Exploiting Social Software to Semantically Enrich Multimedia Content for Online Communities

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Abstract. Today, the emergence of social software technologies transforms the Internet to a medium of mass social interaction and collaboration, also promoting the formation of massive online communities. On the other hand, huge amounts of multimedia content, provided by and shared among individuals and community members, are constantly accumulated in content sharing enablers. This position paper presents research work towards the exploitation of social software applications for understanding, semantically enriching and delivering multimedia content, our ultimate goal being to support online communities.

Keywords: Online Community, Multimedia Content, Social Software, Social Tagging.

1   Introduction

The Internet has long been the aid of various kinds of web-based collaboration and virtual teamwork [1]. Today, the emergence of several technologies such as wikis, blogs and content sharing enablers, transforms the Internet to a medium of mass social interaction and collaboration, also promoting the formation of massive *online communities*. Such technologies are commonly referred to as *social software* technologies, and perceived as a particular type of software that concerns itself with the augmentation of human social and/or collaborative abilities [2]. Especially as regards to content sharing enablers, these are applications that allow users to store, search for and display user-contributed content also referred to as *social content*.

Huge amounts of social content, provided by and shared among individuals and community members, are constantly accumulated in content sharing enablers such as YouTube (see http://ww.youtube.com) and Flickr (see http://ww.flickr.com). The principle characteristic of these technologies is that they enable users to share content they have created themselves. It is a fact that media recording devices and editing tools have become widely popular, allowing for amateurs and home users to produce huge amounts of multimedia content. Furthermore, social software technologies

enable users to annotate the provided content with comments of their own, a practice commonly referred to as *social tagging* (or *social bookmarking*).

Considering the continuously increasing availability and accessibility of multimedia content via social software applications, our research addresses how the user communities can be assisted with more efficient multimedia content management and delivery mechanisms. Acknowledging that multimedia content sharing and social tagging are both common practices of online communities, our approach aims at producing meaningfully annotated multimedia content utilizing the content's user assigned tags. More specifically, our goal is to support online communities in sharing their experiences and common interests in a context sensitive manner, enabled by Internet communication and Web 2.0 services and applications. Towards this aim, this paper presents research work towards the development of a framework for improving the analysis and understanding of multimedia content exploiting social tags, so as to generate and handle efficient mechanisms for the intelligent consumption of multimedia content.

The remainder of this paper is structured as follows. In the following section we highlight the issues that motivate our work. More specifically, we present in brief online communities and social tagging, as well as an overview of issues related to multimedia content sharing via social software. In Section 3 we present the conceptual foundations of our approach, as well as issues related to the understanding, semantic enrichment and delivery of multimedia content to online communities. Finally, the concluding section provides a synopsis of our contribution and sketches future work directions.

2   Online Communities and Social Tagging

In general, the concept of online communities refers to the online communication spaces where individuals develop a sense of belonging, usually through interacting with other users on topics of common interest. Early online communities were mostly formed through the use of emailing lists, or bulletin boards. Today, most communities are formulated around some kind of a web-based interface that allows them to exchange their personal ideas, opinions and beliefs, such as blogs or multimedia content sharing applications. Information sharing and exchange is an ongoing process among community members. As characteristically stated in [3], in a focused community it is the member-generated content that adds stickiness to a site encouraging people to stay, participate and revisit.

Web 2.0 can be defined as a set of technologies that allow easy content sharing on the Web and enable social software. Social software, *i.e.* software that supports activities in virtual social spaces, comprises a wide range of different types of applications such as web logs, wikis, social tagging sites, content sharing enablers, and contact sites. Social tagging is the process of informal and personal association of a keyword or term or tag to a piece of information (usually for online resources such as computer files, web pages, digital images). This type of item description enables keyword-based classification, thus improving the "searchability" of content [4].

Several sites enabling social tagging facilitate users to store, classify, share and search links through the practice of folksonomy techniques on the Internet or Intranets.

The availability of social software applications has also resulted in the phenomenal growth of user embodiment in virtual spaces and the constant emergence of online communities. Users play a significant role beside content in Web 2.0 [5]. As clearly stated in [6], the increased user contribution leads to the growth of "collective intelligence" and reusable dynamic content. Digital media such as images, video and audio are broadly used for sharing of ideas among community members that engage in collaborative activities. However, the current approaches have several limitations regarding the efficiency of user generated tags. For example, in many cases the keyword list is incomplete or contains a lot of mistakes and irrelevant terms. These issues constrain a more extended usage of current applications. In order to solve these problems, the presented research approach suggests the use of multimedia content understanding towards improving the consistency of the user-generated annotation, suggesting new terms and eliminating irrelevant tags.

3 Exploiting Social Multimedia Content

Our approach aims at developing an efficient and effective framework of representations and mechanisms for the social-oriented structuring and analysis of user created multimedia content. Knowledge representation and analysis of multimedia content, especially regarding image and video, are research areas with a of plethora contributions [7]. These mostly focus on technological aspects, providing a great amount of methods, tools and techniques for the management of multimedia content. Still, it is a fact that existing approaches do not exploit the social aspects related to the end users for understanding the media.
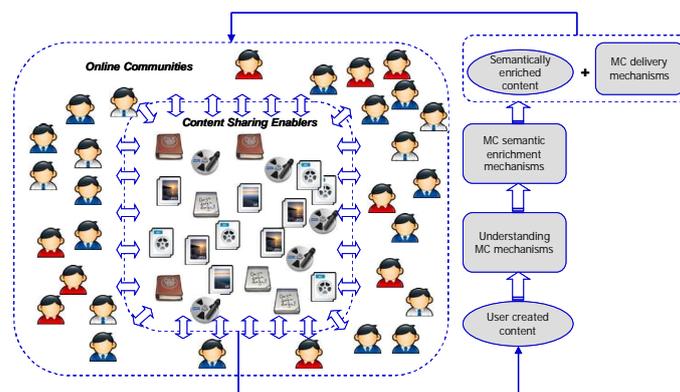

Fig. 1. Our content analysis approach based on the user-generated tags.

Our work exploits the social software approach for developing a robust conceptual model as well as for developing the necessary mechanisms for the semantic enrichment of multimedia content in meaningful ways. Towards this, we make use of

social tagging for the semantic enrichment of multimedia content. More specifically, our work concerns the development of ontologies based on concepts that derive from the user defined tags and can be of aid to the semantic interpretation and enrichment of the content [8]. This also involves the development of mechanisms for the automatic generation of tags, as the user assigned tags are not always sufficient, as was explained before. Furthermore, another important aspect of our work concerns the consistency checking and amendment of social tags. Fig.1 schematically depicts our content analysis approach based on user-generated tags (where MC stands for Multimedia Content).

3.1 Ontologies for Content Understanding

Knowledge extraction from multimedia content is generally considered as a very intrinsic task in multimedia processing, and one of the most crucial steps towards content understanding. A variety of tools and techniques such as low-level feature extraction, image segmentation, object classification, tracking and recognition, image annotation and indexing have already been used towards this [7, 8]. These utilize at some extend some kind of knowledge and their performance depends highly on the broadness of the application and the specific type of the media. On the other hand, the role of social entities such as individual and community users empowers new opportunities for efficient multimedia knowledge extraction and content management. Especially social tagging where tags assigned by the users to the multimedia content can be exploited for the extraction of knowledge. The social role of users forming user communities and groups, who are the ones tagging content in the first place, is crucial in the process and has a direct effect on the available tagging information. In other words, it is the contextual effect of socializing users that directs the tagging process and influences their semantic interpretation. Taking the above into account, and in the context of modeling knowledge for multimedia understanding, we propose the use of enriched ontologies within a specific domain, which include relations among the following: (i) formal representation of the domain, (ii) concepts that derive from the user defined tags and (iii) visual concepts that can be extracted with multimedia analysis techniques. These ontologies together with the user-generated tags can be used as a-priori knowledge (incorporating the social knowledge) in order to drive the content analysis and understanding procedure. Social tags can be used as context that drives and constrains the content analysis algorithms. For example, using image pattern recognition techniques, with location information and taking into account the user tags, it will be possible to recognise that a photo really depicts the Eiffel Tower and not a person in front of the Tower.

3.2 Semantic Enrichment of Multimedia Content

Semantic descriptions of content are of great importance as regards to the speed and ease of navigation through multimedia content repositories. Recent research efforts in the area of semantic video annotation try to derive the semantics from the videos' low

level features or from any other available basic metadata. It is a fact that various efforts towards this prove to be effort and time consuming, while the outcomes are not considered to be satisfactory. Our approach proposes the creation of meaningfully annotated multimedia content exploiting the user assigned tags. Tagging information can provide a unified semantic interpretation of the multimedia content. Based on the ontologies described in the previous subsection, both user and automatically assigned tags to the content can be managed according to the properly developed ontologies. Furthermore, we propose the use of advanced semi-automatic social tagging approaches, where the automatic tagging results could be presented to the user, so that the user could be able to interfere with them in a meaningful way, and provide his feedback about them. For example, reasoning and consistency checking mechanisms could be applied in order to either suggest new keywords or eliminate irrelevant ones. We also propose that the multimedia content provided by the users could be enriched with three main types of information, i.e. spatial, thematic and temporal information. In this way, tags could be mapped to high-level semantic concepts defined by a spatiotemporal and a domain specific ontology. In this way, social tagging could be enhanced with extra user-oriented functionalities, such as the ability of users to interact with content tagging. This could also be used for future training/learning of tags, with respect to the specific content types.

3.3 Delivering Semantically Enriched Multimedia Content

Data storage and data access technologies change the way people interact with their data and each other. Delivering the semantically enriched multimedia content should take into account all available social and contextual information. On the other hand, social software is about personal services on the web, and consequently it is about personalization. Taking that into account, we propose the delivery of content to the online community members according to user related information. More specifically, in our approach we exploit the user profiles and preferences, ratings and user and automatically provided tags, profiles of the users who share this content, community profiles, spatial and temporal information, like user/event location, time of the event, etc. Furthermore, reasoning techniques could further assist the matching of content and users. Following the "affinity systems" paradigm that allow people to register their membership of groups (e.g. old school friends or work colleagues), individuals could enter personal details that are either matched against the profiles of others or searchable by others. In this way, the enriched content could be mapped onto any user or community of a particular profile and deliver to them content of their interest.

4 Conclusions and Future Work Directions

Social software enables the sharing of huge amounts of content via the Internet. Sharing of content can be perceived as a collaboration activity resulting in the formation of online communities of various sizes and types. Exploiting social software enabled collaboration practices can help us understand both social aspects of online communities' behavior, as well as multimedia content. In this work, we

attempt to explore this Internet enabled social activity towards the abovementioned aim. We can exploit ontology-based mechanisms to enrich the content in meaningful ways integrating social tagging and content analysis approaches, in order to support online communities in sharing more efficiently and effectively their experiences and common interests. Towards this aim, our future work directions concern the full development of the proposed framework. Furthermore, our efforts comprise the development of all necessary mechanisms for understanding, semantically enriching and delivering multimedia content to the online communities.

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