

Using Linked Data for Interactive 3D Web Content Integration

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Abstract

The recent advances in Web and mobile technology broke exciting new possibilities for virtual reality (VR) on the Web. Authoring and sharing of 3D content is becoming a very important activity. Associating semantics with the 3D web content facilitates automatic, machine interpretation of 3D information. In order to support such an integration, we created an ontology to abstract the semantic knowledge in the virtual environments. Based on the ontology we propose to use Linked Data for content publishing. Linked Data helps the content integrator to recognize the object and infer more knowledge from the data. We use JSON-LD, a Linked Data implementation, to demonstrate the usefulness of the newly proposed approach.

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1 Motivation

The recent technology trends such as Google glass and Project Tango reveal the possibility of a new era of virtual reality (VR), that is VR for everyone on a variety of devices, from desktop to mobile. Mobile devices are now transforming from content consumer devices into content creation platforms. With more contributors authoring their products in 3D format and sharing them via the Web technology, the 3D content becomes a thriving type of online resource available to everyone. Publishing and sharing of 3D content is becoming a practical requirement for many Internet users.

2 Content Publishing with Linked Data

The online 3D content does not have a well defined way of publishing the model semantics as well as its interactivity. In our previous research [Zhang and Gračanin 2013], we created a framework called *CaffeNeveto* define the standards and specifications of constructing Distributed Virtual Environments (DVEs) from distributed components. In order to address the challenge of describing the 3D scene and the object activities inside virtual world, we defined an ontology to model the interactive 3D content for public knowledge sharing. The ontology abstract the online 3D content featured with the following characters: *a variety of VE specific objects* (e.g. scene, sensors, 3D geometry), *3D UI conventions*, *collaborative control targets*, and *streaming content updating*. The published ontology in OWL can be accessed at <http://www.caffeneve.org/oim.owl>.

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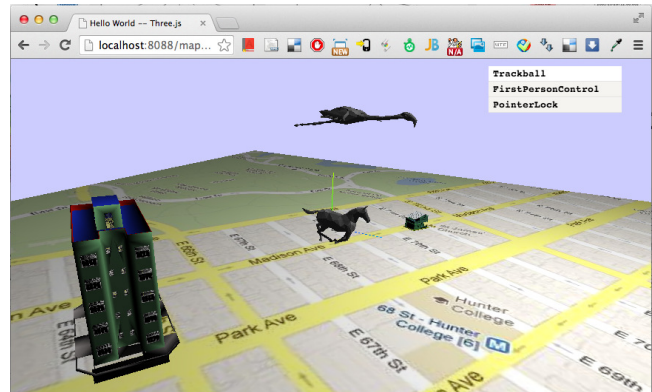


Figure 1: Accessing the Integrated Application using Browser

We extended Tim Berners-Lee’s Linked Data concept into a 3D content for the 3D resource publishing. Using the Linked Data, the data publisher uses serialization formats (such as RDFa, N3, or Turtle) to contribute self-describing data as part of a global graph database. With the Linked Data technology, a knowledge graph can be built to associate the relationships between data and semantic objects. The content contributor can easily modify or extend their content while the integration server is still able to conveniently adapt the changes. The integration servers can recognize objects and their behaviors from the data and dynamically construct the interactive content during the integration.

In our example, we use JSON-LD, a lightweight Linked Data format [Lanthaler and Gütl 2012]. The JSON-LD is used to associate the semantics defined in ontology into the descriptive 3D content using “@context” node. The 3D content contributor publishes JSON data via Web API. The application integrator server identifies the object and infers the needed information by referring to the properties in the “@context” node from the public ontology vocabulary. Figure 1 demonstrates an example application we created after integrating interactive content from four services. The JSON-LD context objects that refer to the primary ontology objects used in the example are accessible at <http://www.caffeneve.org/oim/>. The application is developed using *three.js* and the content can be accessed using WebGL supported browsers.

We believe using Linked Data to describe the application data has a promising future for creating large scale and extensive 3D web applications that can take advantage of distributed 3D web content.

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