A companion screen application for TV broadcasts annotated with Linked Open Data

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Abstract. Increasingly, European citizens consume television content together with devices connected to the Internet where they can look up related information. In parallel, growing amounts of Linked Open Data are being published on the Web, including rich metadata about its cultural heritage. Linked Data and semantic technologies could enable broadcasters to achieve added value for their content at low cost through the re-use of existing and extracted metadata. We present ongoing work in the LinkedTV project, whose goal is to achieve seamless interlinking between TV and Web content on the basis of semantic annotations: two scenarios validated by user trials - Linked News and the Hyperlinked Documentary - and a companion screen application which provides related information for those programs during viewing.

1   Introduction

More and more consumers will have SmartTVs at home [4], complemented by laptops or tablets which can function as second screens, e.g. to explore related content (from broadcaster's archives and other online resources) alongside a TV programme. Multitasking while watching TV is a significant consumer trend, with 88% of TV viewers going online in parallel, and 40% using their second screen to get more information on what they are watching [1]. Broadcast companies want to provide their viewers with richer interactive television experiences, and are becoming increasingly interested in enriching television content with hyperlinks to data sources that could enhance the attractiveness of watching their content and keep viewers from switching to other content sources online. The European project LinkedTV (`http://www.linkedtv.eu`) believes that a "true TV ecosystem must functionally integrate the apps with the television programming" [5]. Thus it develops an end-to-end workflow that automates the process of

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[4] 54 million SmartTVs sold in 2012 will grow to 170 million in 2017, by then 64'Smart-TV device forecasts', Informa Telecoms & Media. `https://commerce.informatm.com/reports/smart-tv-device-forecasts.html`

[5] TVs can't be smart. Stop trying to make it happen. - WIRED Opinion, Gary Myer, Oct 2013

enriching TV programmes with content, which significantly enhances the user experience. For this, semantic technologies and Linked Open Data (LOD) datasets are used to lower the cost of annotation, which is not scalable in a completely human curated enrichment. In order to get an insight into what potential end-users want to see and do, we conducted user studies. Based on this, a companion screen application was developed that allows viewers to get extra information on the topics in their favourite TV programmes while watching, which they can bookmark and share. In our submission we will talk about 1) the technical process, 2) the LinkedTV use cases (Interactive News, Hyperlinked Documentary) validated by user trials, and 3) the companion screen application.

2   Technical process and workflow

The end-to-end server-side workflow of LinkedTV starts with automatic analysis of the audiovisual material and its metadata, applying shot and scene segmentation, visual analysis for concept detection [2], and entity extraction from subtitles [3]. Media Fragments [6] are generated which refer to specific temporal and spatial parts within the analysed television show that present a particular topic or object. For example: an art expert mentions the Greek goddess Hebe, and a Media Fragment corresponding to the utterance is created, e.g. using subtitle information. These Media Fragments are annotated with named entities extracted from the text or visual classifiers. For this, LinkedTV has developed a dedicated ontology [7] and re-uses Linked Data URIs for the entity identifiers. For example, the concept Hebe (ancient Greek goddess) can be found in DBpedia with the URI `http://dbpedia.org/resource/Hebe_(mythology)`. LinkedTV uses "white lists" of Web content sources trusted by the media owner to contain high-quality links that can be used for enrichments. Distinct Web services provide link matches in these "white list" sources for entities, e.g. recent media shared via social Web channels, structured databases of media resources such as the European digital library Europeana, and HTML-based Web sites via a dedicated crawler for embedded media items. A programme editor has access to a dedicated Editor Tool [8] to curate which of these links they want to show to their end users, since usually many more potential targets are found than are reasonable to show. Finally, the LinkedTV Player displays the curated results using HTML5 technology on the companion screen.

3   Use cases and user studies

Two scenarios were used to inspire the LinkedTV work: Linked News and the Hyperlinked Documentary. The Linked News scenario is based on the local news

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[6] `http://www.w3.org/TR/media-frags/`

[7] `http://linkedtv.eu/ontology`

[8] `http://editortool.linkedtv.eu`

show RBB Aktuell by Rundfunk Berlin Brandenburg; the Hyperlinked Documentary scenario is based on Tussen Kunst en Kitsch (similar to the BBC's Antiques Roadshow, henceforth TKK) of Dutch public broadcaster AVRO [9]. Both programmes contain distinct chapters about specific topics, e.g. Obama's Berlin visit in June 2013 or a 19th century gold watch by famous watch maker Breguet. These specific topics, being linked to open data from the Web, can be enriched with further Web content which offers more information and context about the topics in these chapters. For example, the watch chapter is supplemented with links to the Wikipedia article and Europeana images relating to the figure inside the watch - the Greek goddess Hebe - thanks to the DBpedia URI in the video annotation and the ability to SPARQL query Europeana. To understand what news and TKK viewers really want, we conducted user studies with representative audiences in a living room environment [10] The results of the user trials led us to adapt our scenarios to highlight topics and objects in the TV programmes which were more of interest to typical viewers, and to link them to Web content which they would have liked to search for.

4 Enabling companion screens for enriched television content
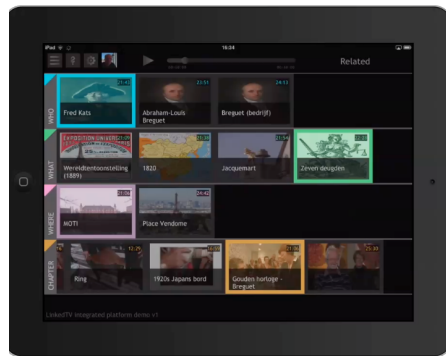
(a) User interface highlighting concepts currently active in the TV programme

(b) Living room setting for the Linked News scenario

Fig. 1: LinkedTV companion screen application

To support viewer access to LinkedTV enrichments via companion screen applications, we developed the Springfield Multiscreen Toolkit (SMT). It supports

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[9] http://avro.nl

[10] LinkedTV D3.5 'Requirements Document for LinkedTV User Interfaces (Version 2)' (http://www.linkedTV.eu/wp/wp-content/uploads/2013/12/LinkedTV_D3.5.pdf).

application developers by abstracting away the low-level details of the synchronization and distribution of content between screens. Developers can create a single application that is independent of how many screens are involved and such an application can dynamically react to changes in the amount and types of screens attached to it. Applications are developed using standard technologies, such as HTML5 and Java. The first prototype allows companion screens to control video playback on the main screen and synchronise the associated LinkedTV enrichments to the main screen video.

5 Conclusion

LinkedTV is continually refining the annotation and hyperlinking workflow, expanding the LOD sources it uses and how the available metadata from those sources can be increasingly used in guiding the system to select more relevant links to enrich TV programming. A new, larger cycle of user trials using the scenario demonstrators will help validate further the usefulness of the selected enrichments for viewers, acceptance of personalisation functionality when it requires modelling of user preferences or tracking viewer behaviour, as well as the intuitiveness of the user interface. Furthermore, the cognitive load for end users that a dual screen set-up demands will be explored. The results of the evaluations will be used to improve the added value of using Linked Open Data in the enrichment process for our broadcast partners, namely: greater automation leading to lower costs for providing added value services around their content, which in turn helps keep viewers connected.

References

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3. "Enriching Media Fragments with Named Entities for Video Classification", Yunjia Li, Raphael Troncy et al. in the Linked Media (LiME) workshop, WWW 2013, Rio de Janeiro, Brazil, May 2013.