

NoTube: the television experience enhanced by online social and semantic data

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Abstract—The NoTube European project¹ puts the TV user back in the driver's seat by generating user profiles from data the user creates on the Social Web, and in this way facilitating a personalised TV experience without an intrusive user profiling process.

Keywords- television, semantic multimedia, IPTV, interactive, personalized, recommendation, Social Web

Introduction

With the hundreds of channels available via modern TV providers, content selection and dealing with the vast amount of TV-related information become significant challenges for users. TV metadata is created and distributed by a small group of people, as a result of the closed-source information exchange protocols that are the standard for providing electronic programme guide (EPG) data to users. Yet people often have several clusters of personal data on the Web, such as their profiles on social networks, or ratings of videos on YouTube and IMDB. Analogously, there are many isolated clusters of broadcast data on the Web, such as broadcast data on EPGs and background information on Wikipedia. Within the NoTube vision context, we speculate that the conjunction of all these bits and pieces of data provide accurate information on someone's interests, which is suitable for generating relevant recommendations on TV broadcasts. Further, we assume that Semantic Web technologies provide important building blocks for realizing this vision, particularly the subset known as 'Linked Open Data', as they enable the global identification mechanism of URIs and the means to define relations between data anywhere on the Web. Hence NoTube seeks to converge at a data and content level the TV and Web worlds, and enable as a result a new television experience.

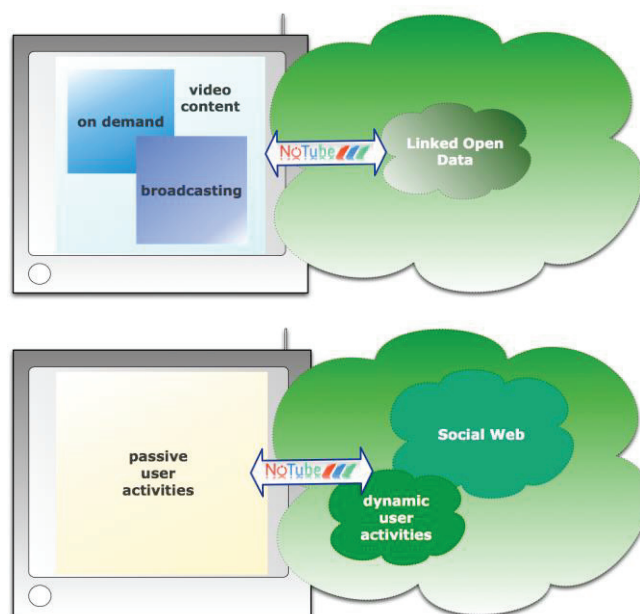


Figure 1. NoTube bridging the TV and Web

In this paper we describe how we build a recommendation system that uses existing Web services and shared background knowledge to collect, enrich and recommend TV data. The value of this work is the tapping into openly available data sources from the Web and the re-use of that information in the TV domain. This is an aspect of TV-Web convergence currently overlooked in current TV offerings, but one which we believe opens the door to new types of TV application in the future.

I. SOCIAL AND SEMANTIC TV TODAY

Digital TV can be characterized by the multitude of channels available – including VoD and Catch-up TV – and the additional of new and improved services in relation to that content – e.g. advanced EPGs and videotext display. The additional of the IP channel to the television, via the set top box or directly included in the set, makes Web based applications a further possibility, e.g. Yahoo! ConnectedTV.

¹ <http://www.notube.tv>

The main focus on Web-TV convergence apps to date has been on social apps, where the TV viewer can share their individual viewing experience on the fly with friends, typically over Web social networks like Facebook or Twitter, or in cases app-specific networks. Apart from the re-use of open Web APIs, the TV application market today is quite fragmented and apps are developed for specific platforms and devices. The second screen is an example of this: TV viewers want to access related functionality and content on their second screen connected to the current TV program, but the emerging apps to do this each use their own communication protocols and content identification, so content owners will find themselves focusing on narrow deals with specific apps or redeveloping the second screen experience for their content across multiple, non-interoperable implementations. The future TV market will need to open to some common APIs and identification schemes if a wide uptake of the next generation of TV services is to become viable. Semantic technology has already been proposed within the EBU as a possible technology basis for this, as common identification of things and mediation between different schemas are intrinsically part of it²; the NoTube project has put forward a vision for shared TV APIs to allow any second screen device to communicate with any TV device, sharing for example current program information, on top of which new services and functionalities could be offered by applications. Hence NoTube addresses a state of the art in television that does not currently exist, but prototypes what can be intuitively possible where semantics and an open Web are seamlessly woven into the world of TV data. As such, it provides a motivation for the TV world to move towards this vision, providing new benefits to TV viewers and discovering new value in the media content chain for producers and operators.

II. JANA WANTS A BETTER TV EXPERIENCE

Let us introduce Jana as an example future user of the NoTube infrastructure. She is socially active on the Web and does not see the need to explicitly define her preferences or wait until she has used the recommender system long enough for it to learn her preferences. In the first use-case we deal with Jana's recommendations based on her online social activity. In the second use-case, Jana is interested in a programme and uses the 'I would like to know more'-button. Jana then gets information about this program, which contains links to Wikipedia, the Internet Movie Database (IMDB) or online information sources. Next to this, she also gets recommendations of related programmes. With the 'why'-button option Jana can see why each program has been recommended to her.

As we consider enriched TV program descriptions, the reasons

² „Semantic TV – is the semantic web a part of broadcasting's future?”, JP Evian, EBU. http://tech.ebu.ch/docs/techreview/trev_2009-Q3_SemanticWeb_Evian.pdf

for recommendations are often based on interesting semantic relations between entities. For example, when Jana is watching an episode of 'True Blood', this makes her curious about the series, so she picks up her smartphone to find out more about it using the NoTube application. When she presses the 'I want to know more' button the Wikipedia page is shown as well as some recommendations. One of the recommendations is the pilot of the series 'Six Feet Under', which she already knows. She is curious about the reason of the recommendation, so she presses the 'why?' button next to it and sees that: both series were created by 'Alan Ball' and they share two genres: 'black comedy' and 'drama'. She is happy to learn that the two series were created by the same man and continues by looking up information about Alan Ball. More about Jana and this scenario can be seen in two online videos³.

III. MAKING BETTER TV POSSIBLE

The better TV experience is enabled by the NoTube architecture, which is based on a set of services that constitute the building blocks, and a middleware for coordinating those services into a workflow which, via the application logic, provides an enhanced TV experience at the front end (TV device).

Figure 2 below shows this workflow, made up of various services provided by NoTube or externally accessed from the Web, with a number of NoTube UIs giving the user access to the data at each step of the workflow.

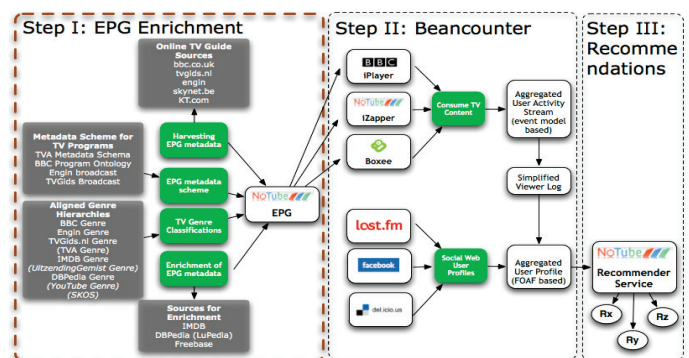


Figure 2. NoTube service workflow

STEP 1: ENRICH EPG DATA

Enrichments of EPG metadata are used to provide the end users with extra information about the content in which they are interested. For example, a scheduled broadcast of a movie could have an enrichment that enumerates the main actors together with pointers to Webpages about them at the Internet Movie Database (IMDB).

However such pointers are to HTML pages which can be understood by humans but a machine can not make good use of them, e.g. to determine which actors they are closely related to

³ <http://www.notube.tv/project/workpackages/20-wp7c-internet-tv-in-the-social-web>

(e.g. via a co-starring relationship). A recent movement on the Web to provide machine processable information about things is known as Linked Data⁴: the core principles are at everything has a unique URI to identify it, and that if a machine requests a resource from that URI they should get machine processable information about the thing. Linked Data uses a common data model known as RDF to represent information about things, and loose schemas have grown up to describe how to describe particular types of thing. However, few schema have achieved shared usage across Web sources, such as FOAF⁵ for persons, while the announcement of schema.org⁶ may provide now a new impetus towards common description schema for types of things. A key aspect of Linked Data is that things are related to other things via properties, e.g. a film is related to its director, actors, genres and shooting locations. Since the other things can also be referenced via Linked Data, further information can be acquired from them, including links to yet more things, etc.

Different Web sources, in particular the BBC, have embraced Linked Data and begun to publish their data according to Linked Data principles, making their content (e.g. different BBC TV programmes) uniquely referenceable (by URI) and able to provide machine understandable information about them. Figure 3 below shows a part of the Linked Data cloud (a visualization of all Linked Data sources on the Web) which covers TV and music data providers:

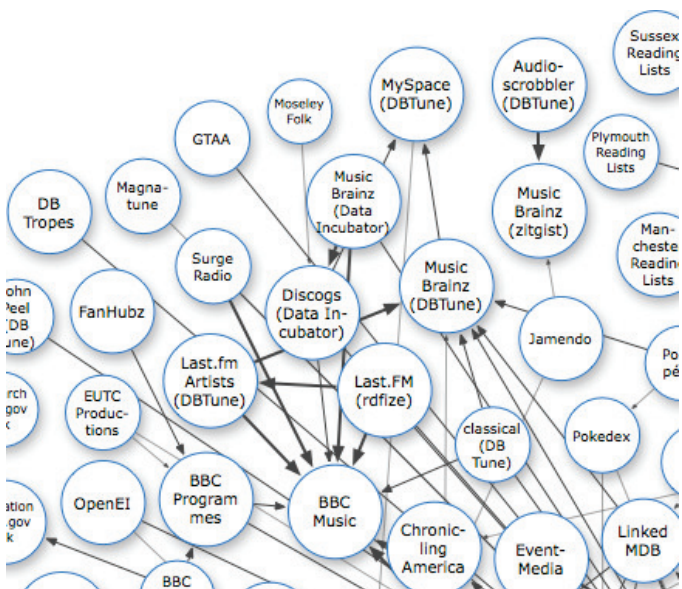


Figure 3. Part of the Linked Data cloud for TV and music⁷

By enriching the EPG data, links to semantic entities in the Linked Data cloud are added to the metadata of TV programmes. The interconnected entities in the Linked Data cloud allow for finding interesting relationships between entities, e.g. that two movies have been made by people that have a common interest in film noir.

⁴ <http://linkeddata.org>

⁵ <http://www.foaf-project.org>

⁶ <http://schema.org/>

⁷ Courtesy Linking Open Data cloud diagram, by Richard Cyganiak and Anja Jentzsch. <http://lod-cloud.net>

The task of enriching the TV metadata is a problem of NLP (Natural Language Processing). Many relevant entities to TV programs are mentioned in TV metadata currently only as text strings, and it is the task of our LUPedia⁸ tool to identify relevant named things and associate them via a property to a resource representing that thing in Linked Data. While specialized Linked Data sources are also usable, a commonly reused Linked Data source for identifying any thing is DBPedia⁹, a Linked Data publication of the information contained in Wikipedia articles and infoboxes.

LUPedia generates for a given TV programme a set of related Linked Data entities identified from its metadata, using DBPedia for identification of each entity, whether an event, a person, organization, place, or work (e.g. musical or artistic).

Taking a simple example, the BBC programme The Film Programme, episode first broadcast on 1 July 2011, has the Linked Data URI

<http://www.bbc.co.uk/programmes/b0124qtt>

The published synopsis of the programme mentions several actors and directors which can be extracted by LUPedia:

Lupedia enrichment service



LOOKUP OPTIONS:

- Skip matches shorter than 3 symbols
- Skip matches which are stop-words
- Keep only first and longest match at given point
- Skip matching position and return a list of distinct entities (JSON/XML only)
- Single greedy match only
- Keep only matches with highest weight
- Keep only the most specific class
- Case sensitive matching

Weight threshold: 0.50
 Output format: HTML

INPUT:

Francine Stock meets with Tom Hanks to discuss his new comedy Larry Crowne, and reveals why smoking marijuana and watching pornography doesn't necessarily make a character irredeemable.

Asghar Farhadi's A Separation was the first Iranian film to win the Golden Bear award at the Berlin film festival earlier in the year. As it gets its UK release, critic Karen Zazindost discusses this tale of a troubled marriage.

Director Bob Rafelson looks back at his celebrated feature from 1970, Five Easy Pieces, starring Jack Nicholson.

They were the first country to send a man into space but did Russia also win the cinematic space-race? Film historian Ian Christie discusses a glut of Russian-made films inspired by the cosmos.

Producer: Craig Smith.

DATASETS:

- LinkedMDB
 - Film
 - Director
 - Actor
 - Cinematographer
 - Producer
 - Writer
 - Film story contributor
- DBPedia
 - Event > Convention
 - Event > FilmFestival
 - Event > MilitaryConflict
 - Event > MusicFestival
 - Event > SpaceMission
 - Event > SportsEvent

Figure 4. using LUPedia to enrich EPG data (Human UI)

STEP 2: GENERATE USER MODELS

Another source of data from the Web, which can be used to generate a profile of interests for the viewer without explicitly requiring them to participate in an intrusive profiling process, is their Social Web activities. For example, a user's activity stream on Twitter or Facebook may contain postings of videos about different topics, and posts which mention things the user is interested in. Facebook recently announced that its users have liked TV shows 1.65 billion times¹⁰, indicating the scale of data about TV preferences such a platform can acquire.

⁸ <http://lupedia.ontotext.org>

⁹ <http://dbpedia.org>

¹⁰ <http://www.lostremote.com/2011/05/18/facebook-users-liked-tv-shows-1-65-billion-times/>

Other social networks are even more focused on TV related activity, gathering information about the programmes being watched, liked, not liked (e.g. Miso <http://gomiso.com> or GetGlue <http://getglue.com>). Some interactive TV platforms now also integrate TV program recommendation and liking into the viewing experience directly, e.g. Boxee or BBC iPlayer.

This leads to a mass of information about user interests. In NoTube we analyse this information – with the user’s permission – extracting relevant entities as with the EPG enrichment and generating from this an user profile of weighted interests, where those interests are identified by Linked Data concepts. An user interface is available to allow users to create their profiles via the social Web activities, known as the *NoTube beancounter*. It currently supports analysis of user activity in Facebook, Twitter and Last.fm. The provision of an UI for the Beancounter is part of NoTube’s dedication to allowing users to understand and control their own profiles – they choose which Social Web accounts to connect or disconnect, and may also add or remove individual topics in their profiles as desired.

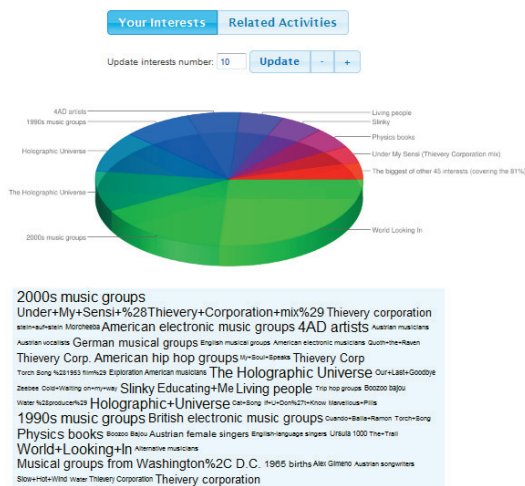


Figure 5. An user profile graph in the NoTube beancounter

STEP 3: RECOMMEND CONTENT TO USERS

Recommender algorithms that fall in the category of content-based filtering algorithms use content descriptions of the items for determining the relevance to the users. To give a simple example, when a user often watches content annotated with the Western concept, then other content annotated with the same or related concepts may be interesting to her – e.g. cowboys, Clint Eastwood. However, in NoTube we have recognized that such direct recommendations prove to be of little use – a Western fan is likely aware of such related programming. As such, today it is collaborative filtering recommendation which achieves the most usage in Web systems, and now by extension in the social TV world, i.e. viewers regard with trust recommendations for TV watching sent to them from their friends in social networks, and to a lesser extent can be

recommended TV programs liked by others who are considered by some means to be similar to them in TV preferences. However, this approach is still likely to miss a great deal of the long tail content in TV archives, which is of relevance to people but, since it is not watched by any others, can also not be recommended to the new TV viewer.

The use of Linked Data means we can re-use the existing expressed links between things in the Linked Data cloud to determine how closely related two entities are. For example, different types of entity could be categorized to belong in specific genres (e.g. aliens for Science Fiction, zombies for Horror) and matched to TV program genres. As a result, a user with a strongly weighted interest in aliens (from their generated profile in Step 2) is recommended more Science Fiction TV. However, Linked Data can also contain, or uncover, more surprising links between concepts. For example, how are the US TV comedy series Happy Days and the pornographic film Deep Throat related? Via Linked Data, one can follow the link from Happy Days to the character actor Ron Howard, who years later co-produced the documentary Inside Deep Throat, which deals with the story behind the making of the Deep Throat film. While this “surprising” link may not be the desired result of a recommendation, it shows well how Linked Data may connect users to TV they would not have otherwise considered watching, yet is reflective in some way of their interests.

In NoTube, we continue to explore how following links in Linked Data can help uncover “serendipitous” links between user interests and TV programming, along related topics, and how this can be used to provide more useful and interesting TV recommendations, particularly for “long tail” content usually forgotten deep in TV archives.

I. SHOWCASES FOR BETTER TV

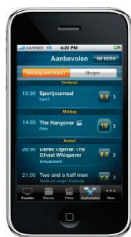
The NoTube project has three showcases which prototypically demonstrate the better TV made possibly by the integration of social and semantic data into the TV experience.

Personalised News from RAI

The RAI demonstrator shows how news programmes enriched with concepts (people, places, themes) allow the creation of a news stream personalized to the viewer combined with easy browsing to additional information.



Figure 6: screenshot from personalized news showcase



The IFanzy demonstrator enables a user to create an interests profile in a simple fashion, which can be used to generate recommendations of TV programs within the EPG view. It runs as an app on both ConnectedTVs and on smartphones.



Figure 7: screenshot from personalized EPG showcase

Social Television from the BBC

The BBC demonstrator aims to explore how best to connect our activities on the Social Web with our experience of TV. Primarily, it explores three use cases:

- (1) Using existing Web behaviour to generate recommendations for TV
- (2) Bookmarking TV to the Web
- (3) Enhancing TV programme viewing with background information from the Web.

This showcase focuses on a second screen as a solution to the problem of TV viewing while interacting and accessing additional information. An open API is developed for communication between the connected TV and the second screen, e.g. to share which program is currently being watched, to make it easier for the viewer to enhance and share with others their TV experience.



Figure 8: BBC social television showcase with TV and second screen device

Also the media owners and TV service operators can benefit from the approach taken in NoTube. The convergence of TV and Web in a growing range of “connected devices” and the growth in sales of such devices to consumers means future TV viewers are just as connected online as when active in other activities. “Second screen” scenarios are a current focus of TV services, since it detracts less from the TV program itself (on the main screen) and the local second screen device is more amenable to user interaction. The cost of building apps around TV content at present is quite high, both due to the closed nature of the content itself and the fragmentation of the TV platforms for which the application may be implemented. The success of the Internet, and of the Web, was grounded in open standards and interoperability: every browser *should* be able to access and display the same Web content (disclaimer necessary!). Similar moves in the IPTV platform space, whether YouView, hbbTV or GoogleTV, have yet to show fruit. NoTube reduces the cost of TV application development through the re-use of open Web data and provides services over that data, such as LUPedia, the Beancounter and recommendation engine, that could make new TV apps possible for social and semantic television. As long as connected devices have HTML(5) browsers installed, Web apps are an appealing trajectory to take for new TV services as well, to overcome the current platform fragmentation.

III. CONCLUSIONS AND FUTURE WORK

The NoTube approach, demonstrated by the accompanying showcases, is focused on the wish to make television more social, more personal and more in the control of the user. It is built around a vision of open data and open APIs which allow for eased and seamless integration of Web content with TV programming, across different devices. TV is largely a passive experience, while much of the future expectations around digital and interactive TV, in which the Web is seamlessly integrated, rely on active user participation. Our experiments have shown it is important to get not just the user interface, but the user *experience*, right. Initial evaluations with test users have indicated that this can meet their needs for future experiences of television¹¹ but work needs to be done on more serendipitous recommendation of TV content, as well as integrating deeply the NoTube technology into the TV experience so that the benefits can be wrought without expecting TV viewers to make many extra interactions.

ACKNOWLEDGMENT

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¹¹ See blog posts on NoTube evaluations: <http://notube.tv/2011/07/01/finding-interesting-new-programmes-trial-results/>; <http://notube.tv/2011/06/20/results-of-second-screen-usability-study/>