MULTIMEDIA ARCHIVE ORGANIZATION AND DOMAIN MODELLING USING GWAPS

Jakub ŠIMKO, Mária BIELIKOVÁ

Slovak University of Technology in Bratislava
Faculty of Informatics and Information Technologies
Ilkovičova 2, 842 16 Bratislava, Slovakia
{jsimko,bielik}@fiit.stuba.sk

Abstract. There are several tasks in multimedia archive organization and domain modelling, which still have to be performed by humans this day. Games with a purpose (GWAPs) represent a motivational framework for this. We present several GWAPs for metadata acquisition for multimedia and several for lightweight domain modeling.

1. Introduction

The creation and upkeep of effective digital archives require valid and up-to-date metadata above its resources. This includes both *direct descriptions of the content* (such as tags) and *domain models* that interconnect the descriptive semantics and tell some additional facts about the corpus. To create and maintain this metadata layer over an archive of any resource type requires significant portion of human work even today, despite many research attempts made to acquire it automatically. The specific type of content we are interested in, are metadata resources – for them, an automated metadata acquisition is even harder, than for example, textual resources.

Since the scale of resources needed to be annotated is often very large, we cannot rely on the work on few individuals creating the core semantics (though they may possess a high level of expertise needed for the job). A general alternative solution, adopted by many researchers and practitioners is *crowdsourcing* – an outsourcing of a task to a larger group of lay workers. Though the workers are not experts, by using the redundant task solving and small-enough tasks, crowdsourcing can achieve qualitatively comparable results than dedicated expert work, but on larger scales. The key aspect of course is the motivation of the workers, with many possible schemes: money, reputation, altruism or fun.

The latter is a key factor in a special branch of the crowdsourcing approaches, the games with a purpose (GWAPs). The GWAPs are computer games that apart from the fun

they provide to the player, harness the player's brain power in favour of solving some useful tasks or more specifically for creating useful artifacts. They do so by aligning the solving of the tasks (that are hard to be performed by machines) with game goals. As the most successful GWAP, the ESP game for acquisition of image tags is often presented [6]. The motivation by fun is the greatest advantage of GWAPs to other crowdsourcing approaches, especially to monetary motivation (which is costly).

But even the GWAPs suffer from several disadvantages, such as cold-start problems of multiplayer game schemes they usually use. They are also (in general) unable to perform more specific tasks that require higher degree of expertise from their players. In our work, we focused on these issues by bringing up alternative game mechanics and artefact validation schemes into GWAPs. We have devised several GWAPs for metadata acquisition, one branch for multimedia metadata, other for domain models. In both cases, we aimed for games not suffering from cold start and also for the deployment in specific tasks.

2. Multimedia metadata acquisition through GWAPs

In our work, we primarily focused on the *images* as a type of multimedia for which the metadata are to be acquired. For images, as well as for other multimedia, the metadata acquisition is hard by automated means. In practice, these approaches rely especially on the examination of textual context of the images (e.g. on the Web) or are able to do a basic classification based on image recognition. Yet more in-depth analysis is left to humans. There is also a specific type of images, which makes the whole issue even harsher, and this are the *personal images,* which also need their metadata, but these are not present on the Web (for obvious reasons) with suitable textual context, nor there are classifiers capable of delivering specific metadata, such as person names, places or events connected to the images. In fact, even the general crowd of people from the Web is ineffective in acquisition of metadata for personal archives, since its individuals do not possess the necessary knowledge.

We have devised a GWAP called PexAce [1, 3, 5] for acquisition of image metadata. As a prevention against cold-start problem caused by a lack of available players at the initial deployment phase of the game, our intention was to create a single-player game design with an alternative artefact (semantics) validation scheme (i.e. other than multiplayer agreement on a single tag). Finally, we achieved this by a mechanics that only *motivates* players to describe images in the game, but computes score and gives feedback to the player according to different game mechanics.

The PexAce is a card game similar to *Concentration* board game (also known as Memory or Pexeso). The player in the game attempts to find pairs of identical cards (images) concealed on the board. He does so by sequentially selecting and disclosing different pairs of cards, keeping them if they are identical or concealing them again if they are not. The player has to remember the positions of the cards in order to finish the game in lowest possible number of turns as possible (which determines the scoring function). Yet, as an aid to the player, the game allows him to write down textual annotations over the cards and review them even without having to disclose them and loose turns. After processing these annotations to tag suggestions and after post-hoc collaborative filtering between multiple players, we were able to acquire 94% correct tags over a general domain images.

With a game concept working for general domain images, we aimed it also for personal images. These images also require metadata from which their owners could benefit, but at the same time, image owners are usually not motivated to create these metadata [8]. Therefore, we tried PexAce game concept to motivate the owners. We loaded the game with person's own photos and let the person to play. It appeared that players liked the game even more with their own images. On the other hand, we had to adopt slightly different approach to validation of tags extracted from the player's annotations: since we cannot rely on the validation by other players, we simply have to trust the player and rely on the recurrence of certain tags (which decreases the probability of accepting messy tags). To our satisfaction, players heavily relied on specific information (e.g. person names) when describing their images in the games. The key role in this was also played by additional motivation: the players not only played, but helped themselves by annotating their own repositories.

3. Domain model acquisition through GWAPs

The second field for which we created and deployed GWAPs was the acquisition of domain models. Domain models have their use across all digital archives: they play the important role in interconnecting of the resources, abstraction and visualization of the information space and more [7]. At the same time, their creation often requires human work and is problematic especially for specific domains, where lesser number of experienced people is available for the job. In our research, we focused on a very lightweight type of domain model semantics – the non-labelled relationships (associations) between terms. Yet even for this relatively simple task, human attention is required.

We have devised a game called the Little Search Game [2, 4] for term relationship acquisition, which is based on a negative search paradigm. In the game, the player is given a search query and is asked to expand it with other query terms, but only negative ones (i.e. terms usually decorated with a minus sign, directing the search engine to filter out the search result containing these search terms). The player's goal is to use negative terms that reduce the total number of yielded results as much as possible. In order to achieve this, the player must enter terms with high co-occurrence with the given search query (and its terms). And because the players translate this as "find terms related to the initial search term", they leave us with their suggestions on term relatedness. These, we collect and filter collaboratively to produce term relationship network. Using our GWAP, we were able to collect 91% valid term relationships.

The first deployment scenario used web search engines for query execution with the whole Web as the corpus. In the second scenario, we used a search engine over a much smaller domain-specific corpus and asked people familiar with it to play the game in this setting. This way, we were able to gather even domain specific term relationships.

4. Conclusions

By motivating humans with the fun incentive in GWAPs, we can harness their brain power for semantic acquisition tasks. And though for the crowdsourcing, the acquisition of semantics for specific domain (i.e. solving a specialized task), we made it possible by a special GWAP design, which relies on an additional player motivation (self-interst) and

specific single player game mechanics. As for the future of our games, in PexAce, we see a large potential concerning the personal image annotation. In small, controlled experiments, we already show the game could do the job. Now is the time to perform a larger scale, open experiments by deploying this game into practical use. As for the Little Search Game, we seek for a more attractive interface, since it is still based mostly on text.

Acknowledgement: This work was partially supported by grants No. VG1/0675/11, KEGA 028-025STU-4/2010, APVV 0208-10 and it is a partial result of the Research and Development Operational Program for the projects Support of Center of Excellence for Smart Technologies, Systems and Services, SMART (ITMS 26240120005), SMART II (ITMS 26240120029) and the project Research of methods for acquisition, analysis and personalized conveying of information and knowledge, PerConIK (ITMS 26240220039), co-funded by ERDF.

References

to other papers publishing the results that are summarized here

[1] Šimko, J., Bieliková, M.: Personal image tagging: a game-based approach. In Sack, H., Pellegrini, T., Eds.: *Proceedings of the 8th International Conference on Semantic Systems (I-SEMANTICS '12)*. ACM, New York, NY, USA, (2012), pp. 88-93.

[2] Šimko, J., Tvarožek, M., Bieliková, M.: Little search game: term network acquisition via a human computation game. In: *Proceedings of the 22nd ACM conference on Hypertext and hypermedia (HT '11)*. ACM, New York, NY, USA, (2011), pp. 57-62.

[3] Šimko, J., Bieliková, M.: Games with a Purpose: User Generated Valid Metadata for Personal Archives. In: *Proceedings of the 2011 Sixth International Workshop on Semantic Media Adaptation and Personalization (SMAP '11)*. IEEE Computer Society, Washington, DC, USA, (2011), pp. 45-50.

[4] Šimko, J., Tvarožek, M., Bieliková, M.: Semantics Discovery via Human Computation Games. *International Journal on Semantic Web and Information Systems (IJSWIS)*, (2011), vol. 7, no. 3, pp. 23-45.

[5] Šimko, J., Tvarožek, M., Bieliková, M.: Human computation: Image metadata acquisition based on a single-player annotation game. *International Journal of Human-Computer Studies (IJHCS)*, (2013), vol. 71, no. 10, pp. 933-945.

Other references

[6] von Ahn, L., Dabbish, L.: Designing games with a purpose. *Communications of the ACM*, (2008), vol. 51, no. 8, pp. 58–67.

[7] Marchionini, G.: Exploratory search: from finding to understanding. *Commun. ACM,* (2006) vol. 49, no. 4 , pp. 41-46.

[8] Vainio, T., Väänänen-Vainio-Mattila, K., Kaakinen, A., Kärkkäinen, T., Lehikoinen, J.: User needs for metadata management in mobile multimedia content services. In: *Proceedings of the 6th International Conference on Mobile Technology, Application & Systems (Mobility '09)*. ACM, New York, NY, USA, (2009).