User-generated Semantic Content Framework for E-learning

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Abstract – **This paper presents a framework for collaborative or individual user-generated semantic content gathering and markup, with primary application in e-learning. This framework is a part of the ongoing research at the Faculty of Electronic Engineering Niš and is a follow-up to the previously designed and developed semantic layer framework for online learning material.**

Keywords – **E-learning, Semantic Web, Ontology, Web 2.0.**

I. Introduction

This paper describes a conceptual model of a framework for collecting user-generated content in e-learning systems. Though the notion of e-learning, established in 1998, still lacks precise definition, its convergence towards autonomous, adaptable, intelligent systems is obvious. Design of these systems imply that there is, in general, physical distance (spacial and/or temporal) between the tutor and the student, that students use some version of technology to access the material (as well as for the interaction with peers) and that some form of student support exists [1]. Opposite to the traditional education paradigm, which uses *push* delivery of knowledge that might be applied in student's future (and that is largely over-quantified), e-learning is aimed at *just-in-time* and *just-enogh* knowledge delivery [2], which makes it particularly suitable for continuous education in business environment. To achieve this goal, e-learning systems need to be adaptible and dynamic by nature. Adaptibility is achieved through student modeling, while the dynamic trait requires a repository of fine-grained learning material (learning objects, LO) that are agregated in lessons and courses on demand, personalized for each individual user and for any particular use case. LO repositories are universal and reusable resources, which are dependant on metadata (LO meta-tags) – data that enables the system to determine rules of sequencing and navigation, and other stages of course aggregation. Global initiatives like [3] support this aspect of LO, though global consensus (or "killer application") hasn't been achieved yet. Aggregation mechanisms can benefit from ontologies as means for structuring LO and building dynamic instruction materials – which is the main link between Semantic Web technologies and e-learning. This paper presents a prototype of a semantic-based textual e-learning markup tool aimed at user-generated small-scale learning objects. This prototype is in development at the Faculty of Electronic Engineering, and it is based on the previously developed system for supplemental semantic layering of the online text material [4].

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II. Drag-and-Drop Semantic Interface

A. Introduction

Existing system, labeled Drag-and-Drop Semantic Interface (DSi) adds semantic layer to any digital textual material. This is achieved through coupling drag-and-drop funcionality with a graph (or ontology) of relations between key notions/terms in the text, enabling the user to graphically interconnect different terms and, by doing so, querry the ontology. If the link between chosen terms is defined, system will return all possible relations. This way the tools of Semantic Web have been applied for e-learning purposes.

B. Conceptual Details

If we assume that learning means acquisition of new knowledge, behavior, skill, value, preference or understanding [5], and define understanding as a psychological process connected with and abstract or concrete object where a person is able to use concepts to meaningfully interact with this object [6], we can conclude that learning means the acquisition of a concept about a new object. If a concept is defined as something that determines all entities and/or *relations* in a given category/class, by means of definitions [7], we can conclude that learning essentially implies acquisition of *facts* and *relations* (links between facts), if we leave behavioral learnings out of this discussion (these learnings cannot be delivered through textual material in focus here). Simply put – a new notion can only be explained/taught by defining its relations to other, known notions. These relations are central to the system described.

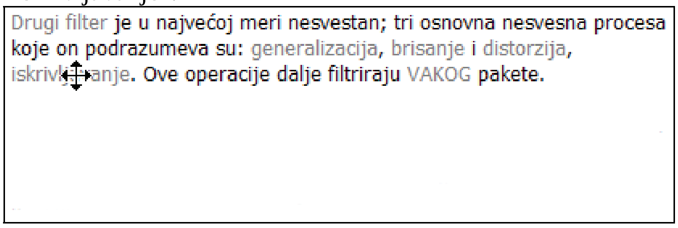
B. Implementation Details

On the implementation side, DSi solution has two key components: human-computer interface, implemented with a Scriptaculous JavaScript framework [8], and the interface to an RDF graph (in XML serialization) through the Simple JavaScript RDF Parser and Query Thingy framework [9]. This two-sided solution enables the user to graphically interact with a relation base stored as XML. Instructional design can be separated in two - textual and semantic development, and these can be performed by different authors. Semantic layer, carrying relations between terms, can be applied to any textual material (and vice versa), having in mind that relations are context-dependant. Primary focus in design of DSi was on the simple and intuitive user interface to the relatively complicated semantic storage.

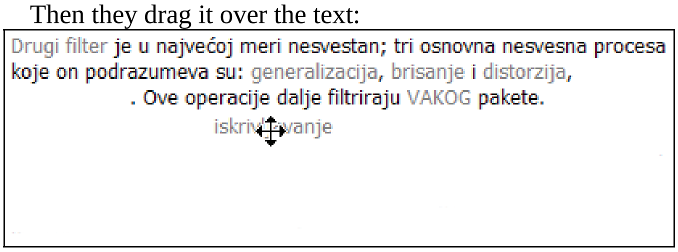
III. User-Generated Content Interface

After implementation and testing, previously invisible aspects emerged. The user interface is single-sided. Semantic layer needs to be prepared in advance, using appropriate RDF editor like Protégé [10]. This requires domain experts to understand basic notions of ontologies/graphs which severely limits the author base. The only way to harness the infinite potential of non-IT users is to make the knowledge acquisition automated through the simplest possible user interface. This interface is already present in the current version of DSi.

Reversing the process realized in DSi, a semantic editor concept model is developed. User interaction is identical as in current DSi, for example the user takes the word "iskrivljavanje":

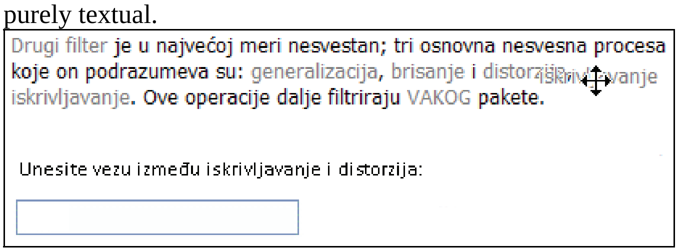


Then they drag it over the text:



Finally, they drop it onto the word "distorzija". These two words may and may not be synonyms, depending on the context. In the context of Neuro-Linguistic Programming [11], out of which the example has been retreived, these words are synonimical. After dropping the word "iskrivljavanje" onto the word "distorzija", the system interacts with the user through an appropriate GUI element.

In the current conceptual model, the interaction is performed through a simple text field, so the relations is purely textual.



The system searchs the RDF for duplicate relations. If the duplicate is found, newly entered relation is ignored. If the input is correct, new RDF triplet is formed with the new relation. In XML format, for the illustrated example (and if the user's input is "same_as", source code will look as follows:

```
<dsi:Primer rdf:nodeID="generalizacija">

   <dsi:name>generalizacija</foaf:name>
   <eg:same_as rdf:nodeID="distorzija"/>

</dsi:Primer>
```

An interface like this enables any user of the textual material to generate their own connections between notions. These connections can be immediately visible to other users accessing the same material or other materials within the same domain (in the area of validity of entered connections), enabling collaboration between peers.

IV. Directions for Further Development

Primary direction for further development of the system is the introduction of an automated reasoner that can infer hidden (implicit) relations. This is even more important in collaborative environments, where users can create relations that can be bound to form compound relations (for example, any transitive relation between X and Y and between Y and Z will lead the reasoner to infer a new relation between X and Y; in this example, different users may have entered the same transitive relation to X-Y and Y-Z, but may not have been aware of the existence all three elements in material).

Secondly, a form of peer-review mechanism will be added. With every query, a user will be prompted with the existing relations and offered to choose the one they agree upon the most (or other forms of marking may be used, like a classical 1-5 star rating for all existing connections). This way the most popular connections as voted by users will "bubble-up" the system. This is, however, not a guarantee of the truthfulness of those connections; still, the wiki approach, counter to the initial doubts, proved to yield quality material. Peer-review proposed will benefit from the very similar concept.

Further development may include tagging of relations (according to domains/scopes of validity) and/or providing a framework for users to moderate the connection base development (for example by allowing them to detect and mark synonymic or antonymic relations in the RDF, thus enabling them to "purify" the RDF).

V. Conclusion

This paper describes a conceptual model of a semantic editor with a user-friendly interface, aimed at collecting user-generated content as an underlying semantic layer in systems for e-learning. Conjunction between Semantic Web and e-learning is an area of wide and extensive research, since it is the Semantic Web that truly provides tools for dynamic and personalized on-demand learning material delivery. Nevertheless, instructional design of these materials requires Semantic Web skilled domain experts. Conceptual model proposed in this paper emphasizes the user input and conjunction between e-learning, Semantic Web and Web 2.0 concepts. Though this compound isn't new, sometimes called e-learning 2.0 [12], the particular implementation, especially the user interface, is the author's original contribution.

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