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PROJECT PERIODIC REPORT

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Television Linked To The Web

What is LinkedTV?

Networked Media will be a central element of the Next Generation Internet. Online multimedia content is rapidly increasing in scale and ubiquity, yet today it remains largely still unstructured and unconnected from related media of other forms or from other sources. This cannot be clearer than in the current state of the Digital TV market. The full promise and potential of Web and TV convergence is not reflected in offerings which place the viewer into an Internet closed garden, or expect PC-like browsing on a full screen Web, or offer interesting new functionalities which however lack any relation to the current TV programme.

Our vision of future Television Linked To The Web (LinkedTV) is of a ubiquitously online cloud of Networked Audio-Visual Content decoupled from place, device or source. Accessing audio-visual programming will be “TV” regardless whether it is seen on a TV set, smartphone, tablet or personal computing device, regardless of whether it is coming from a traditional or new media broadcaster, a Web video portal or a user-sourced media platform. Television existing in the same ecosystem as the Web means that TV content and Web content should and can be seamlessly connected, and browsing TV and Web content should be so smooth and interrelated that in the end even “surfing the Web” or “watching TV” will become as meaningless a distinction as whether the film is coming live from your local broadcaster, as VOD from another broadcaster, or from an online video streaming service like Netflix.

As a result, not only commercial opportunities but also opportunities for education, exploration and strengthening European society and cultural heritage arise. Imagine browsing from your local news to Open Government Data about the referenced location to see voting patterns or crime statistics, or learning more about animals and plants shown in the currently viewed nature documentary without leaving that show, or jumping from the fictional film to the painting the character just mentioned to virtually visiting the museum when it can be seen.

Technologically, this vision requires systems to be able to provide networked audio-video information usable in the same way as text based information is used today in the original Web: interlinked with each other at different granularities, with any other kind of information, searchable, and accessible everywhere and at every time. Ultimately, this means creating

hypermedia at the level of the Web. The Web's original success was the underlying hypertext paradigm built into HTML. Hypermedia has been pursued for quite a while as an extension of the hypertext approach towards video information. But it needs complex video analysis algorithms and is still an issue of research. LinkedTV provides a novel practical approach to Future Networked Media.

How to solve the interlinking of Web and TV

To enable a new generation of online applications which can interweave TV and the Web several research challenges need to be overcome. These are the subjects of the collaborative research in the LinkedTV project. Manually connecting TV and Web content is costly both to create and maintain, and it does not scale. A key goal of LinkedTV is to develop tools and approaches to better automate the preparation of content via shared annotations, and the creation of links between content based on those shared annotations. Firstly, **intelligent video analysis** can identify concepts of interest in the spatial and temporal segments of video. Hybrid approaches combining textual, audio and visual feature extraction maximize the accuracy of automated analysis, lowering the overall cost of generating annotations of large scales of video material.

The concepts in the analysis results are mapped into shared Web based vocabularies, using Linked Data sources such as DBPedia or GeoNames. This Linked Data based annotation is the basis for the **hyperlinking to Web content**, which has been subject to annotation with the same concept vocabularies. As a result, video is enriched at a fragment level with Web based content.

HTML5 and HbbTV based hypervideo players will enable the LinkedTV experience across different devices including SmartTVs and tablets. Those **presentation engines** will be implemented for both single and multi screen usage, providing an **intuitive interface** to the LinkedTV scenario enrichments in a **contextualized and personalized** way. Three **scenarios** guide and inform LinkedTV in terms of the content to use and the experience to offer. With public broadcaster RBB the regional news can be enriched with topical content addressing different viewers' interests. With cultural heritage archive Sound and Vision, Europe's rich heritage is brought closer by linking to it from TV programming. Finally, more explorative usage of interactive TV will be performed by the University of Mons, for example by making use of the possibilities of gesture control and behavioural tracking in front of TV.

A **LinkedTV platform** will provide access to the functionalities of the LinkedTV experience: annotation, linking and playout. Therefore it encapsulates a set of components into an end-to-end workflow, which cover the research challenges of the project: media analysis, annotation, hyperlinking, enrichment, personalization and integrated playout.

Work performed and achievements so far

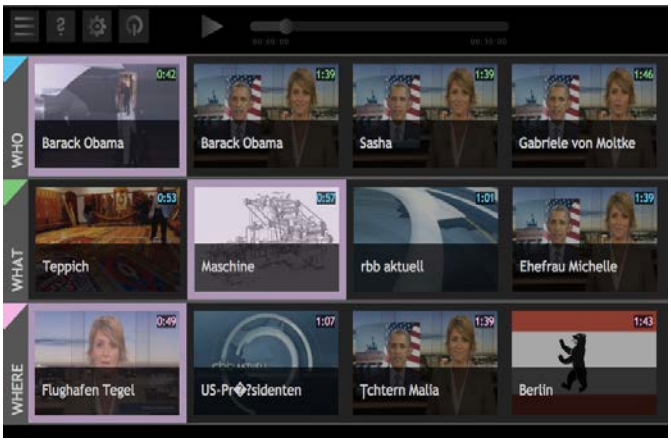
After the second year of LinkedTV the project is already close to its goal to enable a new generation of online applications which can interweave TV and the Web.

From a technical point of view a stable basis has been built by implementing a first integrated version of the **LinkedTV platform**. The platform triggers the process of media analysing, annotation, hyperlinking and enrichment of video content, stores the results and provides access for presentation and personalisation. The first step of the process towards the creation of hypervideo content is the **media analysis**. Analysis tasks that are being addressed in LinkedTV include the (semi)-automatic decomposition of the audiovisual content (e.g. temporal segmentation), the association of content segments with object and/or scene labels, text and audio information analysis, and event and instance-based labelling of content segments. The results of the media analysis are than transformed into RDF descriptions following the LinkedTV Core Ontology. Those Linked Data based annotations on media fragment level are the basis for the next step, the **hyperlinking and enrichment process.** It takes as input the annotated video and computes for each media fragment a set of enrichments. Therefore a set of technologies for retrieving the enrichment content from the web was developed and integrated via the LinkedTV platform. The two fundamental resources for obtaining this content are regular web sites and a web service access to popular social networks and media sharing platforms such as Flickr, Instagram, Twitter, Facebook, Google Plus or YouTube. As a result, the video is enriched at a fragment level with Web based content.

All research and development results are continuously improved and in parallel evaluated both internally and externally by participating in **benchmarking** activities like TRECVID and MediaEval. The internal evaluation is supported by a first version of the so called **editor tool**, which presents the automatic annotation and enrichment results and allows for manual corrections and enhancements. The final version will be dedicated to a fast and convenient final approval of the automatic results and for manual curation by a professional content creator. When the final approval has been given, the enriched hypervideo content can be presented by a single or multi screen application to the user.

Based on an own **user model** taking implicit and explicit preferences of the user into account, the annotations and enrichments are filtered to allow for a **personal user experience**. Therefore a considerable tool set and a dedicated workflow for extracting, learning and modelling of user information, usage and behaviour was developed.

For the creation of **innovative hypervideo applications** LinkedTV offers a toolkit that enables developers to implement HTML5 applications that run across multiple devices. The **toolkit** simplifies the development of multi screen applications by abstracting away the low-level details of content distribution and synchronization among clients. On top of this toolkit a generic **second**



screen application (see screen shot above) applied for the two main LinkedTV scenarios (cultural heritage and news) is available to demonstrate the current results of the LinkedTV workflow. You can find the current versions of the **LinkedTV scenario demonstrators** here:

- http://www.linkedtv.eu/demos/hyperlinkeddocu
- http://www.linkedtv.eu/demos/linkednews

To ensure that the LinkedTV scenarios and its applications reflect real world user interest and requirements a first set of user trials were conducted. Due to the results of this process of **user-centred design** the LinkedTV scenarios and **user interface** prototypes of the first year were adapted where necessary.

Making the research community and the media industry aware of the achievements so far and LinkedTV's vision was also one of the main activities in the reporting period. The project was presented at a great number of **major community events** like ISWC2012, ICMR2013, WWW2013 and ESWC2013 to name only few of the latest. Another workshop on FutureTV was organized at the EuroITV 2013, now for the second time already. A dedicated LinkedTV session was held at INTETAIN 2013. The project's **website** is the central source of information and regularly updated news. By now **26 online demos** of LinkedTV results and **16 publicly available LinkedTV tools and services** can be accessed from the website.

In the second reporting period the project intensified the elaboration of a concrete **business strategy** for LinkedTV. First possible **business models** within the identified target markets were explored and deeper knowledge about how these markets create and deliver value was gathered.

Outlook

In the remaining duration of the project, LinkedTV will continue with the evaluation of the LinkedTV platform and the tools both from a research point of view as well as from a user perspective. The project will concentrate on the integration of the personalization and contextualization results into the overall workflow and tool chain thereby respecting data protection and privacy concerns. The business models and strategy will be further elaborated resulting in concrete steps to bring LinkedTV into the market.

Contact and project details

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Project number: 287911

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For more information, please visit our website: http://www.linkedtv.eu

