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Use of Folksonomies in the Creation of Learning Experiences for Television

Marta Rey-López, Rebeca P. Díaz-Redondo, Ana Fernández-Vilas, and José J. Pazos-Arias

The use of digital television as a way of delivering distance courses may be a solution to the problem of how to bring education to the less privileged classes. In previous articles we presented our solution to the creation of learning experiences for this medium, based on an appropriate combination of television programmes and educational elements via the use of ontologies. In this article we aim to improve the algorithms responsible for establishing relationships between the two types of content, by exporting collaborative tagging systems, successfully used on the Internet, to the field of digital television, and using folksonomy-based reasoning to detect the above mentioned relationships.

Keywords: Collaborative Tagging, Folksonomies, T-Learning, Web 2.0.

1 Introduction

In recent years distance learning has gained a high degree of acceptance, especially in terms of continuous training courses. As examples we have the proliferation of distance postgraduate courses, continuous semi-face-to-face or virtual courses, and even the widespread use of online learning platforms as a support to face-to-face learning, which all of which techniques are becoming increasingly more common in Spanish universities.

This trend is mainly driven by the pace of modern life, which makes it hard to find enough time to attend face-to-face courses. Although distance learning has made use of various media since its inception (such as the mail, radio, and television), the preferred gateway used today is a computer connected to the Internet; what is known as e-Learning[1]. However, Internet penetration is still relatively low; 50% in the European Union and 70% in the USA[2], and much lower in underprivileged areas. The gap between those with access to information technologies and those without has become known as the digital divide and has prompted

[1] Although this term encompasses any type of distance learning which is transmitted by technological means, it is generally used to refer to learning delivered over the Web, and so it would be more correct to use the term *Web-Based Learning*.

[2] Source: <http://www.internetworldstats.com>.

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governments to look for alternative ways to access distance learning and thus promote social inclusion (a good example of this are the efforts being made by the Brazilian government [1]).

Television plays a very important role in this scenario, since it enjoys practically universal penetration in developed and developing countries alike. This is why efforts have been made in this direction, in an attempt to take distance learning to sectors of society which otherwise would find it difficult to access this method of learning [2] [3] [4] [5]. But efforts are also being made to create learning experiences via television (T-Learning) that are not specifically oriented towards promoting social inclusion, but rather serve as a complement to formal education [6] [7] [8] [9] [10] [11] or to provide more informal learning [6] [12] [13] [14] [15]. A full picture of the state-of-the-art in the field of T-Learning may be found in [16].

In previous articles we explained our concept of learning experiences in the field of interactive digital television (TVDI) [17] [18], that consist of relating television programmes and educational elements in such a way that the former draw users towards education and increase its appeal and entertainment value, while the latter satisfy the curiosity that may be aroused by television viewers concerning the topics covered in television programmes.

To establish a relationship between the two types of content, we proposed the idea of using ontologies based on metadata accompanying those contents (TV-Anytime [19] in the case of television programmes and ADL SCORM [20] in the case of educational content), as well as a third ontology that we called a "gateway ontology", that described the domain of the topic on which we were working and which allowed us to establish relationships between the other two ontologies. However, this method, besides proving to be very costly in terms of computing capacity, depended on the original content creators providing information about the content; that is, the contents needed to reach the client receiver correctly tagged, which was not always the case. Also, this method only took into consideration the view that the content creators had of the topics in question, probably a very different view to that of television viewers.

With the aim of finding a solution to this problem, in this article we present a new approach to the establishment of relationships between television programmes and educational elements, based on social technologies that are gaining wide acceptance on the Web, Web 2.0 for our purposes, and that aim to facilitate creativity, collaboration and agile exchange of information among users. In the new system, we maintain the use of ontologies for the selection of content but we introduce a new reasoning algorithm for establishing relationships between educational content and television programmes based on reason-based folksonomies.

2 Collaborative Tagging and Folksonomies

Collaborative tagging systems are those which allow users to tag contents and share them in such a way that they can categorize not only content that they themselves have added, but also content added by other users [21]. Sites commonly cited as examples of collaborative tagging are Del.icio.us[3], for the tagging of Web pages, or Flickr[4], for the tagging of photos.

In order to define the structures generated by this type of classification, in 2004 Thomas Vander Wal coined the term folksonomy [22], defining it as "*the user-created bottom-up categorical structure development with an emergent thesaurus*". At the same time he established two different types of folksonomies: broad folksonomies, constructed as a result of tagging contents in systems in which any user may tag all the content in the system (as in Del.icio.us), while narrow folksonomies are the result of tagging systems in which only a small number of users may tag content (for example, Flickr, where only the author of the photos and users designated as friends of the author may assign tags to them).

Folksonomies, whether wide or narrow, are structures that can be represented as an undirected graph in which the nodes are the various tags assigned in the system and the transitions are the relationships between two nodes that are joined. These relationships are assigned a weighting which will depend on the number of times tags describing a content item appear together: the higher the frequency, the higher the weighting [23].

A structure of this type lends itself to be used to establish relationships between elements of the system. In fact, this is the approach that we use in our system, although other related works have already been published. We go on to take a look at some of these works.

The approach presented in [24] combines the use of folksonomies and the semantic Web for recommending films. To do this it uses a folksonomy generated from tags assigned to films in the Internet Movie DataBase[5], together with information about the films provided by the online video club NetFix[6], and creates an ontology from them. To determine whether is suitable for a user, a comparison is made between the tag cloud[7] of a specific user and the tags assigned to the film in question.

The proposal in [25] makes use of users' favourite Web pages (obtained from a collaborative tagging system for Web bookmarks such as Del.icio.us) and their tags to recommend new Web pages. To do this it calculates the affinity between users and Web pages, grouping related tags together and finding out which Web pages are the most appropriate to each group. Next it calculates the affinity of the user with the tags of the groups to determine which Web pages are the most appropriate to him or her.

[3] <http:// del.icio.us>
[4] <http://www.flickr.com>
[5] <http://www.imdb.com>
[6] <http://www.netfix.com>
[7] A user tag cloud is the set of tags belonging to the films that the user has rated, weighted by the rating that the user has assigned to them.

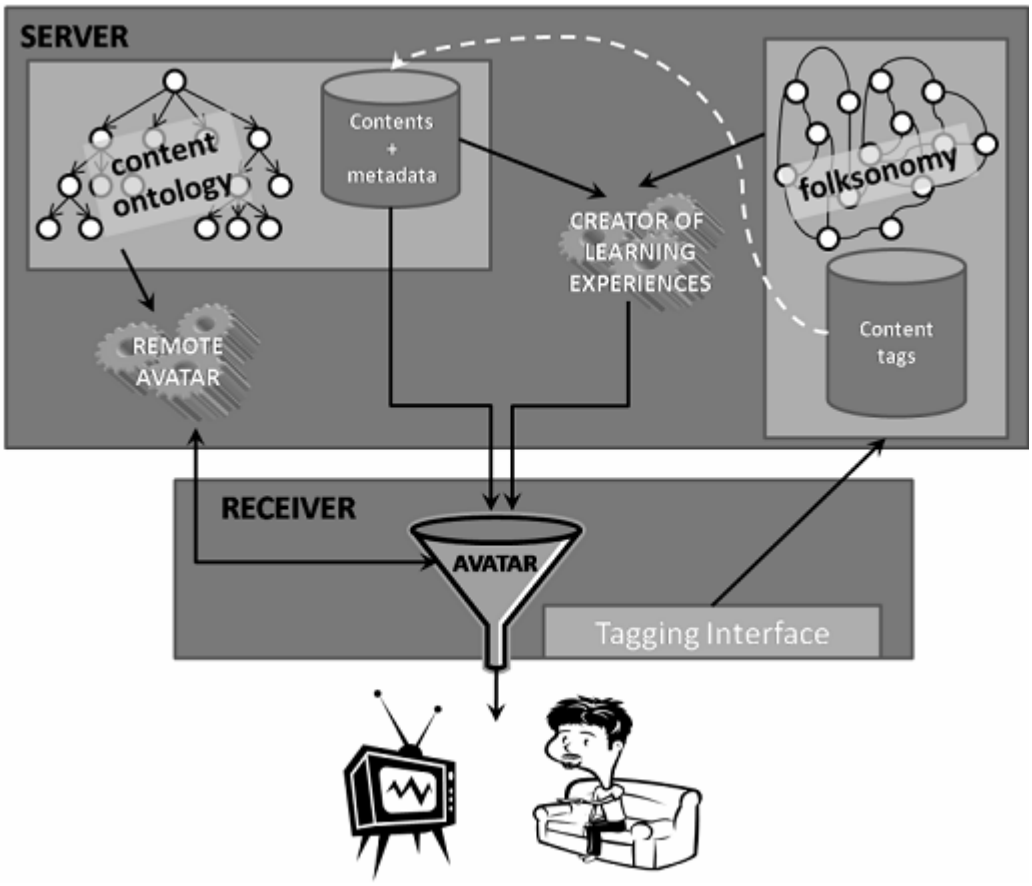

Figure 1: System Architecture.

Folksonomies can also be used to calculate the relevance of content shown in information retrieval systems; for example, the approach set out in [26][27] describes an algorithm known as FolkRank (based on the idea of Google's Page-Rank), whereby a resource tagged as important by important users is considered to be *important*. The principle is applied to both users and tags.

[28] presents another work in which tags are grouped together according to the relationship between one another. In this case, in order to establish similarity between tags, the system takes into account not only the number of times that two tags appear together but also the number of times that the first of the two tags is used together with tags that, in turn, are used together with the second of the two. Finally, these groups are refined by searching for each pair of tags on a number of different semantic search engines to confirm the relationship between them.

3 Content Relationship Using Folksonomies

The idea of our proposal, as we explained at the beginning of this article, is to use data structures generated from collaborative tagging systems to perform reasoning that will allow us to relate educational content to television programmes, with the aim of creating hybrid learning experiences. In our first approach to this task that we present in this article, we will maintain the use of ontologies for the selection of content suitable for the user, using folksonomy-based reasoning solely for combining television programmes and educational elements. The system architecture is shown in Figure 1.

End users receive the television programmes and educational elements by means of metadata that the content creators themselves have added (in accordance with the TV-Anytime standard for television programmes and ADL SCORM for educational elements). The educational content is filtered in the receiver using the semantic reasoning-based TV content recommender AVATAR[8], the workings of which fall outside the scope of this article [29].

Television viewers are able to tag the content that they see, whether television programmes or educational elements, using the collaborative tagging interface shown in Figure 2. This interface was designed to be controlled by using the remote control only. The green button allows the interface to be accessed at any time for tagging the programme the user is seeing or the educational element he or she is study-

[8] As can be seen in the figure, because of the large computing capacity required to perform them, these algorithms are run on the server to which the local content recommender makes requests.

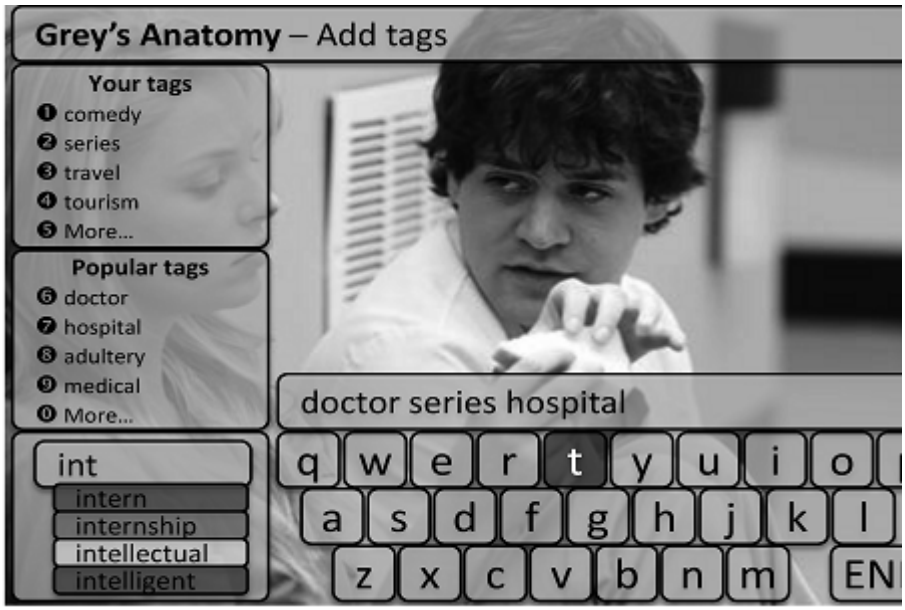

Figure 2: Collaborative tagging interface.

ing. Once in the interface, users are presented with a virtual keyboard where they can write the tags they want to use to describe the content, by using the arrows and the "OK" button. The tags that the user has already assigned to the programme are displayed above this virtual keyboard. Television viewers are also provided with a set of aids to make tagging easier, given the difficulties inherent in performing this process using only the remote control. Users may use popular tags to assign to the content (selected using the number buttons): in top left hand corner the most popular tags that the particular user has assigned to other content are displayed, while below these are the most popular tags that other users have assigned to the programme. The interface is also equipped with a predictive text system that presents users with the most popular words matching what they are writing (bottom left corner), which users can select by using the coloured buttons. Finally, to escape from the interface and return to the programme, the user only has to press the "END" button.

The tags assigned by the users are sent to the server where they are used for two purposes: (i) to store all the tags for all the content items in the system and their weighting and (ii) to create a broad folksonomy with the tags assigned to all the content items in the system based on the above mentioned data.

Once a content is tagged a number of times over the predetermined threshold, the most popular tags are included in the metadata accompanying that content to improve the recommendation made by AVATAR.

The folksonomy created by this collaborative tagging system is a graph in which the nodes correspond to all the tags assigned to the system and the transitions are the relationships between them. The weighting of the relationship between two tags is proportional to the number of times that those tags describe the same content and the weighting of the two tags in that content (i.e., the number of different users that have described the content with the same tag).

Thus this structure allows us to establish relationships between content items for the creation of learning experiences, which takes place on the server side. To do this we use the set of tags that have been assigned to each content item that we wish to relate. In order to calculate the degree of similarity, a calculation is made not only of the number of matching tags between the two contents, weighted according to their weighting in the two programmes, but also of the relationships between the first content tags and the second, also weighted according to the weighting of the tags assigned to the two content items.

Once we have obtained the degree of similarity of the central content with other content in the system, we establish a threshold over which we link additional content with the central content, thereby generating the learning experience, by linking the additional content to the main content by means of mechanisms provided for that purpose by the TV-Anytime standard. These experiences are sent to the receiver, where AVATAR filters the additional content so as to offer the user only content that is appropriate to him or her.

4 Conclusions and Flines of Research

In this article we have explored the basic principles Web 2.0 technologies, focusing on collaborative tagging systems and the structures that they generate: folksonomies. After describing some proposals in which folksonomies are used for content recommendation, we conclude that they are appropriate for establishing relationships between content tagged using this method. Making use of this characteristic,

we have introduced a system that relates educational content and television programmes in order to create personalized learning experiences for the latter medium. As we commented at the beginning of this article, this system does not depend on a prior description of content provided by the content creators, and will therefore work even though the creators no longer exist.

The success of folksonomies, as described in [30], is based on the small amount of effort required from users compared to the benefits they obtain, since the fact that collaborative tagging systems have no structure of their own means that there are scarcely no entry barriers to such systems. Also, as soon as the user tags a programme, he or she can receive immediate feedback on other programmes described with the same tags. These factors are what make us think that such a system could be successfully applied to television, since content tagging will allow users to reach content of interest easily and quickly, in return for the minor effort of tagging other contents that they have seen previously. However, to make access to these systems even easier, it is necessary to provide mechanisms to help television viewers carry out this process; an example of such a mechanism could be the proposed tagging interface presented above.

As we can see from the explanation of the algorithm described above, it can be computationally very costly to calculate the degree of similarity of content to be included with all the other content in the system. For this reason we are working to improve this algorithm so that it is able to make use of the ontologies that define categories of television programmes and the concepts explained in educational elements. In this new version of the algorithm, the tags assigned to a content item will be propagated to the latter's superclasses, as well as to other classes or instances related to it by properties. Thus, when we wish to find television programmes related to an educational content item, first of all we need to establish the degree of similarity of the content item to the classes that define the different programme categories, in order to be able to then focus on the instances of the most related categories, thereby reducing the amount of calculation required to search for related programmes. This technique also allows us to search for new subcategories based on the tags assigned to the instances and to establish relationships between concepts and kinds of television; for example, to conclude that sports programmes are related to the concept of "injury".

Finally, taking advantage of the collaborative nature of this approach, we thought it worthwhile to extend it to relationships, in order to obtain an "establishment of collaborative relationships", whereby feedback of the relationships appropriate to the user would be sent to the server (relationship is considered to be appropriate to the user if the user decides to make use of the corresponding link). Thus the server incorporates this information (the relationship between two specific content items is appropriate to users with certain characteristics) into the recommender, which will take it into account when filtering additional content.

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