A Development Environment for Engineering Intelligent Avatars for Semantically-enhanced Simulated Realities (Demonstration)

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ABSTRACT

As of today, the behavior of avatars in virtual worlds is usually realized by script sequences which provide the illusion of intelligent behavior to the user. In the research project ISReal, our research group developed the first platform for deploying virtual worlds based on Semantic Web technology, which enables agents to reason about and plan with semantically annotated 3D objects. Powerful tool support is required to design agents which exploit the functionality of the ISReal platform. We decided to reuse existing facilities provided by the model-driven BOCHICA framework for AOSE and extended it with a platform model for agents situated in semantically-enhanced simulated realities.

Categories and Subject Descriptors

I.2.11 [**Distributed Artificial Intelligence**]: Multiagent systems; D.2.6 [**Programming Environment**]: Graphical environments

General Terms

Design, Languages

Keywords

Agent Oriented Software Engineering, Development Environment, Semantic Virtual Worlds

1. INTRODUCTION

Modeling multiagent systems (MAS) is a complex endeavour. An ideal domain specific agent modeling language would be tailored to a certain application domain (e.g. virtual worlds) as well as to the target execution environment (e.g. a legacy virtual reality platform). At the same time it is desirable to reuse application domain independent model artifacts that already proved their use. In [3], the BOCHICA framework for engineering MAS was introduced. It is is based on the platform independent core modeling language DSML4MAS and can be tailored through several extension interfaces to the user's needs.

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The underlying idea of the ISReal project was to use Semantic Web technology to enhance purely geometric objects with ontological information (OWL-based) and specify their functionality by semantic service descriptions (OWL-S-based), called *object services* [1]. Object services are grounded in animation and simulation modules. Intelligent avatars are equipped with a sensor component to perceive this information. Developing ISReal avatars involves, beside the core concepts of MAS (e.g. goals, behaviors, and interaction protocols) also ISReal specific aspects such as Semantic Web technology and 3D-related concepts. The remainder of this paper provides an overview of the BOCHICA framework (Section 2) and the ISReal specific extensions for the development environment (Section 3).

2. THE BOCHICA FRAMEWORK

The BOCHICA framework evolved from the PIM4AGENTS approach and is based on Eclipse technology. Here follows an overview of some of the new features:

Expressiveness. Expressive modeling languages are required for closing the gap between models and code. For this purpose, we further developed the underlying core modeling language so that large portions of the source code can be generated.

Conceptual Extensions. The BOCHICA framework offers various interface concepts that can be extended through external plug-ins. For example, existing concepts can be specialized for certain application domains or execution environments. Moreover, new ways for modeling existing aspects can be contributed (e.g. behaviors or interactions).

Language Extensions. There exists a large number of software languages that are relevant for developing agent-based systems such as knowledge representation languages, query languages, or programming languages. BOCHICA provides abstract language interfaces such as `BooleanExpression` or `ContextCondition` which can be extended by external language plug-ins. The interfaces check syntactical correctness and the binding of variable symbols in the surrounding scope.

Transformations. The BOCHICA framework uses modular *base transformations* for generating code for certain target agent execution platforms. As BOCHICA gets extended, an *extension transformation* extends a base transformation for the new concepts. Currently, we have a base transformation for Jadex which is implemented in QVT.

Reusability. It is desirable to reuse model artifacts that proved their practical use and were validated (e.g. inter-

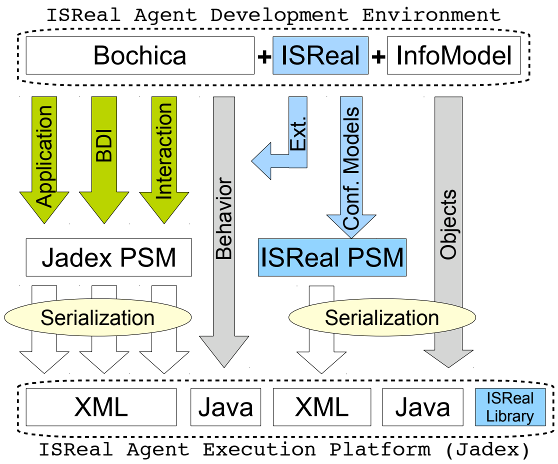

Figure 1: The development environment for ISReal agents consists of a Jadex base transformation (green), behavior and information model transformations (gray), and ISReal specific extensions (blue).

action protocols or goal hierarchies). For this purpose, we established a reverse engineering approach for extracting the underlying structure of Jadex BDI agents [2]. The approach is used to build up model repositories and ease the migration of existing projects to Bochica.

3. PLATFORM EXTENSION FOR ISREAL

For the development of intelligent ISReal avatars we decided to reuse the facilities of the Bochica framework by providing a ISReal platform extension (see Figure 1). The main features are:

ISReal Concepts. The ISReal platform model contributes ISReal specific concepts such as ISReal sensor configurations and the configuration of the agents' local knowledge bases (e.g. known object services, A- and T-Box).

Service Orchestration. ISReal agents use their sensor component for perception-based service discovery and orchestrate object services of the virtual environment using plans. We extended the modeling environment such that ISReal object services can be orchestrated by plan templates.

Semantic Web. In order to enable intelligent ISReal avatars for SPARQL-based reasoning, we provide a SPARQL language extension for Bochica. This extension allows for example to define the target condition of goals and the context condition of plans with SPARQL. We re-used the SPARQL domain specific language provided by EMFText[1].

ISReal Transformation. Based on the existing base transformation from Bochica to Jadex we created an extension transformation which provides additional mapping rules for ISReal specific artifacts. For example, it is responsible for generating configurations of the agents' knowledge bases, the SPARQL extension, and the integration into the overall ISReal platform.

ISReal View. Finally, the ISReal plug-in provides a custom ISReal view which allows the creation and configuration of ISReal specific model artifacts such as the agent sensor and the knowledge base configuration.

[1]http://www.emftext.org/

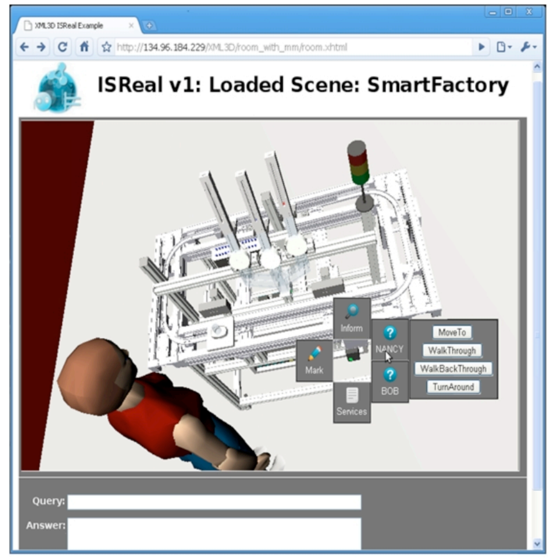

Figure 2: This figure depicts an intelligent avatar operating a virtual machine using object services. The user interface is based on XML3D.

4. CONCLUSION

In this paper we provided an overview of the development environment for intelligent ISReal avatars. The developed cross-disciplinary system integrates agent, Semantic Web, and AI technology, computer graphics, as well as model-driven AOSE. The demonstrator will cover all aspects starting from the modeling phase, throughout code generation, and the execution in the ISReal platform (see Figure 2). The reuse of the infrastructure provided by the Bochica framework reduces development and maintenance costs of the tool chain. A set of slides and a video can be found at[2].

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