A Hybrid Approach to Improve Student Navigation of Learning Materials in a Web 2.0 Environment

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Abstract. Tag-based folksonomy is commonly used in Web 2.0 technology but it lacks relationships among tags. We consider this weakness and propose to make use of the hierarchy concept from taxonomy to make-up the flat-level tag cloud diagram. A software tool is developed to quickly map individual tags to hierarchical concepts through word matching, and subsequently establishes relationship between folksonomy and taxonomy. Students will find it easier to locate and discover learning materials by relating tags to concepts and vice versa. Through this work, the tag quality is improved, leading to a better understanding on tagging.

Keywords: Tag, folksonomy, taxonomy, Web 2.0, hybrid learning.

1 Introduction

Although web-based online courses prevail in higher education, they are usually used as a supporting tool to traditional class-based instruction. This combination of on-site teaching and technology-assisted learning, often named as hybrid learning [10], is becoming popular and is helping instructors to communicate with students more efficiently and effectively.

Following recent web development, web-based education is changing focus to Web 2.0. Collaborative tagging has emerged as an important component in the quickly developing social networking field. As part of the new discipline, there are many research interest shown in the tagging area [1, 2, 5, 6, 7, 8, 11]. The main objective of tagging is to facilitate content discovery on web by enhancing content storage (Internet write) and the later content retrieval (Internet read). This read-write web, as differed from the mostly read-only web, is the main distinction between the Web 2.0 and the classical web. We discuss in this paper the use of Web 2.0 to enhance student learning experience as well as to improve the success of hybrid learning. The paper also presents a software tool developed to relate tags and hierarchy concepts. It merges taxonomy with folksonomy to obtain a better understanding of tagging.

In the rest of this paper, Section 2 describes a characterization of the key concepts of tags, folksonomy and taxonomy and presents the conceptualized approach. Section

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3 presents the proposed system tool. The evaluation, comparison and discussion are given in Section 4. Finally, a conclusion about this paper is shown in Section 5.

2 Characterization of Folksonomy and Taxonomy

This section describes key concepts on tag, tag cloud, folksonomy and taxonomy. A conceptualization of the proposed approach is explained.

2.1 Tag and Folksonomy

Tags are freely chosen words with no pre-defined categorization. The words that form tags are created in a personal manner. They are used informally, though it can be presumed that these words are meant by users to be precise. Tag may not be narrowly-focused as it can include other thing, and thus would have broad meanings. As tags are chosen freely by users, there should not be a pre-defined classification or categorization of tags. No classification relationships among tags exist in a folksonomy, only with limited grouping.

Tagging allows users to categorize, and organize, and to establish cross-references and inter-relationships, as contents can be separated from each other in physical location or far apart in terms of topic semantics. Grouping tags into categorizations and clusters can reduce the effort for information retrieval. Folksonomy is user generated and cannot be regarded as systematic, reliable and consistent. Due to this user-centric characteristic, some tags cannot show their relevancy or relationship to others.

Tag cloud is a pictorial listing of tags. The tag listing is uni-dimensional. These one-level tags are displayed as a flat diagram. The tag listing is either a complete listing of all available tags or a selected one according to information demanded. The tags in the list are usually displayed in a sorted order. The choices of tag sequence include count by number, alphabetical order, and recency by time or others. The ordered listing of tags establishes a positional relationship among tags. There is no further meaning to be embodied in a normal tag cloud, other than the linear ordering and the count reflected in font sizes.

With wide spread uses of tags in the user-centric social networking environment, many tags have been created by users. The volume of these tags increases dramatically over time and accumulate to a point that the scale badly requires effective organization, if meaningful tag retrieval is to be obtained. Subsequently, nowadays large-scale folksonomy poses a complex scale problem and creates a need for effective organization. As hierarchy is a central part of organization and classification is a common approach to group commonalities, there exists a possibility for supplementing the flat tag cloud with a hierarchical structure, thus linking taxonomy with folksonomy.

2.2 Concept and Taxonomy

Taxonomy is a practice of pre-defined categorization. Many things can be classified according to some taxonomic categories.

Taxonomy has long been commonly used to categorize objects such as websites, books in order to help user navigation and search. Concepts constitute the main component of taxonomy. Taxonomy appears in a form of hierarchical structure. It displays a parent-child relationship that include either a general-specific, major-minor or management-work relationship. The arrangement of levels is usually in a vertical hierarchy.

Quality taxonomy requires expertise in the classification field. The apparently ad hoc methodology of folksonomic tagging could be unreliable and inconsistent. Noise may be introduced and results in difficult user navigation by tags. On the other hand, users can gain more freedoms to organize contents with folksonomy, because the nature of tag cloud includes no pre-defined classifications. In contrast to taxonomy with a set of controlled vocabularies which are usually derived by professionals, folksonomy reduces the effort in content categorization. Folksonomy plays an important role in visualizing tag groups. This paper proposes a hybrid approach that combines the advantages and disadvantages of each of these two approaches for improving user navigation.

2.3 Conceptualization and Approach

While many have made contrasts, few have explicitly combined taxonomy with folksonomy, apparently due to the differences mentioned above. There have been limited attempts to combine tagging with eLearning, such as in [12]. There are works on the use of tags to navigate systems, like Tribler [7]. Tags used in shopping sites, such as Yahoo! Shopping, are based on controlled vocabulary. There are also works on grouping tags to enhance tagging services [11], as well as incorporating tag hierarchies, such as in RawSugar. These tag hierarchies are used to enhance exploration and search and solve the problem of being too specific in search. Guber and Huberman [2] have made an in-depth analysis of taxonomy and folksonomy. They compare the advantages and disadvantages based on the characteristics of abstracted hierarchical levels and non-exclusive (or do not exclude related items), as shown in Table 1.

We make use of the taxonomy properties to replenish the weaknesses of folksonomy, that is, cannot describe hierarchical structure of concepts. As tag and concept are far apart and there are no pre-established relationships between tag and concept, we propose to relate tags and concepts by using the mechanism of word matching, as illustrated in Figure 1. The freely chosen tags are supplemented with concept semantics and classification knowledge by finding commonalities in the wordings. Subsequently, one-level tag cloud is enriched with the hierarchical level of concepts.

Table 1. Comparison between folksonomy and taxonomy.

	Advantages	Disadvantages
Folksonomy	Non-exclusive	Non- hierarchical
Taxonomy	Hierarchical	Exclusive

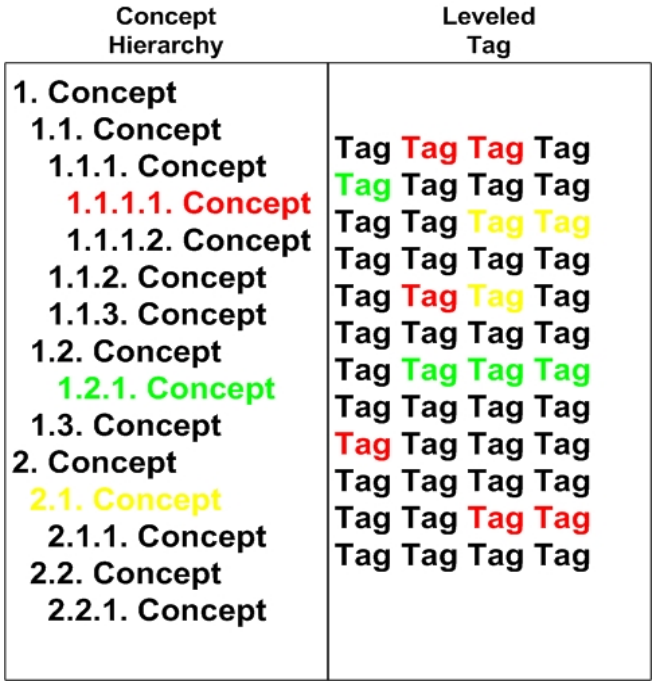

Fig. 1. Concept and tag relations diagram.

We suggest the use of tagging as a first step in the process, to be appended with classification afterwards. Therefore, the inclusion of taxonomy is aimed to supplement folksonomy with concept and hierarchy stored in existing taxonomy. It is not meant to replace folksonomy. Our approach is different from other tag cloud improvement, such as in [5] which uses clustering algorithm to select tags. A conceptualization of our proposal is shown in Figure 2.

3 Software Tool

This section describes the system, in terms of defining the system requirement and design, and implementation into a course.

3.1 System Requirement

The system aims to provide a tool to relate tags and concepts in a hierarchical structure for learning materials. The main features of the system include tagging, relating concept, tag and concept summary and additional tags generation. They are described below :

- Tagging to support adding, viewing, storing and retrieving of tags
- Relating concept to support adding and editing relations between tags and concepts
- Tag and concept summary to support retrieving and displaying related tags and concepts
- Additional tags generation to proceed automated tag creations

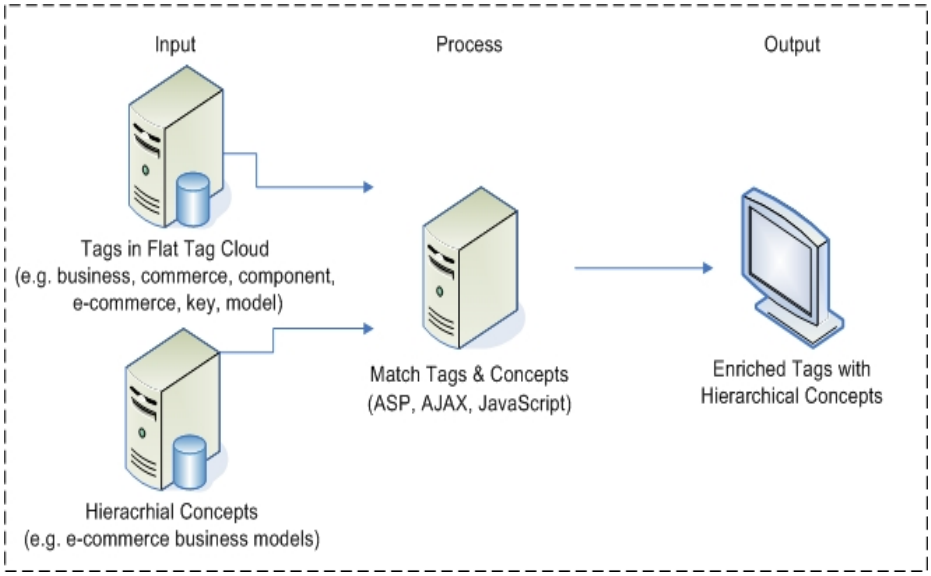

Fig. 2. Conceptualization.

As fast response time is one of the requirements for the system tool, the system is implemented with an advanced web development technique to create a responsive and interactive web application. The AJAX technology, which stands for Asynchronous JavaScript and XML, is used in the matching process between tags and concepts. It increases response time in information retrieval because AJAX adopts a more efficient method that requests lesser amount of XML data and updates web page without reloading everything to transfer data. The use of AJAX has significantly improved the page loading speed.

3.2 System Design

Figure 3 shows a visual representation of the summary of tags and concepts, and their interrelationships through matching of tags and concepts.

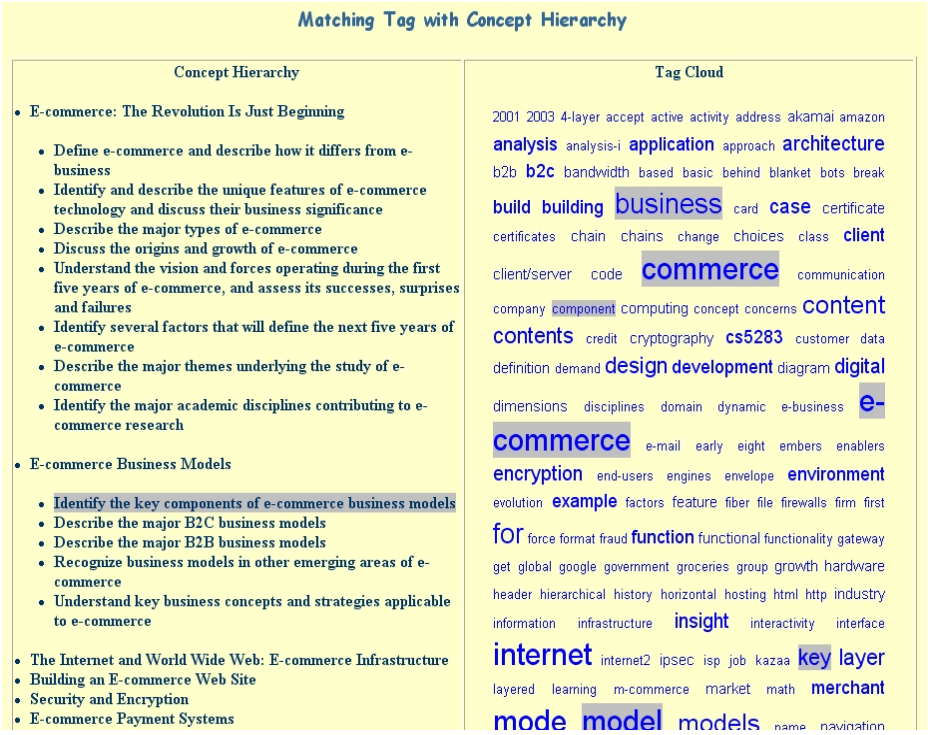

Fig. 3. Screen of matching tag with concept hierarchy.

There are two parts in the screen, namely Concept Hierarchy and Tag Cloud. The concepts and tags are shown on the left and right hand side of the screen respectively. These concepts are similar to indexes or table of contents in books that lists out keywords with levels. The source of concepts is mainly from user input so the concepts about learning materials can be captured or uploaded from users. Afterwards, the concepts are stored in the system. They will be built in a hierarchical structure and displayed in different indentations to clearly represent hierarchical levels. The tags are displayed in the form of tag cloud, which is a list of tags with various font sizes. The tag cloud comprises tags where font size reflects the popularity (the number of slides associated to each tag that assigned by users and system generated) of tags. The source of tag is from both user-added tags and system-generated tags from content of slides. Tag cloud is generated dynamically according to the tags being stored in the database.

The system effectively integrates the tags and concepts together. Users can select either a tag (or concept) to find out related concepts (or tags). When the tag (or concept) is clicked, the related concepts (or tags) will become blinking in the screen.

In Figure 3, one of the concepts “Identify the key components of e-commerce business models” is selected and all the related tags “business”, ”commerce”, “component”, “e-commerce”, “key”, “model” become blinking. Users can use left button of the mouse to click on concepts or tags to find out the related tags or concepts. They can also use mouse right click on selected tags to view all slide of selected tags in another screen.

3.3 Course Implementation

The implementation is applied into a course in E-Commerce Technology, based on the Web 2.0 concept, which includes the newer technology of collaborative tagging. The system allows users to contribute and share idea by adding tags to the lecture slides. In the system, tags are regarded as pieces of information related to lecture slides. Students are enabled with functions to assign tags to slides. The system can also generate tags from slides automatically. Each slide is associated with tags. These tags are also related to others slides so that cross-references to other slides are possible via tags. Students can easily find out the related slides by using tags. In addition, the system maintains some hierarchical structure of concepts. It supports functions to match the words of concepts and tags so that it relates concepts and tags. A summary of concepts and tags are displayed on screen. When the concepts and tags are related, the system executes an AJAX functions to match words and display their relationships.

4 Evaluation and Discussion

The use of tags with hierarchy concepts has been presented in previous sections. The software tool helps students to navigate and discover learning materials by creating relations between tags and hierarchy concepts. There are three possibilities on the existence of tags and concepts in the system implementation :

- Both tags and concepts exist in the system
- Tags exist but no related concepts are found
- Concepts exist but no related tags are found

When tags and concepts are found, their connection is obvious and users can see the hierarchical structure of tags. Meanings for some tags may not be further enriched if there is no concept related to a tag. Subsequently, users may consider to reviewing or removing the tag so that tag quality is improved in the tag cloud. If there is no tag with a corresponding concept, it may be necessary to add additional tags about this concept, which can be done by users manually or with an automated tag generator.

Compared to Golder and Huberman analysis [2], the paper does not resolve all the problems beset in folksonomy and taxonomy, particularly in semantic relations between words that include tags and concepts. The three properties of polysemous (multiple meanings), synonymy (same meaning) and basic level variation (different abstractions), reflected in the possibilities mentioned above, are currently remedies

with manual processing. The issue of semantic for individual tag as well as tag collection requires further understanding. Like RawSugar, our system enhances student search and exploration with tag-related concept hierarchy.

There are four advantages to the proposed approach. Firstly, the software tool improves user navigation experience because users can choose a tag to find out learning materials and they can also browse learning materials by hierarchy concepts. Secondly, it improves existing tags quality with reference to the highly structured and closely related concept hierarchy. Users can review existing tags and compare with the relations of tags and concepts. Thirdly, it helps users to clean irrelevant tags. This is done by matching concepts and words to expose the relevancy of tags. And it is shown after the combination of tags and concepts by the software tool. Lastly, it gives more ideas for users to generate additional tags from concepts. The second and third points together improve the quality of tags.

5 Conclusion

We have presented a web-based tagging system that adopts a hybrid approach for students to navigate learning materials. Students take class teachings at school and obtain reinforcement learning with the software tool to establish further relationships among concepts through tags. The developed software tool makes it faster in mapping tags and learning concepts. The system combines Web 2.0 tagging with a pre-defined hierarchical structure of concepts. The enrichment of tags in folksonomy with hierarchical concepts from taxonomy allows students to organize ideas and creates multi-level structure, in addition to the one-dimensional listing of tags. By organizing tags into multiple hierarchical levels, it gives an improved view of tags that contributes to better visualization of learning materials. User navigation experience is improved due to the additional hierarchical structure as well as the more refined tag classifications. An E-learning example, with lecture slides, tags added to slides, tag cloud, and a table of contents to represent concepts and organization of concepts, has been used to illustrate these ideas. In sum, the hybrid approach gives an improved flexibility of the learning process, resulting into a new learning management tool.

We have discussed the tagging topic, which is gaining popularity and public concerns. There are three potential contributions to the tagging field from this paper. Firstly, the proposed hybrid solution may have a wide applicability to different applications. Secondly, this would build a better understanding to tagging theoretically as the one-level tag has multi-level characteristic in mapping to hierarchical groups. Thirdly, this would solve practical problem toward a better navigation of learning materials. Future works include devising a detailed measurement and evaluation method to validate the learning outcome with empirical results, and exploring improved mechanisms for matching words [7, 8].

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