An Approach of Assistance of Learner’s Annotative Activity through Web Services

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Abstract. In E-learning environment, the learner felt a need for the annotation tools to annotate knowledge and information manipulated in digital form. These tools help this learner to effectively achieve his various activities. The existing annotation systems are necessarily based on annotation models to conceptualize its properties in a formal way to be exploited by computer systems. Several models have been proposed in the literature in different contexts. However, these models suffer from an under exploitation of the annotation’s semantic. They consider this annotation only as a simple track of reading made by the learner to memorize or share notes. In this article, we try to better exploit the semantic of annotations by proposing a new approach which presents the learner’s annotative activity as a potential source of Web service invocation. This approach gives rise to a new annotation system rich en features in its architecture which seeks to provide learner with the relevant Web service to meet his annotation’s goal.

Keywords: E-learning, Learner, Annotative activity, Annotation system, Web service

1 Introduction

Usually, the learner mobilizes varied data to realize his different activities in E-learning domain. Therefore, this learner is a member of the category of "knowledge worker" [9] who needs to be assisted by computing tools to better manage his personal knowledge needed to carry out his activities. The need for these tools in web pages becomes more and more claimed and felt, because information is often manipulated and exchanged in electronic format [15]. Among these tools, we are interested in our research works in the annotation systems existing in the Web. These annotation tools are widely used in E-learning platforms because annotation practice is omnipresent. During his reading, the learner always uses comments, highlight, post-it etc., to annotate the reading resources in his learning session [16].

Indeed, many systems have been developed to annotate digital documents, often adapted to specific application domains and for particular uses of documents [6,8]. By leveraging the capabilities of storage, communications and information processing computers, these annotation systems handle electronic annotations and propose new services with regard to the annotation’s paper: multimedia comments, sharing annotations, thread of discussion, search information, etc... [15]. The annotation tools are necessarily based on annotation models to conceptualize its properties in a formal way to be exploited by computer systems. Several models have been proposed in the literature in different contexts. However, these models suffer from an under exploitation of the annotation’s semantic. They consider this annotation only as a simple track of reading made by the learner to memorize or share an understanding or a remark on a read passage. The annotative activity is superficially processed and analyzed by most of the researchers who develop annotation systems. While the annotation is semantically richer than that is presented by these works there.

In this article, we want to propose a new approach of assistance of learner’s annotative activity through Web services. Therefore, we consider the annotation not only as a means of memorization of the learner reactions in the reading process but also as a potential source of web services invocation that can assist the learner and help him to achieve his goals in any reading domain on the Web [13]. This approach is based on a new annotation’s conceptual model rich in semantic properties allowing to accommodate the new approach. Based on this conceptual model, we develop a prototype of annotation system in form of plugin to enhance the new features offered by the proposed approach.

This article is organized as follows: Section 2 presents literature review that inspired our work, including a study of models and systems of annotation on the Web. Section 3 presents our approach that includes a conceptual model of the annotative activity and architecture of our annotation system. In section 4, we try to propose a running example of learner’s annotative activity to better explain our contribution. Finally, section 5 concludes this article and presents future work.
2 State of the art: Annotation models and annotation systems on the Web

2.1 Annotation systems on the Web

The annotation systems have been developed since 1989 to transpose on electronic document the annotation practice. Then, these systems gradually took advantage of processing capacities and communication of the modern computers to enrich the electronic annotation practice. Several researchers and companies were interested in the creation of annotation systems to facilitate the process of adding notes on digital documents. We can find many commercial software and research prototypes created to annotate documents available on the Web. We identified through our study of the state of the art dozens of annotation tools developed by:


- **Commercial companies**: such as iMarkup [10] developed by iMarkup Solution company, XLibris [18] offered by Microsoft Corporation company, and Adobe reader annotation [1] proposed by Adobe Systems company...


Figure 1 shows a collection of some annotation systems developed in different contexts among all tools studied in the art’s state.

![Fig. 1. Examples of annotation system on the Web](image)

Each annotative activity realized by a learner using an annotation system passes through two complementary processes: choose the anchor and the shape of the annotation in a given document (*process 1*) and specify the properties of the annotation (*process 2*). Based on these two processes, we can classify the existing annotation systems into three categories:

- **Manual annotation system**: each of the two previously mentioned processes is manually executed by the user himself. The creation process is completely chargeable to the annotator, who selects the shape and the anchor of the annotation and then specifies properties to give to this note. This type of annotation system tries to simply reproduce the annotation process on paper towards computer. Consequently, when it is a question of annotating a wide collection of digital documents, the annotative activity becomes heavy for the annotator. Mosaic [5] and ComMentor [21] are examples of manual annotation system.

- **Semi-automatic annotation system**: in this type the first process is performed by the annotator while the second process is executed by the annotation tool. The annotator begins to annotate manually. Meanwhile the tool textually analyzes his annotations and generates rules of annotation. Then, the tool uses these rules to deduct passages potentially annotables and create candidate annotations. The user can then validate or not the annotations proposed by the tool. The system uses these validations to correct its rules. From a certain level of improvement, the semi-automatic annotation system can continue the annotation process alone. This type of annotation system is used especially in the context of the Semantic Web. Indeed, the
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Khan [11] proposed Annotea. This model describes the annotation as an object with properties:

- context of research conducted in the World Wide Web Consortium to develop a standard model of annotation,
- in a formal way to be exploited by computer systems. Several models have been proposed in the literature. In the annotation systems studied above are necessarily based on annotation models to conceptualize its properties. The annotation systems which exist in the literature are not adapted to our approach of invocation of web services from the learner’s annotative activity, and do not reflect its peculiarities. To propose a model of the annotation which exist in the literature is presented by these works there.

2.2 Annotation models

The annotation systems studied above are necessarily based on annotation models to conceptualize its properties in a formal way to be exploited by computer systems. Several models have been proposed in the literature. In the context of research conducted in the World Wide Web Consortium to develop a standard model of annotation, Khan [11] proposed Annotea. This model describes the annotation as an object with properties: title, type, annotates which means the relationship between the annotation and the annotated resource, body, context, creator, created which means the date of annotation creation, date which means the date of modification of the annotation, and related which means the relationship between the annotation and the annotated resource. In the frame of Microsoft Academic Search, Marshall tried to develop a device of annotation XLibris based on a model formed of two dimensions. Thus, the annotation has two aspects: shape (text, symbols, and marginal notes) and goal (future attention, reminder, resolution of problem, interpretation, and fortuitous reflection). Tazi [22] inspired from the theory of language act and applied it to the representation of the annotation. He proposed to formalize the annotation as a couple commitment-context, such as the commitment is a quadruplet (annotative act, used means, goal, annotative reason) and the context is n-uplet (annotator, annotation reader, annotated document, annotator role, date, and annotation session). The advantage of this model compared to others is to have identified that the annotation has a subsequent effect or immediate that is directly on the document (change in structure, for example) or outside the document (a scheduled action). Another annotation model presented to develop the annotation tool MemoNote by the Joseph Fourier university. Therefore, Azouou [3] described the annotation through three facets: cognitive facet (shape, anchor), personal facet (annotator, date, and place), and semantic facet (annotation goal, domain goal, and learning goal).

We hold from this study of different annotation models, the importance of the property of annotation goal. Its identification allows to find the semantic of the annotation desired by the annotator. Several researchers [3, 6, 11, 16, 22] have studied this goal and tried to identify its potential values. These studies have led to different results because they were made in different contexts. These various models agree on some basic properties such as the shape, anchor, author, date and goal of the annotation. This difference in the structure depends on the purpose for which these models were designed. But these models suffer from an under exploitation of the annotation’s semantic. They consider the latter only as a simple track of reading made by the user to memorize or share an understanding or a remark on a read passage. While the annotation is semantically richer than that is presented by these works there.

Also, the annotation system which we propose allows to look for and to invoke web services from the learner’s annotative activity. Indeed, this system should be based on a model of the annotation reflects the three aspects (physical, semantic and contextual) of the annotation necessary for our approach. However, the existing models of annotation [3, 6, 11, 16] can not represent these three aspects of the annotation at the same time. They are not therefore suitable for our proposed annotation system. So, any model of the state of the art is dedicated to accommodate our approach consisting in presenting the annotative activity of the learner as means to invoke appropriate Web services.

3 Our approach: Assistance of Learner’s Annotative Activity by Web Services

3.1 Annotation conceptual model

The models of the annotation which exist in the literature are not adapted to our approach of invocation of Web services from the learner’s annotative activity, and do not reflect its peculiarities. To propose a model of
annotation for our approach, we inspired from model of Azouaou [3], Tazi [22] and work of Mazhoud [17] by trying to modify them to be adapted to our needs. Thus, the conceptualization of the annotation can be formalized through the following model presented in figure 2. The proposed model is based on formalize established by three aspects [13]. The first is the physical aspect which represents the physical dimension of the annotation composed of the shape and the anchor of the annotation. It describes the annotated and the annotating content. The second is the semantic aspect that allows to formally explain the semantic of the annotation. It is used to interpret the meaning of the annotation by software agents. This aspect is composed of the reading domain, reading goal, annotative act, annotation goal, the services communities and finally the annotation effect. The third is the contextual aspect which consists of the set of attributes that describe the current annotation session of the learner. It contains the annotator, the date, the place and the device of the annotation.

Fig. 2. Annotation conceptual model

We detail the semantic annotation, because this aspect plays a key role in the proposed approach of assistance of learner’s annotative activity through the invocation of the relevant Web services according to the annotation’s goal.

**Reading domain**: represents the domain in which the user reads and annotates a document. Reading in which joins this article is qualified as active reading by opposition to the passive reading. The reading activity is transverse in various application domains.

**Reading goal**: presents the goal of reading document. The definition of this goal by the user during a reading activity is a natural way of organizing interests that motivate the user [17].

**Annotative act**: presents the action to annotate. It is the process that involves the choice of an annotation shape according to a well determined goal and to apply it to the annotated passage [17].

**Annotation goal**: represents the object implicitly expressed by the annotator by chosen this annotation to annotate the reading passage. This goal hides a need for means to meet this object expressed by the learner.

**Service communities**: collects a set of services offering the same activity (feature). Every community is described by a name and an objective which represents the feature proposed by this community of services. Thus, for each annotation goal corresponding one or several service community that can meet this goal.

**Effect**: is the result of Web service called from this annotation.

The process of search and invocation of Web services satisfying an annotation goal requires a learning phase from the annotation system to automate this process during the later annotation sessions of the annotator. So, to automate, on one hand the annotative activity of the annotator and on the other hand the process of deduction of the appropriate Web service to answer the annotation goal, we propose to use a pattern of annotation [12]. The proposed pattern allows to deduct the annotation goal from its shape and then based on this object the system interprets the appropriate Web service which assists the user to achieve the goal of the annotation. The pattern refers to some properties presented in the annotation model previously established. Indeed, An annotation pattern represents a conceptual solution to a problem related to the annotative activity. A conceptual solution often precedes the implementation phase. The annotation pattern proposes a solution (the semantic of the annotation) to a problem (find this semantic for a given annotation shape in a given context). Our annotation pattern is composed of four elements:
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1. **Pattern name:** the name of the pattern must be significant. It should express the semantic of the annotation produced by the annotator.

2. **Problem:** describes the problem to be solved by our annotation pattern. It represents the choice of shape and anchor of the annotation.

3. **Context:** the context in our case is a set of information that characterizes the annotation session of the annotator. This information allows us to infer the semantic of the annotation.

4. **Solution:** it is to find some attributes of the semantic aspect of the annotation such as the annotation goal and the service communities.

3.2 The proposed annotation system

The proposed annotation system is a consumer of Web service that sends a search query for service to a directory in order to achieve a goal of annotation made by a learner during his reading activity. Based on the keywords expressed in the query, the directory returns to the annotation system a list of Web services that can meet the annotation goal. Finally, the annotation tool chooses the first Web service classified in the list returned on behalf of the directory, and invokes the service by means of messages SOAP exchanged with the service provider. Figure 3 describes the three actors involved in the process of search and invocation of Web services, as well as the features offered by each of them.

![Fig. 3. Architecture of the proposed annotation system](image)

The study of annotation systems in the state of the art identifies the different features shared by annotation tools. Except for these features, we try to offer new services in our proposed system designed primarily to interpret the annotation goal implicitly expressed by the annotator. Thereafter the annotation system seeks to find an appropriate Web service that can satisfy the interpreted goal. Finally the selected service will be invoked to answer the annotation tools request. The annotator represents the user of the annotation system. Thus, we focus on the features and services offered by the proposed annotation tool.

These functions allow the annotator to create annotations manually or semi-automatically by using annotation pattern. In the case of manual annotation, the learner specifies itself the values of each attributes of the annotation (physical, semantic and contextual). In the case of semi-automatic annotation, the annotator creates a pattern annotation specifying the shape and the anchor. The properties of the context of the pattern are predefined by the annotation system according to the context of learners session. Based on this information, the system interprets the properties of the semantic aspect of the annotation. The learner can so manage these annotations by modifying or deleting them. He can also manage his patrons by deleting or modifying them. Finally, the annotations made by the learner can be viewed again during the consultation of the annotated document later, or searched using multiple criteria or share among groups.

All of these features offered by our proposed annotation system are represented in figure 4 with UML notation.
The proposed annotation system is in the form of a plugin based on the Mozilla Firefox Web browser. It provides the user with four categories of functions (authentication, annotation shape, annotation pattern, and annotation search). Figure 5 describes these functions.

4 Implementation: example of learner’s annotative activity

To test our proposed new annotation system, we present a scenario in which a learner in e-Learning domain consults an English course. The learner is led by our annotation system allowing him to annotate the read resource. The reading goal of the learner is to understand this consulted course. The learner begins to annotate in his reading session. The first made annotation consists in to translate the following proverb "a friend in need is a friend indeed" (see figure 6).
At this stadium, the annotation system consults the annotation ontology and interprets the goal of this annotation. It offers to the learner the choice to invoke an online translator presented as a means to meet the goal of this annotation. If the learner confirms this choice a search query of Web services, to satisfy this goal, will be built and sent to a directory.

The search of the Web service to achieve the annotation goal is done by keyword. So the annotation system specifies at the search query, the keyword "translator" which is the name of the desired Web service. The search result of Web service satisfying the annotation goal "translator" is returned as a list of two Web services : Translator-EnFr; Translator-EnAr (see figure 7).

Finally, the annotation system must choose itself the most relevant Web service to the learner. So in that case appears the need to the personal information of the user helping the annotation system to choose the target language of the translation (French or Arabic). The information such as the native language of the annotator seems decisive to choose well. This information can be extracted from the annotation ontology via the class "annotator / Native language". So if the native language of user is French, then the Web service 1 (Translator-EnFr) will be selected by our annotation system. Thereafter, during the invocation of the Web service selected in the previous stage, the annotation system must automatically supply the passage to be translated without recourse to the learner. This information can be extracted from the annotation ontology via the class "Annotated content".

SOAP messages exchanged between the annotation system and the provider are displayed in figure 8. One of the messages contains the sent query for the invocation on behalf of the annotation system, while the other one presents the answer of the provider containing the execution of the sent request.

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**Fig. 7.** The search result containing a list of two Web services

**Fig. 8.** SOAP messages exchanged between the annotation system and the provider
5 Conclusion

In this article, we presented a new approach which considers the learner’s annotative activity as a potential source of Web service invocation. We began with a study of conceptual models and annotation systems on the Web. We have seen how these existing models suffer from an under exploitation of annotation’s semantic. To overcome this problem, we proposed a new conceptual model for annotation rich in semantic properties allowing to accommodate the new approach of assistance of learner’s annotative activity through Web services. Based on this model, we tried to develop a prototype of an annotation system. We described the architecture and features of the new proposed tool. Finally, we presented a running example of the use of this new annotation system by the learner in his learning activities.

In future work, we will try to implant our proposed annotation system into E-learning platform called “Moodle” in order to propose an assistance to the learner during his session of reading and annotation of consulted documents. In addition we will try to dive deeper into the semantic of annotation in order to acquire to the latter other dimensions and perspectives helping for example to personalize the already invoked Web services using an annotative profile constructed from the annotative habits of the learner.

References

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