figure 1. Named links between pages

With named links we can control the presence of certain properties of the objects described in wiki-page. Here is an example of named links in wiki-markup:

An interferometer was invented by [[isInvetedBy::Mickelson]] in [[timeOfInvention::1887]].

Wiki to ontology binding. We are going to take advantage of both wiki-technology as a content management system and ontologies. Taking an ontology saved in OWL format [3] the system binds each wiki page to concept or object in ontology. This step enables all consistency control, navigation and visualization features described in this paper.

We can help to deal with consistency using ontology checking and named links mechanism. Here by ontology checking we mean:

1. collection of all the links between ontology objects and wiki-pages connected to them;
2. comparison of these two sets and reporting about all mismatches to content managers.

Currently the only way to deal with inconsistencies supported by our system is to make requests to adding facts to the ontology from content managers to ontology engineers.

Lets consider the following situation as an illustration: suppose that we have the fact that Mickelson has made the first experiment related to the interferometry. When a content manager was adding the Interferometry wiki page he got a recommendation to make the named link called ExperimentedFirst pointed on Michelson. Content manager added [[ExperimentedFirst::Michelson]] but also he added the name of the second scientist experimented on Interferometry together with Michelson. It was Edward Morley.

In such a case the system will send a notification to experts and knowledge managers that there is a proposition to add a new fact to the ontology. Experts can deny or accept this proposition.

V. MOBILE DEVICES SUPPORT

Mobile OntolingeWiki subproject helps attendees to build a solid picture of Optics, gain full notion about exhibits, walk over the museum to be introduced with persons, events, phenomena, etc. The system is oriented to users without any scientific background and aimed to be the first introduction into optics.

Client part of the system will be installed on Nokia N810. It should provide to the user an ability to see the museum as a system of the interlinked concepts and helps to orient in the museum's halls. The user scans QR-codes then the system should give him short description and refine his position on a map.

There will be two main modes. The first mode called Map Mode is aimed to help the user to find exhibits in the museum halls. In this mode we plan to recognize QR-codes to identify exhibits. The second mode that is called Knowledge Mode will be used to show an exhibit in a relation to other concepts in the ontology: one will be able to instantly see how the invention is related to various domains of science, scientist, industry applications. At the moment we have several programs that implement ontology visualization techniques. Our goal is to port them to the platform that is supported by the majority of the mobile devices (we have chosen Flash at the moment).

In the beginning the visitor of the museum can choose one of the tracks proposed by the system. These tracks should have been created by the museum guide. The visitor can effectively learn subjects of the museum without any assistance by switching between two modes.

VI. Conclusion

Thereby OntolingeWiki system helps a museum visitor to get a notion about exhibits and build consistent knowledge about exhibition subjects without guide help. Also it simplifies the process of building information portal about exhibition and validate it correctness.

We consider OntolingeWiki tool as a great step forward in the development of a useful technological environment for creating ontology-based educational portals supporting collaboration.

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