

Developing Semantic Rich Internet Applications with the S^m4RIA Extension for OIDE

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Abstract. This paper introduces the S^m4RIA Extension for OIDE, which implements the S^m4RIA approach in OIDE (OOH4RIA Integrated Development Environment). The application, based on the Eclipse framework, supports the design of the S^m4RIA models as well as the model-to-model and model-to-text transformation processes that facilitate the generation of Semantic Rich Internet Applications, i.e., RIA applications capable of sharing data as Linked data and consuming external data from other sources in the same manner. Moreover, the application implements mechanisms for the creation of RIA interfaces from ontologies and the automatic generation of administration interfaces for a previously design application.

1 Introduction

The development of Rich Internet Applications (RIAs) has lead to the improvement of the user interfaces in Web applications increasing the interoperability of their components by means of an event-driven paradigm, and providing an appearance and user experience similar to a desktop interface. Nevertheless, due to technological issues, RIAs act as black boxes that show their contents in a user-friendly manner but complicate the access to the data to some types of Web clients, which require accessibility, such as, the search engines. This drawback is shared both by browser-oriented RIAs, whose data is visualized according to a list of events triggered by users, and plugin-oriented RIAs, which, in addition to being event-driven, are implemented as binary objects whose information can be only visualized using a plug-in specific for each technology and browser. In this context, the S^m4RIA approach (Semantic Models for RIA) [1] introduces a new model-driven methodology, extending OOH4RIA, for the development of Semantic Rich Internet Applications (SRIAs), i.e., a new type of RIA that facilitate the interconnection to external RIA systems and data sources by means of techniques and technologies from the Semantic Web. Specifically, these

applications are capable of both sharing their internal data as Linked Data (<http://linkeddata.org/>) and exploiting data shared by other nodes of the Linked Data cloud.

This paper describes the main features of the S^m4RIA Extension for OIDE, which implements the S^m4RIA approach in OIDE [2] (OOH4RIA Integrated Development Environment, see Fig. 1) and, thus helping users to model SRIAs using the S^m4RIA models. Furthermore, this extension automates a transformation process (model-to-model and model-to-text) needed for the generation of SRIAs. Complementing the original S^m4RIA approach, the tool also includes mechanisms for the generation of RIA interfaces from ontologies and the generation of administration views for the designed applications.

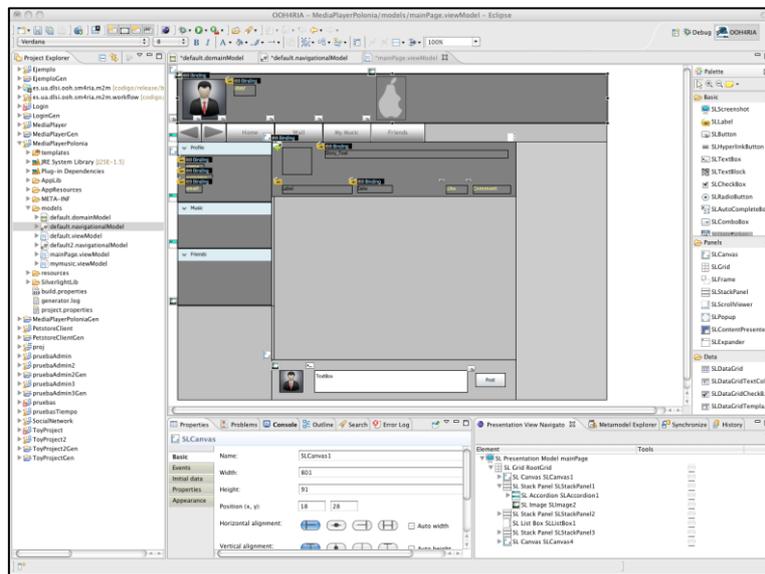


Figure 1. Screenshot of the OIDE tool showing the OOH4RIA Presentation model.

In order to contextualize the contribution of this paper, the next sections briefly introduce the concept of SRIA, the S^m4RIA methodology and its activities. For further explanations, Hermida et al. describe the approach in [1] in depth. Moreover, the following Web site <http://suma2.dlsi.ua.es/ooh4ria/sm4ria.html> also contains general information and a collection of demonstrative videos and use cases.

2 Introducing Semantic Rich Internet Applications

Due to technological restrictions, Rich Internet Applications behave as black boxes in a way that software agents, such as search engines, cannot access the data they share on the Web. RIAs usually include textual metadata that briefly describe the content of the application. However, the information contained in this metadata does not provide a realistic view of the RIA content. In several cases, the only manner of gaining ac-

cess to all the content is to use the visual representation of the data produced by the Web browser. Although there are currently some available solutions, they are still dependent on the technology chosen for the implementation of the RIA.

Semantic Rich Internet Applications (SRIA [1]) extensively use Semantic Web techniques and technologies in order to provide a representation of the contents managed by the application and facilitating the reuse existing knowledge sources on the Web. This solution is technologically independent since it can be adapted to any RIA framework. A schema of this type of application, the software modules it contains and the Media Player case study are described in [1] or at the S^m4RIA Web site. The *S^m4RIA Extension for OIDE*, which is presented in this paper, supports the design and generation of these modules implementing the S^m4RIA methodology.

3 The S^m4RIA Development Process

The S^m4RIA methodology extends the original OOH4RIA methodology modifying some of the existing tasks and including new ones. The development process is divided into three main activities, which include tasks with the same aim: 1) design the components of the SRIA server; 2) design the components of the SRIA client; and 3) generate the SRIA by means of a collection of model-to-text transformations.

The first activity starts when the server designer defines the Domain model, which specifies the data structures used in the application. From this model, the ontology designer builds the domain ontology aligning the concepts extracted from the data structures with concepts of other sources or applications. As a result, the designer obtains the Extended Domain Model (EDM), which is a requisite of the next task of the activity: define the Extended Navigation Model (ENM). In this task, the designer specifies which data and ontology instances of the SRIA will be employed in the application. The ENM specifies the manner in which users navigate these elements by means of a set of navigational classes, which refer to the concepts defined in the EDM. Furthermore, using the ENM the designers can specify the access to external knowledge bases, using SPARQL queries, and the manner in which this information will be gathered and managed.

The second activity of the S^m4RIA process continues by transforming the Extended Navigational Model into a skeleton of the Presentation and Orchestration models using two model-to-model transformations: *Nav2Pres* and *NavPres2Orch*. The Presentation model describes the structure of the user interface (components and visualization) which is complemented by the Orchestration model, which defines the behavior of the interface.

Finally, the last activity of the method is aimed at generating the software components of the SRIA using the information captured in the S^m4RIA models by means of a collection of model-to-text transformation processes.

4 *S^m4RIA Extension for OIDE: Main Features*

OIDE is an application based on the Eclipse framework, developed as a set of Eclipse plug-ins, which supports the OOH4RIA methodology for the development of RIAs. Specifically, this application defines the OOH4RIA meta-models using the Ecore

format and, using the EMF/GMF framework, facilitates the definition using a graphical concrete syntax of the OOH4RIA models: Domain, Navigational and Presentation-Orchestration. Moreover, this tool supports the generation processes that obtain most of the RIA software components (both server and client modules). The generation rules are implemented as a set of Xpand rules, which, at present, transform the models into C# code using the Silverlight, WCF (Windows Communication Foundation) and NHibernate frameworks.

Using OIDE as platform, the S^m4RIA extension for OIDE implements the artifacts and processes of the S^m4RIA methodology as a new functionality of Eclipse. This section describes the elements developed and the modifications to the original tool that facilitate the design of the SRIA software components. More specifically, this extension includes the following features and components:

- a) **New models.** Using the EMF and GMF libraries, three new models have been implemented, whose meta-models have been defined over the Ecore meta-model:
 - *Extended Domain Model:* This model allows the designers to model light-weight ontologies using the tool and map the elements of domain model into ontology elements (represented in Fig. 2).
 - *Extended Navigational Model:* This model extends the OOH4RIA navigational model in such a way that it facilitates the definition of new navigational classes from the EDM and external navigational links, which could be combined creating data/knowledge *mashups*. At present, the tool helps to access the main Linked Data services, i.e., the SPARQL endpoints. Fig 2 depicts an example of this model.
 - *Visualization Ontology Model:* this model allows the designers to represent the characteristics of the structure and the behavior of the user interface from the point of view of the user (in contrast to the designer's viewpoint).

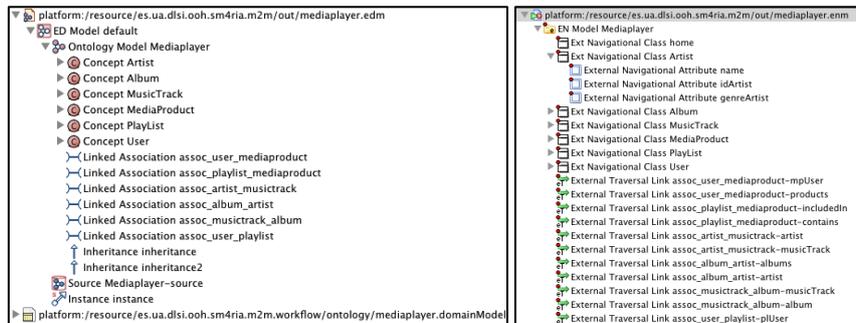


Figure 2. EMF view of the Extended Domain Model (left) and Extended Navigation Model (right).

- b) **Model-to-Model transformations.** The tool includes a collection of M2M rules that facilitate and boost the design processes. The chosen specification language and rule engine was provided by the Eclipse QVT operational implementation. Specifically, the transformations defined in this extension are the following ($M_a - M_b$ transformations are unidirectional, i.e., they transform model M_a into M_b):

- *Dom2ExtDom Transformation*: Domain model – Extended Domain Model. This transformation generates the basic elements of an ontology (concepts, properties, subclass axioms, etc.) from the Domain model. After the transformation process, the EDM generated can be modified/adapted/updated by the designer.
- *ExtDom2ExtNav Transformation*: Extended Domain Model – Extended Navigation Model. From the Extended Domain Model of the application, this transformation can generate a new view of the Extended Navigation Model for software agents.
- *NavExt2Pres&Orch Transformation*: Extended Navigation Model – Presentation Model. This transformation implements the S^m4RIA *Nav2Pres* and *Nav&Pres2Och* transformation, thus creating a predefined UI from the Navigation Model.

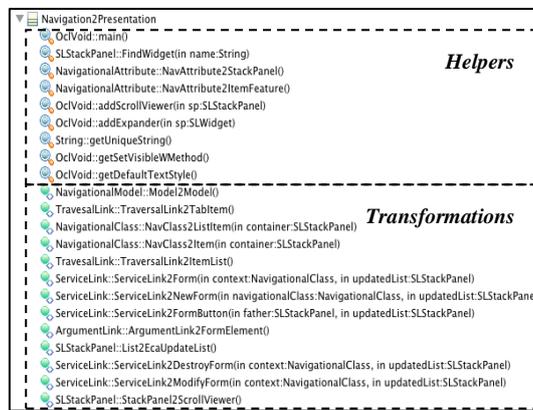


Figure 3. Outline of the NavExt2Pres&Orch QVTo transformation.

- c) **Model-to-Text transformations.** In order to generate the software components specific for SRIAs, this extension defines a set of Xpand transformation rules, which have been grouped by the generated SRIA component they are capable of generating:
- *Generation of OWL ontologies and mapping rules*: this group of rules generates the domain ontology (in OWL) and the mapping rules needed to generate Linked data from the database instances using a Database-to-RDF converter. Moreover, they generate the navigation and visualization ontologies, which provide a global ontological representation of the SRIA.
 - *Generation of the components for the access to Linked Data*: This subset of rules generates the components required to access SPARQL endpoints and retrieve Linked Data.
 - *Generation of the components for the access to local data*: this rule group generates a HTML interface for RIA, which is accessible by any Web client, even those which cannot process the Silverlight UI.

- d) **New processes of software generation.** The new implemented artifacts facilitate the adaptation of the S^m4RIA methodology to new processes of generation. Among them, it is worth highlighting the following:
- *Automatic generation of administrator views for applications.* Using the M2M transformations already defined, it is possible to automatically generate UIs for SRIA administrators (or facilitate the generation of most of their modules) from the S^m4RIA EDM or the OOH4RIA domain model. Fig. 4 shows an example of Presentation model that was automatically generated for a media player.

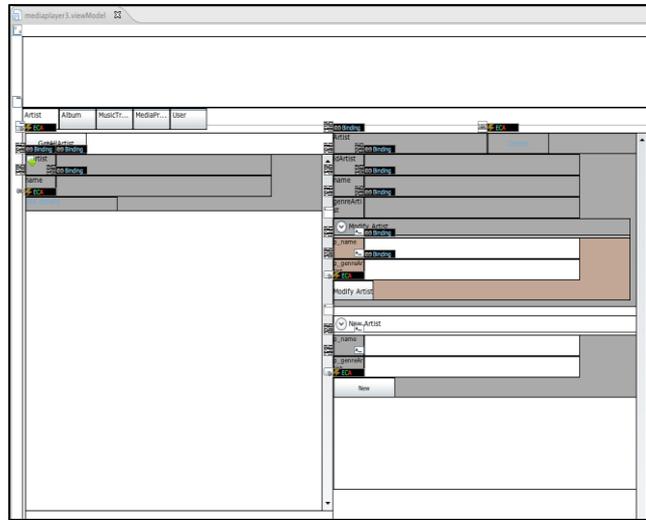


Figure 4. Presentation model for administrative tasks.

As mentioned before, the screenshots and demonstrative videos of this tool are available at the OOH4RIA-S^m4RIA Web site: <http://suma2.dlsi.ua.es/ooh4ria/sm4ria.html>

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