Television Linked to the Web (project presentation)

Tomáš Kliegr, Vojtěch Svátek

Department of Information and Knowledge Engineering, University of Economics, Prague, nám. W. Churchilla 4, 130 67 Praha 3

`{tomas.kliegr|svatek}@vse.cz`

Abstract: The LinkedTV (Television Linked to the Web) project aims to unite television and web experience. The audio visual content is enriched by links to related web pages, videos, podcasts and images. The user interaction is analyzed and a user model built, which enables content personalization. This paper provides an overview of the contributions in the knowledge engineering areas, with an emphasis on results obtained by UEP.

1 Introduction

While conventional television is still the main media, TV over the web is gaining a fast impetus. The web environment as well as the new capabilities of the new TV viewing devices (set top boxes, computers, tables, Smart TVs) open a window of opportunity for intelligent technologies, that should be able to semi-automatically enrich video and personalize these recommendation.

LinkedTV aims to unite television and web experience. The audio visual content is enriched by links to related web pages, videos, podcasts and images. The user interaction is analyzed and a user model built, which enables content personalization.

An important element in the project is the fact that the automatically generated enrichments are curated in a TV studio before being presented to the end user. Since the state of the art in some of the involved areas is not yet advanced enough to provide reliable input for the enrichment, the manual curation step ensures that the content that reaches the user maintains a stable quality level.

2 Project Overview

LinkedTV is funded by the EU within the 7th Framework Programme under the Networked Media Call. The project started in October 2011 and will finish in March 2015. The project duration is 42 months. The total cost of the project is 8 449 406 Euro, with EU contribution 6 489 633 Euro. The coordinator of the project is a German research institute Fraunhofer. There are 12 partners in the project, from eight European countries.

3 Consortium

The consortium consists of the following institutions: Centre for Research and Technology Hellas from Greece (CERTH), Condat AG from Germany, EURECOM from France, Fraunhofer Institute for Intelligent Analysis and Information Systems from Germany, Noterik BV from the Netherlands, Rundfunk Berlin-Brandenburg from Germany (RBB), Modul University from Austria, CWI from the Netherlands, Dutch Institute for Sound and Vision from the Netherlands (S&V), University of Mons from Belgium, University of St. Gallen from Switzerland, University of Economics, Prague (UEP). The consortium comprises three types of organizations: research, technology providers, and content providers.

Research partners. CWI is focused on user interface development, Eurecom works in the area of exploitation of linked data for multimedia purposes, Fraunhofer has two roles: it performs low-level video processing, and also contributes to personalization, Modul university main contribution is in exploitation and dissemination, University of Mons performs research in multimodal interfaces and their use for personalization, University of St. Gallen investigates viable business models for the exploitation of the technology developed in the project. The contribution of the University of Economics, Prague is further developed in Section 5.

Content partners. S&V is a Dutch national media archive, RBB is a German television broadcaster. The two main languages of the content analyzed are thus Dutch and German.

Technology providers. Condat AG and Noterik BV provide solutions for indexing, management and retrieval of digital media. In the project, Condat AG provides technical infrastructure and Noterik BV in collaboration with CWI develops the "LinkedTV" player, which showcases the technologies developed in the project.

4 Work packages

Internally, the project management is divided into 9 work packages. Research relating to the area of knowledge engineering is performed in work packages 1, 2 and 4:

WP 1 (Intelligent hypervideo analysis) performs analysis of audio-visual material. This work package is led by CERTH. The main focus of the research are techniques from the areas of shot and chapter segmentation, video concept detection, automatic speech recognition, event detection, keyword analysis and multi-modal fusion. Selected techniques developed in this WP have been evaluated in the TRECVid contest.[1]

WP 2 (Linking hypervideo to web content) performs enrichment of video content. This work package is led by Eurecom. The content is retrieved from 3rd party APIs, as well as using focused crawling of a set of trusted websites designated by the con-

---

[1] http://trecvid.nist.gov/

tent partners. The seed video as well as enrichment content is analyzed using entity recognition and disambiguation algorithms. The result of the analysis is represented using semantic web technologies.

WP 4 (Contextualization) performs personalization of video content. This work package is led by Fraunhofer. The user interest clues are obtained both from explicit user interaction with the content, as well as using physical behaviour tracking by Microsoft Kinect [4]. User profile is represented by concepts from LinkedTV User Model Ontology (LUMO), which are mapped to concepts from DBpedia and YAGO ontologies, which are identified by entity classification performed in WP2.

5 UEP@LinkedTV

In this section, we highlight the main contributions of UEP to the technical work packages 1,2 and 4.

- A language-dependent keyword analysis web service for German, English and Dutch.
- Algorithms for classification of entities in text into a custom set of classes. The output of these algorithms is combined with the result of concept detection to obtain better results coming from the intermodal fusion.
- Entityclassifier.eu: Entity classification web service, which supports German and Dutch in addition to English [1].
- Linked Hypernyms Dataset (http://ner.vse.cz/datasets/linkedhypernyms/) We generated a significant extension to the DBpedia knowledge base for English, German and Dutch languages by analyzing the free text of articles using natural language processing techniques [3]. The additional entity types are used by entityclassifier.eu.
- A focused crawler, which is based on Apache Nutch and Solr, which we have extended to support crawling and retrieval of multimedia content (images, podcasts, videos). Part of the technology has been used in the MediaEval contest [6].
- InBeat.eu – is a web service recommender system, which comprises of the GAIN module for capturing user interactions, PL module for preference learning, and RS module for recommending content [5].
- The LinkedTV project also supported the development of the EasyMiner.eu association rule mining web application and web service [7]. This can be used as one of the providers of data mining models for the inbeat.eu PL module.

6 Evaluation and impact

Demos of the software tools developed by UEP within the project have been presented at premier conferences on machine learning [1], recommender systems [5] and artificial intelligence [4] (accepted for presentation).
The individual algorithms and tools developed or co-developed by UEP have been successfully evaluated in multiple contests: 1st and 2nd place at MediaEval 2013 [6],

the InBeat system obtained 2nd place at RecSys'13 News Challenge[2]. Entityclassifier.eu participated in the highly competitive NIST TAC 2013, finishing in the middle [2]. Additional benchmarking activities are ongoing.

The assessment of the "end-product", with most of the components integrated, is planned for the last 6 months of the project.

Acknowledgments

References (selected publications)

[1] Milan Dojchinovski, Tomáš Kliegr. Entityclassifier.eu: Real-time Classification of Entities in Text with Wikipedia. In ECML/PKDD 2013, September 2013, str. 654-658. Volume 8190, Springer.

[2] Dojchinovski, I. Lašek, T. Kliegr, O. Zamazal. Wikipedia Search as Effective Entity Linking Algorithm. In Proceedings of the Text Analytics Conference (TAC 2013), Gaithersburg, Maryland, USA, 2013, U.S. National Institute of Standards and Technology (NIST).

[3] T. Kliegr., O. Zamazal. Towards Linked Hypernyms Dataset 2.0: complementing DBpedia with hypernym discovery. In 9th International Language Resources and Evaluation Conference (LREC'14), Reykjavik, Iceland, May, 2014.

[4] T. Kliegr, J. Kuchař Orwellian Eye - Video recommendation with Microsoft Kinect. In Conference on Prestigious Applications of Intelligent Systems (PAIS'14) collocated with European Conference on Artificial Intelligence, Prague, Czech Republic, August 2014, IOS Press

[5] Jaroslav Kuchař, Tomáš Kliegr. GAIN: web service for user tracking and preference learning – a SMART TV use case. In Proceedings of the 7th ACM Recommender Systems Conference (RecSys 2013), Hong Kong, China. October 2013.

[6] Mathilde Sahuguet, Benoit Huet, Barbora Červenková, Evlampios Apostolidis, Vasileios Mezaris, Daniel Stein, Stefan Eickeler, Jose Luis Redondo Garcia, Raphael Troncy, Lukas Pikora, "LinkedTV at MediaEval 2013 Search and Hyperlinking Task", Working Notes in Proc. of the MediaEval 2013 Workshop, 18-19 October, 2013, Barcelona, Catalunya, Spain.

[7] Radek Škrabal, Milan Šimůnek, Stanislav Vojíř, Andrej Hazucha,Tomáš Marek, David Chudán, Tomáš Kliegr. Association Rule Mining Following the Web Search Paradigm. In Proc. of European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECML-PKDD 2012), Bristol, UK, 24-28 September 2012, volume 7524, 2012, pp 808-811. Springer

---

[2] https://sites.google.com/site/newsrec2013/challenge