Chapter 10
Ontology-Enhanced User Interfaces: A Survey

Heiko Paulheim
SAP Research CEC Darmstadt, Germany

Florian Probst
SAP Research CEC Darmstadt, Germany

ABSTRACT

Ontologies have been increasingly used in software systems in the past years. However, in many of those systems, the ontologies are hidden “under the hood”. While a lot of useful applications of ontologies on the database and business logic layer have been proposed, the employment of ontologies in user interfaces has been gaining comparatively little attention so far. For providing a deeper understanding of that field as well as assisting developers of ontology-enhanced user interfaces, the authors give an overview of such applications and introduce a schema for characterizing the requirements of ontology-enhanced user interfaces. With this article, a state of the art survey of approaches is presented along with promising research directions.

INTRODUCTION

During the past years, ontologies have been used in information sources for numerous purposes, such as annotating resources for better information retrieval, integrating data from different sources and systems, and automatically coupling intelligent agents. In most of those fields, ontologies are used on the information source and the business logic layer, and thus hidden “under the hood”.

One of the most complete surveys of using ontologies in software engineering is probably given by Ruiz and Hilera (2006). The authors have analyzed more than 50 possibilities of employing ontologies in software engineering, only two of which target at user interfaces. Heitmann, Kinsella, Hayes, and Decker (2009) have presented a survey on applications using semantic web technology and, not much surprisingly, they found out that
more than 90% of those applications come with a 
user interface. The survey, however, contains only 
little information about how the employment of 
semantic web ontologies influences the provided 
user interfaces.

In this article, we want to shed light at this area 
and take a closer look at the various possibilities of 
enhancing user interfaces with ontologies. We have 
reviewed various projects and identified a number 
of purposes for which ontologies can be used on 
the user interface layer, e.g., adapting UIs to a 
user’s needs, or providing input assistance. Each 
of those purposes poses particular requirements 
to the ontologies and their use in the application. 
So far, no structured review of those requirements 
and approaches has been performed. To summa-
rize these approaches, we prefer the more general 
notion ontology-enhanced user interface instead 
of ontology-driven user interface, as sometimes 
used (e.g., Paton et al., 1999; Visser & Schuster, 
2002), since ontologies may also be employed to 
provide one single functionality in a larger user 
interface (and thus enhance the user interface) 
without being the key element driving the user 
interface. We propose the following definition:

Definition: An ontology-enhanced user interface is 
a user interface whose visualization capabili-
ties, interaction possibilities, or development 
process are enabled or (at least) improved by 
the employment of one or more ontologies.

According to this definition, we have looked at 
projects where the development process and/or the 
usability of a user interface has been improved by 
employing ontologies. Applications such as pure 
ontology editors or viewers thus are out of scope 
here, since the ontologies do not improve the user 
interface in these cases – in these applications, 
ontology engineering itself is the purpose, not a 
means to enhance the user interface’s capabilities.

While this definition is quite broad, it does not 
encompass every application using an ontology. 
There are many applications that use ontologies in-
ternally – e.g., for integrating different information 
sources, or for enabling information exchange with 
other systems – where the fact that an ontology is 
used in a particular place does not have any effect 
on the application’s user interface. Furthermore, 
there are applications providing functionality 
which are implemented with ontologies, and the 
applications’ user interfaces grant access to that 
functionality – however, in these cases, the user 
interface as such is not directly influenced (let alone improved) by the employment of an ontol-
ogy. In contrast, we concentrate on applications 
of ontologies that directly improve user interfaces 
or their development.

We have carefully studied the current state of 
the art of improving user interfaces with ontolo-
gies. To that end, we have looked at numerous 
projects which use ontologies in the development 
of user interfaces. From that overview, we have 
derived a number of criteria for both the ontolo-
gies and the mode of their employment which are 
relevant for characterizing ontology-enhanced 
user interfaces. This characterization serves two 
purposes: it allows for a better understanding 
ontology-enhanced user interfaces, and it sup-
ports developers who want to use ontologies for a 
certain purpose in a user interface by pinpointing 
the relevant requirements. Furthermore, the survey 
in this article helps identifying new interesting 
research directions. The survey of approaches 
we present is purely descriptive, as a detailed 
discussion of whether each of the improvements 
addressed could also or even better be achieved 
without ontologies is out of scope of this article.

The rest of this article is structured as follows. 
The next section outlines existing classifications 
of ontologies in software systems in general. 
Based on these classifications, we present our own 
characterization framework, which is especially 
tailored to ontology-enhanced user interfaces. 
Next, we present a representative selection of 
approaches and apply our framework to discuss 
their characteristics. Following our definition, 
these approaches are classified in three catego-