OATS: The Open Annotation and Tagging System

Scott Bateman[1], Rosta Farzan[2], Peter Brusilovsky[3], Gord McCalla[1]
[1]*Advanced Research in Intelligent Educational Systems Lab (ARIES Lab)*
Department of Computer Science, University of Saskatchewan,
Saskatoon, Saskatchewan, Canada
scott.bateman@usask.ca, mccalla@cs.usask.ca

[2]*Intelligent Systems Program and* [3]*School of Information Sciences*
University of Pittsburgh, Pittsburgh, Pennsylvania, USA
rosta@cs.pitt.edu, peterb@pitt.edu

Abstract

This paper presents the Open Annotation and Tagging System (OATS) which draws on previous work in social navigation support, web annotations systems, collaborative tagging and educational metadata. The OATS system augments the text highlighting metaphor by providing a "collaborative tagging" and annotation interface which enables social navigation support. These tools aim to help learners in learning managements systems to better organize and navigate content. While there are many examples of web annotation systems, none provide a combination of annotations, tagging, and value-added functionality, which are decoupled from the system in which they are used, through a web service interface. This proof-of-concept system identifies a relatively simple method for developing value-added functionality that can be more easily incorporated in a wide range of systems used in e-learning.

1. Introduction

This paper presents the Open Annotation and Tagging System (OATS) and draws on the work started with AnnotatEd at the University of Pittsburgh. AnnotatEd allows students to highlight text in learning objects and describe the learning object with descriptive notes [1]. Like AnnotatEd, OATS aims to solve a problem with the growing breadth of information made available in learning management systems (LMS). OATS is currently a fully functional proof-of-concept system, which extends and augments the highlighting metaphor by providing a "collaborative tagging" interface, among other features. While there are many examples of web annotation systems, none provide this unique combination of annotations, tagging, and value-added functionalities. Further, the functionalities are decoupled from the systems in which they are used, through a web service interface. This provides learning management system independence, and shows a method by which LMS functionalities can be developed independently. To this end the aim is to increase the uptake of research systems developed in online learning, through facilitating the integration process for the systems.

The remainder of this paper is laid out as follows: part two surveys our previous related work in web annotation systems, social navigation support, collaborative tagging and details on the AnnotatEd system; part three introduces OATS and restates its goals, detailing the functionality and architecture of the system; finally part four gives our future plans for a system ready for deployment by late 2006, as well as implications for related research.

2. Related Work

2.1. Web Annotation Systems

The growing number of web annotation tools can be classified in two groups. The annotation systems of the first group focus on developing an advanced architecture and building a more sophisticated but simple-to-use annotation interface to improve web-based annotations. They try to support content-aware annotation on any arbitrary web page. Gibeo [2] is an

example of a well-designed web annotation system. Once the user is registered with their website, in order to annotate any random web page, the user merely needs to add ".gibeo.net" to the URL. When any part of the text on the page is highlighted, a set of options is displayed to allow the user to specify the quality of the highlighted text, with labels such as "important", "wrong", or "cool". The users can also add comments, corrections, links, or shared discussion to any part of the text. Every annotation is shared with all users of the system and clicking on the annotation provides detailed information, such as the annotation author. Marginalia [3] is a Javascript web annotation system that focuses on providing intuitive functionality for any arbitrary web page as well as the Moodle discussion forum. Marginalia allows users to highlight any part of the text and write associated comments in the margin of the pages. Annotations may be marked as public or private.

The annotation tools of the second group use annotations for collaboration over the web. In contrast to the first group which focuses on the best way of collecting user-information, the second group instead aims to improve the sharing of information. The most famous tool in this group is Annotea, which enhances the collaborative development of the Semantic Web via shared web annotations. Annotations are in the form of comments, notes, explanations, or any other type of external remarks attached to any web document or portion of the document. The users are able to access all attached annotations when they open the original document [4]. Another popular tool is a "web discussion" feature in Microsoft Office 2000 that allows collaborative annotation of any web page. [5] studied the application of this annotation tool in the collaborative writing of a large product group at Microsoft and reported quite a variation in the usage of these annotations.

2.2. Social Navigation Support

Classic adaptive navigation support techniques are well-known tools for guiding learners to the appropriate resources [6]. However, since these techniques rely on manual annotation of the content by experts, they are not well suited for the large volume of open corpus documents. Social navigation support (SNS) techniques are based on social navigation theory [7]. Dourish and Chalmers define social navigation in information space as "moving towards cluster of people" or "selecting subjects because others have been examining them." SNS technique makes use of past learners' interactions with the system to guide new users of the system and relies on the *collective knowledge* of a large community of users. The AnnotatEd system – discussed in the next section – provides two types of SNS: traffic-based and annotation-based. *Traffic-based* SNS relies on the traditional footprints concept in social navigation [8]. It generally provides information about the number of visits users have made to each link. Traffic-based SNS promotes links, which have a higher number of visits. For example, Dieberger and Lonnqvist [9] modified the collaborative web known as the CoWeb to visualize traffic-based social navigation. The system tracks how often a page is accessed or modified. It visualizes the density of the aggregated access for the past 24 hours by applying three levels of color intensity to the footprint symbol. *Annotation-based* SNS provides stronger support by employing the annotation activities of the users instead of the number of visitors. These systems promote links to pages annotated by users, especially pages with higher numbers of annotations or positive annotations. For example, Educo [10] provides an annotation tool which allows learners to associate comments with a document. It provides simple annotation-based SNS by keeping track of when comments are modified and visually demarcates new comments.

2.3. AnnotatEd

AnnotatEd (Annotations for Education) provides social navigation and annotation services for browsing collections of linked web educational resources. AnnotatEd was originally implemented to support the Knowledge Sea system [11]. Knowledge Sea is designed to help students navigate from weekly lectures to relevant online educational materials, in a map-based, horizontal navigation format. AnnotatEd enables Knowledge Sea to provide annotation and traffic-based SNS. However, AnnotatEd is independent of Knowledge Sea system and can be used with any linked collection of web resources. AnnotatEd accompanies the learners from page to page by redirecting all the links inside the page through the AnnotatEd server.

AnnotatEd allows students to annotate web pages by placing free-format comments that will be associated with the whole page or by highlighting specific parts of the page. In addition to allowing learners to annotate web pages, AnnotatEd also augments links inside the pages by measuring the past activity of the group in order to offer social navigation support. In addition to indicating group activity, link annotations also indicate individual activity of the user. Each link inside the page is annotated with two different icons shown in Figure 1.

Figure 1. Navigational cues in AnnotatEd

The Traffic icon represents traffic-based SNS. The background color represents the magnitude of visiting activity done by the group of users. A darker color represents a higher number of visits. The human figure represents individual visiting activity. The human icon is presented with different shades of blue and the density of the color represents the magnitude of the individual's visits. The *annotation* icon represents annotation-based SNS. Similar to the *traffic* icon, the background color represents the magnitude of group annotation activity and the color of the sticky note icon represents the magnitude of individual annotation activity.

SNS is not directly supported by OATS, the system presented in this paper, however the data for annotation-based SNS is readily available, and the functionality could be added to the OATS Client library (see section 3.3).

2.4. Collaborative Tagging

Web 2.0 refers to a set of technologies, and more accurately software systems, that have emerged in the last few years. These new Web 2.0 systems provide a set of simple tools for the community of users who make use of them. The users contribute to some aspect of the particular website's content in order to make them useful. The importance of user contributions can range from being essential to being just added value. Among the most popular Web 2.0 or social software systems are: *blogs*, *Wikis*, and *collaborative tagging* sites. [12]

Collaborative tagging makes use of a community's public annotation of resources using keywords that describe those resources (called tags). Each tag is both an annotation to describe the resource and a vote for the annotation being suggested to others. The tagged resources take many different forms depending on the website: del.icio.us[1] tags websites; Flickr[2] tags pictures; YouTube[3] tags videos; and CiteULike[4] tags academic papers.

[1] http://del.icio.us
[2] http://flickr.com
[3] http://youtube.com
[4] http://citeulike.org

Motivation for users tagging is in the service they are accessing. The action of tagging (without considering any outside influence or votes from other taggers), allows for the automatic organization of resources. Further motivation is that since tagging systems are usually web-based systems a user's automatically organized set of resources can be accessed globally. Finally, when taking into account the contributions of other taggers in a given system a user can find: related tags, related resources, and/or related taggers; and a way to become involved and benefit from the community.

Some downfalls of collaborative tagging are the *meta-noise* that can occur due to bad tags being suggested about resources, or tags that don't apply to the context of your searching. (ie. When looking for a picture of an "old glass window", a search for pictures tagged with "windows" could return pictures of different "glass windows" and screen shots of "Microsoft Windows".) Our related and on-going research proposes a solution to this problem, however is outside the scope of this discussion [13]. The work is based on a system of adding rules to the creation of tags based on a dictionary-based ontology. However, it is our opinion, that while these cons of collaborative tagging can be relatively common, they are far outweighed by the benefits of the technique. Further, it is the *openness* of tagging that becomes one of its strengths, as all points of view can be reflected in the metadata that describes the resource and giving a more complete interpretation of the resource – even if different views about the same resource are conflicting.

Collaborative tags have become a powerful tool for creating a type of *social metadata*, and have been principle in exploiting the abilities of the casual web surfer to contribute to the larger web community (a main focus in the Web 2.0 movement). This is not to say that they cannot be beneficial to a much smaller community that may exist in an online class.

2.4.1. Benefits of Collaborative Tagging for E-Learning The first and most obvious benefit to collaborative tagging system for students in a LMS is the ability to organize content and/or learning resources. This organization would be used by students to easily find and revisit materials presented by the LMS. Further, we hypothesize that collaborative tagging harnesses a type of *collective intelligence* [12] that will be of particular use as a cognitive tool for students in an e-learning environment. When tagging resources, the systems suggest a list of tags to use. These suggested tags are based on the most popular tags of other users annotating that resource, or a

similar resource. Within a LMS, this type of collective intelligence will give the student additional perspective about the resources being described. This hypothesis will need to be studied in depth to be validated.

2.4.2. Current Approaches for Collective Intelligence in E-Learning In more "traditional approaches" the ability to harness the collective knowledge in an LMS has been limited as seen in our previous work with iHelp [14]. In iHelp Courses, course content can be associated with on-going discussion forums and chat rooms. This is offered in a lower frame, so that while a student is viewing course content, they can simultaneously enter into asynchronous (discussion forum) or synchronous (chat) discussion, focussed directly on the content they are currently viewing. While, this close coupling of peer and instructor wisdom has proven useful for students and instructor alike, it is still limited in:

1) the type of collaborative information
2) the ability to associate collaborative information with content
3) the method of obtaining collaborative information.

The OATS system addresses these short-comings (as will be shown in section 3.2) by:

1) Extending collaboration possibilities to highlights (more fine-grained), tags (user based semantics), and annotations (supplementary descriptions)
2) Providing an interface for all of its functionality within the content itself
3) Collecting collaborative information for the group implicitly, that is to say using it for a secondary purpose.

3. The OATS System

The OATS system provides a set of tools inspired by related systems that have emerged from work in web annotations, social navigation, web service architectures, and e-learning. So, while much of the individual functionalities are not unique, the complete package is unique, and is an extension of the work that has been started at the AnnotatEd system.

In this first implementation OATS is limited to annotations on text. As most of our learning objects are text-based HTML pages.

The first goal of OATS is studying the benefits and problems associated with social and collective intelligence tools for students and instructors in a LMS (covered in sections 3.1 and 3.2). More concretely it is to provide tools to effectively organize and navigate learning content. In doing so, the learners make available information to benefit their classmates by adding to their perspective to that of the group. While this is yet to be evaluated we belief the existing system contributes by showing a novel interface and approach to integrating several Web 2.0 technologies into a single working system.

The second goal is to provide a proof-of-concept, of how to decouple value-added services from a LMS, while providing all the functionality of a tightly integrated solution (covered in section 3.3). This is an important focus, as the achievements in the field of intelligent and adaptive e-learning systems have been significant, they have yet to become main stream. This is because the applications created in research often focus solely on a limited set of features to benefit users. Thus, the cost of integration of a "closed" research systems is too high. Methods at decoupling functionalities and content seek to overcome this hurdle.

3.1. The OATS Interface: Making Annotations and Tags

3.1.1. Accessing Functionality When integrated into HTML-based content, OATS is ready to start creating annotations. To create an annotation in OATS the user simply starts by highlighting any piece of text in the content, by performing a click-and-drag. This will highlight the text, essentially changing the background color of the text in the document object model (DOM) of the learning object. Whenever, the user returns to that particular page, the highlighted text she has previously made will re-appear for her, as shown in Figure 2.

Figure 2. Shows OATS displaying highlights within iHelp

OATS provides two methods for accessing functionality. The first method is through, a drop down menu which positions itself in the top left hand corner of the learning object. This drop down menu provides access to toggling on and off the user's and group highlights, searching for any annotations in the

system, and for accessing automatic organization of tags; all of which will be described in detail in section 3.2. Figure 3 shows the expanded menu which appears when the user mouses over the unexpanded menu.

Figure 3. Shows OATS menu expanded

The second method for accessing functionality is by clicking on an existing piece of highlighted text. This provides searching and categorization, as well as the ability to add notes and tags, and to delete the entire highlight itself (see Figure 4). Deleting the highlight will also remove any associated tags or annotations automatically.

The entire interface is based on a simulated popup, which is styled to look like a sticky note. A simulated popup is implemented instead of an actual popup to avoid issues with popup blockers, which are now integrated into modern browsers to block unwanted advertisements and sites from appearing. Instead the highlight system writes the popup to the page in a hidden iFrame, which positions itself and becomes visible on appropriate events, such as clicking on a highlight.

The rest of this section will discuss the actual process of adding and maintaining tags and annotations, while sections 3.2 will discuss why learners will tag and annotate and what benefits they will receive.

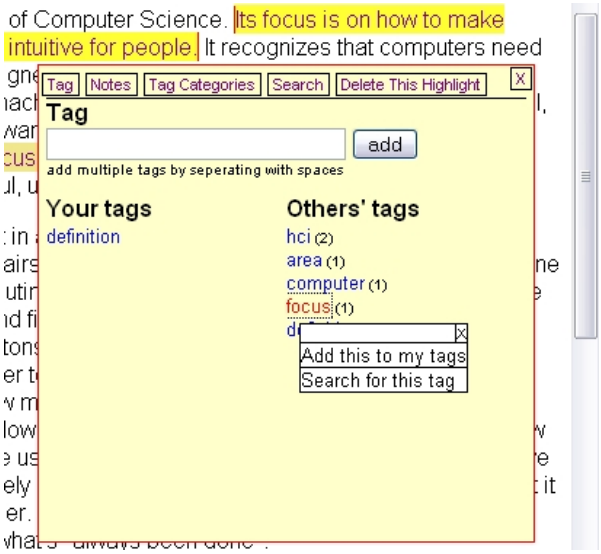

Figure 4. The OATS popup from clicking a highlighted piece of content and for tagging

3.1.2. Tagging Tags in the OATS application, as is the common practice with most tagging systems, is a free piece of text which contains no spaces. To add tags the user first must click on a piece of text she has already highlighted. This provides her with a popup, which has been contextualized to the highlight that has been clicked. By clicking the "Tag" button on the popup menu bar, she will see an interface which allows her to add tags, view currently added tags, delete tags, view tags other people have added, and to add tags of others she may like. Finally, the user may add many tags by listing them in the text box and separating them by spaces. When a tag is added, it appears under the user's "My Tags" area. While tags added by any classmates appears under "Others' Tags."

3.1.3. Annotating Annotating for the purpose of this paper refers strictly to adding longer free text notes. When compared to tags, notes have absolutely no rules, and are used for the purpose of adding normally structured sentence-based messages.

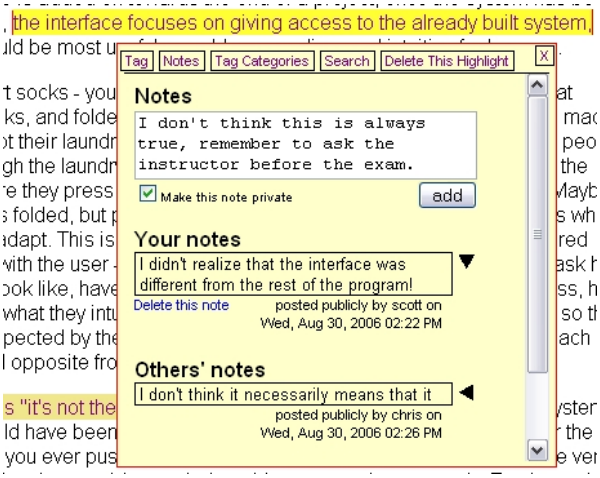

Figure 5. Adding notes for a given highlighted piece of text

To add a note the user first must access a highlight-contextualized menu by clicking on an existing highlight. Then by clicking on the "Note" button on the menu bar she receives an interface for maintaining and viewing notes associated with the current highlight. To add a note she simply types a message in the text area. She has the added capability of making notes "public" (globally viewable) or "private" (viewable only by her); the default is global which she can be changed by checking the "Private" checkbox. When her note has been added it will appear under "My Notes." Any notes added by other users about this highlight will appear under the "Community Notes". All notes contain information on when and who added

the note (see Figure 5). A user can delete her own notes by clicking the "Delete note" link which is located under each of her own notes.

3.2. The OATS Interface: Value-Added Services

3.2.1. Motivating Participation Value-added services refers to the set of functionalities which are provided through a user's action of adding tags and notes. Further, it entails the added benefit in terms of additional support and perspective learner's can receive when the overall community of user's influence is made available.

OATS was designed with the goal of providing enough motivation for users to highlight, tag and annotate text without the added benefit of community support. While, we think the community support is an important selling point of the system, the functionality on the individual level must sell itself. This is because of the issue of the "cold-start", where first users to highlight in the system will not have any benefit of the information provided by others in the community. It should be noted also that the community benefits are therefore considered to be provided through implicitly gathered information, as the community based information is a consequence of users acting primarily for individual purposes.

The two different types of value-added services will be explained together – whether community or individually based – in the remainder of this section, as they are tightly coupled in the OATS interface.

3.2.1. Tag Categories Tag categories, in the individual sense, is an interface to automatically categorize information based on a user's tags. In the community sense it is a way to gain a "global view" of the tagging of the entire community a form of collective intelligence. This functionality can be accessed either through the drop down menu, or from a highlight-contextualized popup by clicking the "tag categories" button.

Information provided by the individual user is located under "My Tags" in the interface. By clicking on "My Tags" a list of all the tags the user has used is revealed, which are ordered from the most to least frequently used tag. By clicking on each individual tag a list of three options pertaining to the tag are presented: "Search for *this tag*", which links the user to the search interface; "View pages you've tagged with *this tag*", which shows all pages that contains highlights which have been described with the given tag; and "View highlights you've tagged with *this tag*", which presents the highlighted text that has been described with the given tag. An example of these functionalities is shown in Figure 6. Links are provided to the pages so that the highlights can be seen in context.

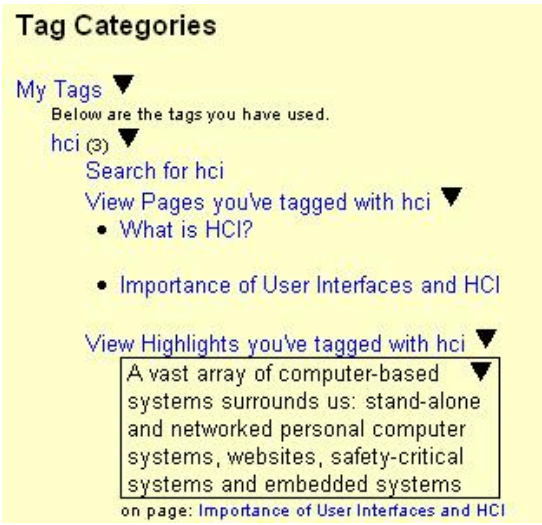

Figure 6. Viewing "My Tags" in Tag Categories interface.

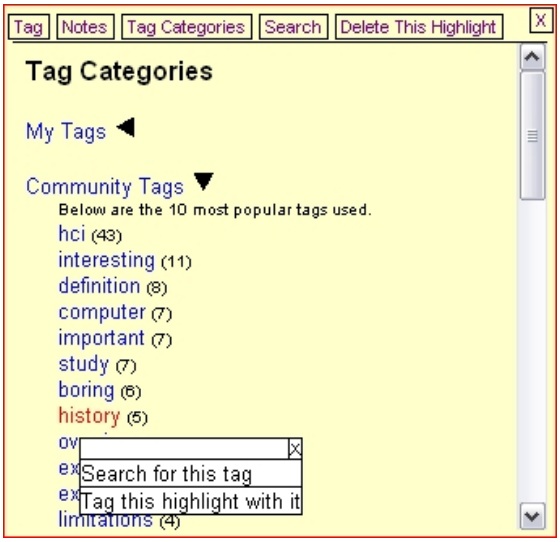

Figure 7. Viewing "Community Tags" in Tag Categories interface.

The community aspect of the Tag Categories is shown in Figure 7. By expanding the "Community Tags" section, the most popular tags are shown in descending order of number of times used. This gives the user an idea, at a much higher level, the overall view of all the content. The user can get sense of what are the most important terms and/or ideas at a course level. By clicking on one of the tags the user can

select to add the tag to the highlight in context, or to search by the given tag.

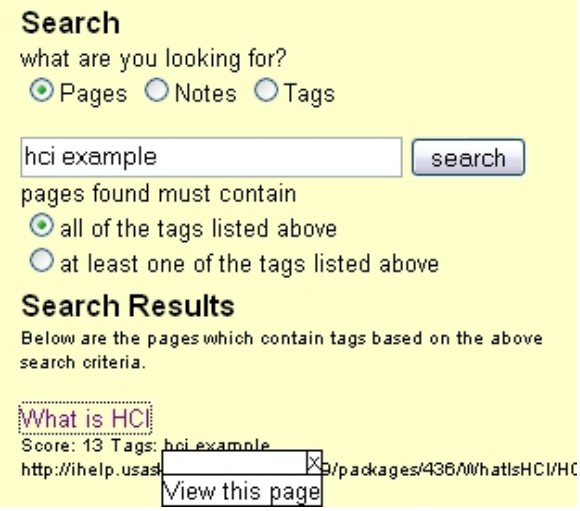

Figure 8. Search for pages by tag.

Figure 9. Search for notes containing text.

3.2.2. Search The searching for tags, notes and pages is an important aspect of the system. Along with the "Tag Categories", the searching functionality will potentially provide the user with enough motivation to contribute to use the system. While most of the search functionality has already been provided in the search interface there is some further functionality that will be added to the interface. For this proof-of-concept the existing functionality is suffice to show the possibilities. Figure 8, shows searching for a page by tags used in highlights of the page. The results are returned ordered by "score". The score simply counts all occurrences of the tag in any user's highlights on the given page. The page with the highest count of tag occurrences in presented first.

Searching for notes, provides the actual notes that match the search criteria as shown in figure 9. This allows the user to quickly find relevant user augmented information, and to which page it pertains.

Finally, an interesting search feature which has been included is to search for tags, shown in figure 10. This allows users to survey important tags that are often associated with the search tags. We feel this is a good example of a cognitive tool that is well-suited for new learners to the system and to a given field of study. Our anecdotal observation is that it is often difficult to know and recall the associated new lingo of a new field of study. We feel that this type of functionality will give users a good method for finding relevant and related terms.

Figure 10. Search for related tags.

3.2.3. Community Highlights Borrowing from the SNS used in AnnotatEd, using the community influence on a given HTML page, we are able to visualize for the user the concentration of community highlights. This relates to SNS, but differs from it in that it provides support for further annotations rather than for navigation, we therefore call it *social annotation support*.

By clicking the "show community highlights" button in the drop-down menu, the visualization is enabled. The visualization works by calculating the overlap of highlights in the text, by users other than the current user. We currently have set four levels set that shows the concentration of highlights: none (0

highlights), low (1-3 highlights), medium (4-8 highlights), or high (9 or more highlights). These translate into different shading of highlights within the text, shown in Figure 11. For instance, in the case of no support the text remains unchanged, for low to high the visualization moves between light and darker shades of red, where light is the lowest and dark is the highest concentration of highlighting. While this particular functionality relies exclusively on other users having contributed by highlighting text on the particular page. Although, having no contributions could possibly give the user some useful information. Such social information could relate to the social view of the importance of the content or if the user is ahead of other students in the content.

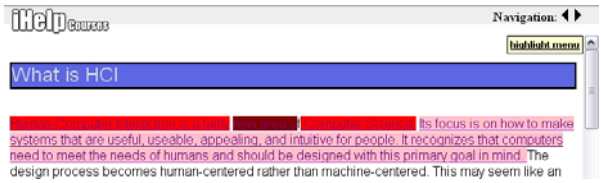

Figure 11. Community support of highlighted text shown in iHelp.

Some research needs to go into exactly what is the best way to calculate these different levels of community support. We hypothesize that user's will find any reasonable algorithm useful, then the case without any visualization. However, it may be that some ratio of highlighted text on the page, to discourage what users would see as an empty system. For instance, in the case of a "fresh" system or in a class with a smaller user base the first users would see no contributions from others, and the concentration of highlights would fill up very slowly. With such a ratio-based visualization, the system would seem to fill up with annotations more quickly.

The concentration of highlights on the page, indicate the community's support of the particular text being important on the page. On tagging sites, like del.icio.us, using a tag is a vote for it being recommended to others for the particular resource. This has been extended in OATS to a part of the content in the page, where the user can simply see that the darker a piece of text becomes on the page the more important it is in comparison to the rest of the surrounding lighter text. To get more refined information on a particular part of the text, the user need only add there own highlight to access the community's tags and annotations.

3.3 OATS System Architecture

One of the main goals of the OATS is to give a complete set of value-added tools that can be used in systems both at the University of Pittsburgh and the University of Saskatchewan, independent of the LMS in which they are deployed. This is closely related to some past work on system architectures that is aiming to decouple different components from adaptive e-learning environments as seen in [15]. The Adapt2 protocol mainly focuses on the decoupling intelligent content (that is content that creates and makes use of its own sophisticated user model, such as interactive simulation or activity), user modeling and the learning management system. The OATS system is the first successful attempt that we know of which seeks to decouple value-added functionality from the LMS or learning portal.

To achieve the decoupling of functionality from the LMS, the system was divided into two parts. The first part is the OATS Webservice implemented as a Java servlet. The webservice manages and maintains all of the logic and stores information on the users and their tags and annotations. The second part is the OATS Client which is written in Javascript. It is responsible for the user interface and delivering information between the user and the OATS Webservice.

3.3.1. OATS Webservice The OATS webservice interface is a Java servlet, using a MySQL database and is implemented as RESTful webservice.

Representational State Transfer (REST), refers to a design pattern for distributed hypermedia systems. A full discussion of REST is outside the scope of this paper, instead we refer the reader to Roy Fielding's thesis [16]. While, we do not argue for REST style web system interfaces for all systems, it dictates a style of accessing web based resources, without the communication layer needed with webservice protocols like SOAP. This is achieved by using a naming pattern for resources and existing request methods provided by HTTP. We feel because of the reduction in messaging overhead it may be particularly well suited for decoupling functionality in systems such as a LMS, where a number of different client libraries may need to be integrated each corresponding to different functionalities.

While, our RESTful interface has not yet fully been implemented a series of server-side rewrites are all that are needed for the URL scheme to become fully RESTful. For example, consider the following scenario: a "GET" request to the OATS Webservice URL http://oatsserver.org/tags/user/johndoe would return an XML document containing all the tags that the user with username "johndoe" has used. While adding a tag would require a "POST" request to the

same URL with message body "url=http://lmsserver.com/lesson1/aboutHCI.html&tag=hci". In this case the user with username "johndoe" has tagged the page at "http://lmsserver.com/lesson1/aboutHCI.html" with the tag "hci".

3.3.2. OATS Client The OATS Client is a Javascript library which is included in an HTML learning object. The inclusion of the client library can be done in several ways, either by manually including it using an HTML "script" tag, or by having the LMS write the Javascript files to the learning object's DOM. Once included the client library writes the OATS interface to the DOM of the learning object, and communicates with the OATS Webservice to obtain any annotations to be initially displayed on the page for the present user.

The client communicates with the service through Asynchronous Javascript and XML (AJAX). This coupled with the manipulation of the DOM to display highlights and the interface allows OATS to be integrated without disturbing other unrelated functionality and to work "out of the box".

It should be noted that one significant limitation of such a system is the security requirements of the browser to access the XML over HTTP request object used by AJAX in modern browsers. To avoid the security problems associated with cross-site scripting, the AJAX library requires that the Javascript source and the URL for which to make communication requests be located on the same server and port as the web page which makes use of them. With regards to the Javascript source, we don't view this as an issue because the text-based Javascript libraries are small enough not to cause any conflicts or problems, and should be easily hosted on the same server as any web-based LMS. However, the requirement for the OATS Webservice (which requires a servlet enabled webserver and a MySQL server) to be located on the same server as the LMS is too great for the claim that OATS is truly decoupled. We provide a simple solution to this problem which is to provide a proxy on the LMS server that simply forwards communications directed from the client to the webservice and back, as suggested in [17]. A simple "stand-alone" proxy will most likely be the next step, to allow for the integration of OATS into Knowledge Sea and to interface with AnnotatEd, as they are not implemented in Java.

3.3.3. Integrating OATS In Practice Based on this *open architecture* of OATS we were able to integrate it into iHelp in literally minutes, by including a single web application resource (WAR) file on the server. It uses an external database which is completely independent of any knowledge of iHelp. We included the Javascript source files in some course content and uploaded a content package to iHelp. The system was available immediately, with the only conflicts being some minor style sheet issues, which were easily resolved.

The only further possible requirement for integration is the availability of a unique user id. A user id needed by OATS from the client LMS to distinguish between each user. By default OATS looks for a "userid" parameter in the URL of the page in which it is integrated or in a parent frame. However, this can be easily changed to allow for a user id in any element of any related document or window of the LMS.

It should also be noted that OATS can be used independently of any LMS, and thus be used as a more general purpose web annotation system outside the domain of e-learning.

4. Future Work

Based on our current assessment of OATS we are targeting a deployment at both the University of Pittsburgh (as a replacement for the annotation functionalities in AnnotatEd), and at the University of Saskatchewan to be used in iHelp; to be done in the last few months of 2006. At this time the system architecture will be re-evaluated, along with the initial evaluation of the benefits of the system to e-learners. Further, the hypothesis based on the benefits of providing learners access to the so-called "collective intelligence" will be studied.

4.1. Relationship to Metadata

Adequate metadata remains a significant road-block in much of the current educational technology research endeavours, such as the dynamic assembly of a course using existing learning objects. This dynamic assembly would allow for personalised course content for individual learners. While some of our ongoing work at University of Saskatchewan [18,19] looks at the generation of this metadata as an automatic process through techniques such as data-mining, it still has a way to go before realization. We also see that complementary human generated metadata or annotations as an important resource: directly (human-created metadata used in an un-altered state for some pedagogical purposes) and indirectly (human-metadata used as a resource in a reasoning process for some pedagogical purposes).

5. Conclusions

This paper has presented a joint project at the University of Pittsburgh and the University of Saskatchewan, started over the summer of 2006, which has resulted in the Open Annotation and Tagging System. We have a provided a proof-of-concept for a unique combination of social software which aims to benefit learners in LMS. Further, we have identified how these value-added functionalities can be decoupled from learning management systems, thus providing functionalities which are more readably available, when compared to more traditional approaches.

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