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Towards the Semantic Web in WBE Systems: A LMS Platform with Metadata, IRLCOOO Materials and Agents

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Abstract: - The research in Web Based Education (WBE) systems is centered in reusability, accessibility, durability and interoperability of didactic materials and platforms of virtual education. In this paper we make a proposal of a development platform Learning LMS based on a special type of labeled materials called Intelligent Reusable Learning Components Object Oriented (IRLCOO), being the metadata a fundamental component toward the Semantic Web in systems WBE, the technologies used for the metadata are the following: XML, XML Schema, RDF, RDF Schema and OWL. The components IRLCOOs conform other fundamental part of the platform LMS, producing learning materials with interface and functionality standardized with SCORM 2004. The multiagent architecture JADE is a software framework fully implemented in Java language. It simplifies the implementation of multiagent systems through a middle-ware that complies with the FIPA specifications, the middleware implemented is for the LMS-WBE system is developed for sequencing and delivery of learning materials composed of IRLCOOs, in function of the student's metric personalized measures, to give a personalized intelligent answer, based on the metadata.

Key-Words: - WBE, SCORM 2004, Metadata, IRLCOO, Semantic Web, agents, JADE

1 Introduction

The traditional point of view of information systems as tailor made, cost intensive database applications, systems WBE is changing rapidly. Mainly for two reasons, the first: a maturing software industry, which is making greater use of off the shelf generic components and standard software solutions, and the second by the information revolution. While an object represents an entity in the problem domain, the component is an atomic piece reusable in binary format of the solution. The object and component perspectives are complementary. A component is an independent unit of production and deployment that is combined with other components to assemble an application. There is some conceptual overlap between objects and components. Objects are instances of classes; in fact, object-oriented design might just as well be called class oriented design. A component is often just a compiled class, or a group of compiled classes. The object approach emphasizes design and development, while the component approach emphasizes deployment [1].

2 IRLCOO and SCORM 2004

The ideal behind of the components IRLCOOs is: to reduce the complexity of elaboration of materials technically, to reduce the complexity of meta labeled SCORM 2004 of the materials [2], to standardize the interfaces and functionality, this was solved in the first phases of the project [3-4]. Later on the components were redefined with the following improvements: redesign and implementation to the paradigm object oriented, separation of content and control, communication between IRLCOO and LMS, communication between Agents [5].

The meta labeled SCORM 2004 and the structured of the material using the IRLCOOs is shown in the Fig. 1 following.

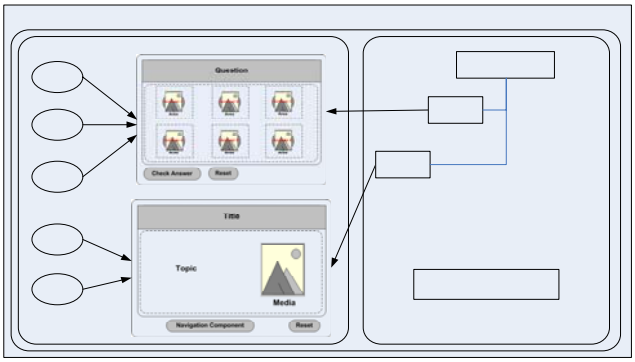

Fig. 1. IMSMANIFEST.XML SCORM 2004 with components IRLCOOs.

The fundamental idea of the components IRCLOOs is to encapsulate functionalities and properties of the different didactic materials of a course, reducing the elaboration complexity and of meta labeled, simplifying its production. But the meta labeled SCORM 2004 is not enough to take the following step toward the Semantic Web, for what had to use other technologies in the labeled goal of the materials to advance in that address.

3 Metadata with XML, XML Schema, RDF, RDF Schema and OWL in the IRLCOOs

IRLCOO were implemented with a group of technologies to be able to enable the Semantic Web with the components IRLCOOs, besides the SCORM 2004 other technologies were used like: Uniform Resource Identifier (URI), Extensible Markup Language (XML), XML Schema, Resource Description Framework (RDF), RDF Schema and Web Ontology Language (OWL) [6-]. As it is shown in the Fig. 2.

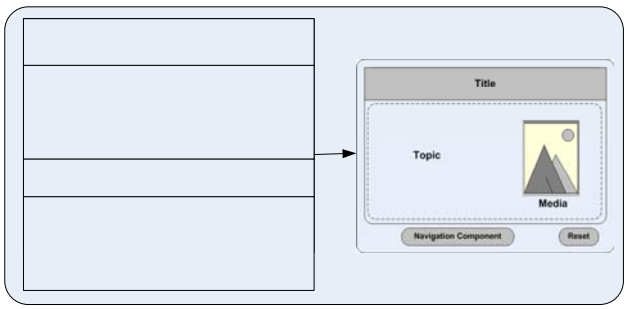

Fig. 2. Meta labeled Semantic with IRLCOOs.

XML provides a surface syntax for structured documents but imposes no semantic constraints on the meaning of these documents. XML Schema is a language for restricting the structure of XML documents. RDF is a data model for resources and relations between them; it provides a simple semantics for this data model; and these data models can be represented in XML syntax, by means of RDF/XML. RDF Schema is a vocabulary description language for describing properties and classes of RDF resources, with a semantics for generalization hierarchies of such properties and classes. OWL is a richer vocabulary description language for describing properties and classes, such as relations between classes, cardinality, equality, richer typing of properties, characteristics of properties, and enumerated classes, among others.

3.1 Metadata: Contents with SCORM 2004 and RDF

While the metadata SCORM 2004 is useful to add information and to structure documents like the IMSMANIFEST.XML, it is correct from the XML viewpoint, this answer is semantically unsatisfactory. This kind of information makes use of the semantic model of the particular domain, and cannot be represented in XML or in RDF but is typical of knowledge written in RDF Schema. Thus RDFS makes semantic information machine accessible, from the point of view of the Semantic Web vision. Serialization converts an object into a persistent form. RDF/XML is the serialization technique used in the rest of this paper, the serializing RDF to XML provides a means of documenting an RDF model in a text-based format, literally serializing the model using XML. This means that the content must both meet all requirements for well-formed XML and the additional constraints of RDF. We show the representation of statement RDF of IRLCOO component content in Table 1.

Table 1. RDF of IRLCOO component content.

```
<?xml version="1.0"?>
<rdf:RDF
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"

xmlns:IRLCOO="http://www.domain.org/IRLCOO/elements/1.
0/">
  <rdf:Description rdf:about=" IRLCOO_01.html">
< IRLCOO:author>Ruben Peredo</ IRLCOO:author>
< IRLCOO:title>Language C++</ IRLCOO:title>
< IRLCOO:type> SELECTION_OF_AREA</ IRLCOO:type>
…
  </rdf:Description>
</rdf:RDF>
```

3.2 Metadata: Navigation with SCORM 2004 and RDF

The metadata SCORM 2004 is useful to add information about navigation in documents like the IMSMANIFEST.XML, it is correct from the XML viewpoint, this answer is semantically unsatisfactory. This kind of information makes use of the semantic model of the particular domain, and cannot be represented in XML or in RDF but is typical of knowledge written in RDF Schema. Thus RDFS makes semantic information machine accessible, from the viewpoint of the Semantic Web vision. Serialization converts an object into a persistent form. RDF/XML is the serialization technique used in the rest of this paper, the serializing RDF to XML provides a means of documenting an RDF model in a text-based format, literally serializing the model using XML. This means that the navigation must both meet

all requirements for well-formed XML and the additional constraints of RDF. We show the representation of statement RDF of IRLCOO component navigation in Table 2.

Table 2. RDF of IRLCOO component navigation.

```
<?xml version="1.0"?>
<rdf:RDF
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:IRLCOO="http://www.domain.org/IRLCOO/element/1/">
  <rdf:Description rdf:about=" IRLCOO_01.html">
     < IRLCOO: Unique_Navigation_ID >23
     </ IRLCOO: Unique_Navigation_ID>
    < IRLCOO: Start> IRLCOO_01.htm2 </ IRLCOO: Start>
    < IRLCOO: Next> IRLCOO_01.htm3 </ IRLCOO: Next>
    …
  </rdf:Description>
</rdf:RDF>
```

3.3 Metadata: Notes with RDF and Annotea

Annotea enhances collaboration via shared metadata based Web annotations, book-marks, and their combinations. By annotations we mean comments, notes, explanations, or other types of external remarks that can be attached to any Web document or a selected part of the document without actually needing to touch the document. When the user gets the document he or she can also load the annotations attached to it from a selected annotation server or several servers and see what his peer group thinks. Similarly shared bookmarks can be attached to Web documents to help organize them under different topics, to easily find them later, to help find related material and to collaboratively filter bookmarked material [14]. Annotea uses an RDF based annotation schema for describing annotations as metadata and XPointer for locating the annotations in the annotated document. We show the representation of a statement RDF of an IRLCOO component note in Table 3:

Table 3. Annotea of an IRLCOO note.

```
<r:RDF xmlns:r="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
      xmlns:a="http://www.w3.org/2000/10/annotation-ns#"
      xmlns:d="http://purl.org/dc/elements/1.1/">
 <r:Description>
  <r:type resource="http://www.w3.org/2000/10/annotation-ns#Annotation"/>
  <r:type resource="http://www.w3.org/2000/10/annotationType#Comment"/>
  <a:annotates r:resource=" IRLCOO_01.html "/>
  <a:context>#xpointer(id("Main")/p[3])</a:context>
  <d:creator>Joaquin Medina</d:creator>
  <a:created>2005-06-10T10:10Z</a:created>
  <d:date>2005-06-10T10:10Z</d:date>
  <a:body r:resource="comment.html"/>
 </r:Description>
</r:RDF>
```

4 Ontology for components IRLCOOs

The term ontology originates from philosophy. it is used as the name of a subfield of philosophy, namely, the study of the nature of existence. There are different definitions of ontologies, one of those most accepted is the following: “an explicit representation of the meaning of terms in a vocabulary, and their interrelationships. In an ontology definition language, ontology is the collection of statements or other semantic definitions for a domain” [10]. The ontology of the componets IRLCOO in OWL is the following:

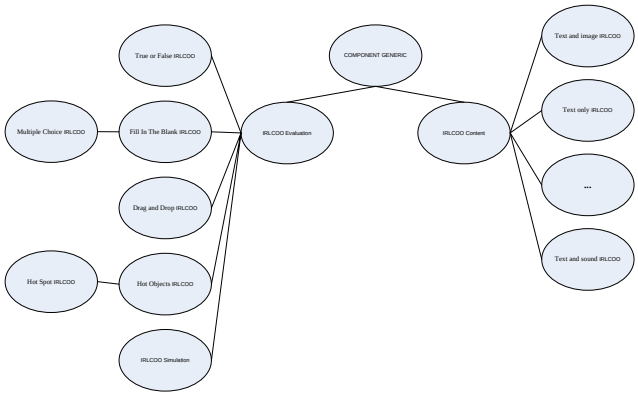

Fig. 3. Ontology IRLCOOs.

5 LMS Semantic Web

EVA was a Learning Management System (LMS) developed in the institution [12], and it allowed us to introduce us in the WBE, later on the Run-Time of SCORM like LMS that we use as platform, but to the which we made him some attaches to enable the Semantic Web, like it is shown in the Fig. 4.

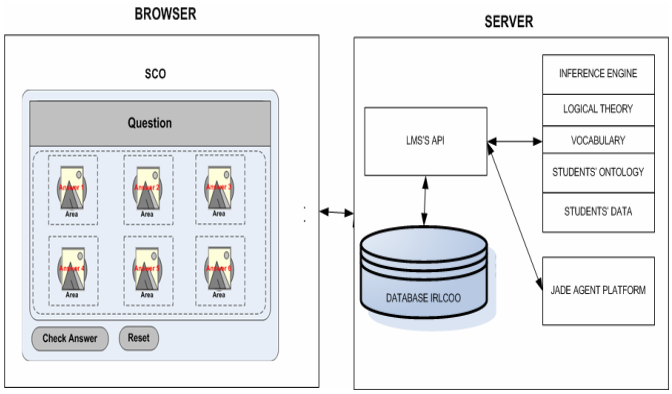

Fig. 4. LMS Semantic and IRLCOOs.

The set of IRLCOO objects are basically of two types: content and evaluation, all the IRLCOO are Web resource, its metadata, a movement associated with the resource, presentation, sound, image, animation, video and type information, navigation and other related resources. The IRLCOO allows the bidirectional of the Semantic Web, since they allow to capture the student's actions and to store them on the side of the server, so much in the handling of the means like of the trajectory that the student continues,

taking the control the LMS to allow to the system composition and dynamic sequence, depending on the student's metric measures and of the inferences carried out in function of their evaluations.

Java Agent DEvelopment Framework (JADE) [13], it is a platform that has gone taking relevance along the time, their main advantage and disadvantage at the same time is that Java uses [14], allowing to implement the specifications of FIPA by means of libraries that are very simple of using, their weaker point is that has some details, as the fact that it is necessary to be careful when installing the platform, since it doesn't support the long names of Windows in an appropriate way, making that many applications don't run appropriately. A middleware has been generated for communication, feedback, to compose and sequences by means of agents that it allows to enable the Semantic Web, has been modified to support the handling of metadata type: SCORM 2004, RDF and OWL, to be able to make inferences and to adapt the trajectory of the student's learning from a more appropriate way to their true necessities.

6 Conclusion

The combination of components IRLCOOs and the additional meta labeled enable the Semantic Web, with the difference that the new system reduces the complexity for the potential developers, since it is had a group of attributes and standardized functionalities, besides a language common of communication among components, standardizing the communication. Being in a meta infrastructure that will allow to make better decisions depending on the metric of the student in their following stage, inferring in function of the metric and of the meta labeled of the IRLCOO.

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