NoTube

Networks and ontologies for the transformation and unification of broadcasting and the Internet

FP7 – 231761

D5.5 Implementation of eCommerce-Oriented Video Annotation Environment

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EXECUTIVE SUMMARY

The objective of this deliverable is to provide an overview of the implementation "Watch 'n' Buy", an eCommerce-oriented video annotation system on the social semantic Web. "Watch 'n' Buy" is a Web application developed following the methodology of Linked Services, i.e. most of its components are encapsulated as Semantic Web Services (SWS). Therefore, we introduce the underlying services support to the harvesting, scraping and enrichment of the metadata about videos and products. We also illustrate the usage of those services by concrete examples. A microblog-like portal and Web-based video player are built on top of those services, which sever as the user interface of "Watch 'n' Buy". We highlight their key features and present screenshots to show the current state of them. Finally, we introduce the work in integrating "Watch 'n' Buy" with the TEAPlayer, which involves the mapping between the conceptual models respectively adopted by "Watch 'n' Buy" and TEAPlayer.

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Abstract (for dissemination)	The objective of this deliverable is to provide an overview of the implementation "Watch 'n' Buy", an eCommerce-oriented video annotation system on the social semantic Web. "Watch 'n' Buy" is a Web application developed following the methodology of Linked Services, i.e. most of its components are encapsulated as Semantic Web Services (SWS). Therefore, we introduce the underlying services support to the harvesting, scraping and enrichment of the metadata about videos and products. We also illustrate the usage of those services by concrete examples. A microblog-like portal and Web-based video player are built on top of those services, which sever as the user interface of "Watch 'n' Buy". We highlight their key features and present screenshots to show the current state of them. Finally, we introduce the work in integrating "Watch 'n' Buy" with the TEAPlayer, which involves the mapping between the conceptual models respectively adopted by "Watch 'n' Buy" and TEAPlayer.
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TABLE OF CONTENTS

List of Figures

List of Tables

List of Acronyms

Acronym	Description
API	Application Programming Interface
GUI	Graphic User Interface
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
OWL	Web Ontology Language
RDF	Resource Description Framework
RDFS	RDF Schema
SIOC	Semantically-Interlinked Online Communities
SWS	Semantic Web Services
UNSPC	United Nations Standard Products and Services Code
URL	Uniform Resource Locator
W3C	World Wide Web Consortium
WP	Working Package
XML	eXtensible Markup Language
XSLT	Extensible Stylesheet Language Transformations

1. Introduction

This deliverable describes the implementation of "Watch 'n' Buy", an eCommerce oriented video annotation system. "Watch 'n' Buy" allows users buy products via the annotations on video. As reported in our previous deliverable 5.4, the overall architecture of "Watch 'n' Buy" is designed following the paradigm of Linked Services (see Figure 1) [1]. In short, the underlying components, e.g. the product and video metadata importers, are wrapped as Semantic Web Services (SWS), whose descriptions are published as Linked Data. With the support of Linked Services infrastructure, "Watch 'n' Buy" can choose proper services and invoke them on the fly. Dedicated Linked Services are developed for gathering the metadata from both the e-commerce websites (e.g. Amazon and eBay) and the video sharing websites (e.g. YouTube). Therefore, the rest of this deliverable first introduces the underlying services of "Watch 'n' Buy". Secondly, it highlights the key features of the Web portal and video player. Finally, it briefly describes the integration with the TEAPlayer, another NoTube prototype developed by WP7.

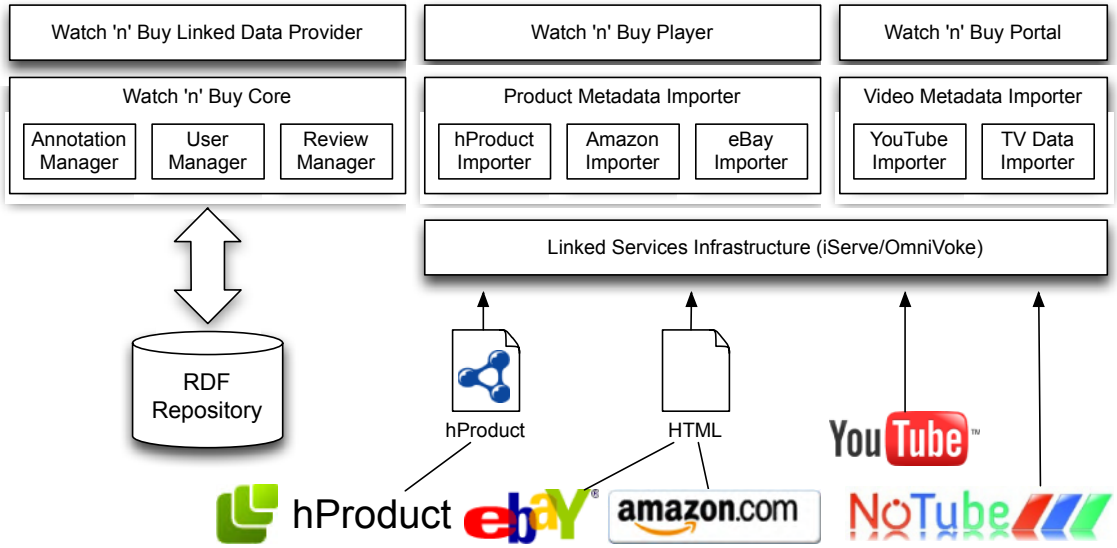

Figure 1. The overall architecture of Watch 'n' Buy.

2. Underlying Services

The "Watch 'n' Buy" application is implemented using the Linked Services technique. In particular, a set of Linked Services has been developed to support data harvesting, scraping and enrichment. This section elaborates the functionalities of those services, as well as presents examples of the invocation results.

2.1. Data Harvesting and Scraping

In order to realize the eCommerce oriented video annotation system, metadata of video and products need to be imported from distributed sources at Web scale. To this end, both the service-based data importing and screen scraping are adopted by "Watch 'n' Buy". For the Web sites such as YouTube, which provide dedicated APIs for metadata retrieval, the metadata can be imported via the invocation of such APIs. Taking the YouTube Data API[1] as an example, the metadata of each video clip can be retrieved from the following URL using the YouTube video ID as a parameter.

http://gdata.youtube.com/feeds/api/videos/{id}

Furthermore, the metadata are in the format of Atom Feed. For instance, the metadata of a video about The Royal Wedding in 2011, which is named "Prince William: I Decided It Was the Right Time", are available at http://gdata.youtube.com/feeds/api/videos/80ciGezyUDg, and presented as follows.

```
<?xml version='1.0' encoding='UTF-8'?>
<entry xmlns='http://www.w3.org/2005/Atom'
       xmlns:media='http://search.yahoo.com/mrss/'
       xmlns:gd='http://schemas.google.com/g/2005'
       xmlns:yt='http://gdata.youtube.com/schemas/2007'>
 <id>http://gdata.youtube.com/feeds/api/videos/80ciGezyUDg</id>
 <published>2010-11-16T21:22:21.000Z</published>
 <updated>2012-01-20T07:16:52.000Z</updated>
 <category scheme='http://schemas.google.com/g/2005#kind'
   term='http://gdata.youtube.com/schemas/2007#video'/>
 <category scheme='http://gdata.youtube.com/schemas/2007/categories.cat'
   term='News' label='News'/>
 <category scheme='http://gdata.youtube.com/schemas/2007/keywords.cat'
   term='royal_wedding'/>
 <title type='text'>Prince William: I Decided It Was the Right Time</title>
 <content type='text'>In a sit down interview, Prince William talks about finally
 becoming engaged to longtime girlfriend Kate Middleton and giving her his late
 mother's sapphire and diamond engagement ring.</content>
 <link rel='alternate' type='text/html'
   href='http://www.youtube.com/watch?v=80ciGezyUDg&amp;feature=youtube_gdata'/>
 <link rel='http://gdata.youtube.com/schemas/2007#video.responses'
   type='application/atom+xml'
   href='http://gdata.youtube.com/feeds/api/videos/80ciGezyUDg/responses'/>
 <link rel='http://gdata.youtube.com/schemas/2007#video.related'
   type='application/atom+xml'
   href='http://gdata.youtube.com/feeds/api/videos/80ciGezyUDg/related'/>
 <link rel='http://gdata.youtube.com/schemas/2007#mobile' type='text/html'
   href='http://m.youtube.com/details?v=80ciGezyUDg'/>
 <link rel='self' type='application/atom+xml'
   href='http://gdata.youtube.com/feeds/api/videos/80ciGezyUDg'/>
 <author>
   <name>AssociatedPress</name>
   <uri>http://gdata.youtube.com/feeds/api/users/associatedpress</uri>
 </author>
 <gd:comments>
   <gd:feedLink rel='http://gdata.youtube.com/schemas/2007#comments'
     href='http://gdata.youtube.com/feeds/api/videos/80ciGezyUDg/comments'
     countHint='334'/>
 </gd:comments>
 <yt:location>New York, NY</yt:location>
 <media:group>
```

[1] http://code.google.com/apis/youtube/2.0/developers_guide_protocol_audience.html

```
   <media:category label='News'
scheme='http://gdata.youtube.com/schemas/2007/categories.cat'>News</media:category>
   <media:content
url='http://www.youtube.com/v/80ciGezyUDg?version=3&amp;f=videos&amp;app=youtube_gd
ata'
type='application/x-shockwave-flash' medium='video' isDefault='true'
expression='full' duration='113' yt:format='5'/>
   <media:content
url='rtsp://v4.cache5.c.youtube.com/CiILENy73wIaGQk4UPLsGSJH8xMYDSANFEgGUgZ2aWRlb3M
M/0/0/0/video.3gp'
type='video/3gpp' medium='video' expression='full' duration='113' yt:format='1'/>
   <media:content
url='rtsp://v6.cache1.c.youtube.com/CiILENy73wIaGQk4UPLsGSJH8xMYESARFEgGUgZ2aWRlb3M
M/0/0/0/video.3gp'
type='video/3gpp' medium='video' expression='full' duration='113' yt:format='6'/>
   <media:description type='plain'>In a sit down interview, Prince William talks
 about finally becoming engaged to longtime girlfriend Kate Middleton and giving
 her his late mother's sapphire and diamond engagement ring.</media:description>
   <media:keywords>royal_wedding</media:keywords>
   <media:player
url='http://www.youtube.com/watch?v=80ciGezyUDg&amp;feature=youtube_gdata_player'/>
   <media:thumbnail url='http://i.ytimg.com/vi/80ciGezyUDg/0.jpg' height='360'
 width='480' time='00:00:56.500'/>
   <media:thumbnail url='http://i.ytimg.com/vi/80ciGezyUDg/1.jpg' height='90'
 width='120' time='00:00:28.250'/>
   <media:thumbnail url='http://i.ytimg.com/vi/80ciGezyUDg/2.jpg' height='90'
 width='120' time='00:00:56.500'/>
   <media:thumbnail url='http://i.ytimg.com/vi/80ciGezyUDg/3.jpg' height='90'
 width='120' time='00:01:24.750'/>
   <media:title type='plain'>Prince William: I Decided It Was the Right
 Time</media:title>
   <yt:duration seconds='113'/>
 </media:group>
 <gd:rating average='4.376344' max='5' min='1' numRaters='186'
   rel='http://schemas.google.com/g/2005#overall'/>
 <yt:recorded>2010-11-16</yt:recorded>
 <yt:statistics favoriteCount='80' viewCount='232313'/>
</entry>
```

In addition, YouTube also provides a Java library[2] that facilitates the manipulation of the metadata of videos. This Java library is exploited to develop the service for gathering the metadata of YouTube videos and transforming them into RDF statements conforming to the W3C Media Ontology [2]. The transformation results of the metadata of the aforementioned video are presented below.

```
video:ex1 a ma-ont:MediaResource ;
ma-ont:title "Prince William: I Decided It Was the Right Time" ;
ma-ont:description "In a sit down interview, Prince William talks about finally
becoming engaged to longtime girlfriend Kate Middleton and giving her his late
mother's sapphire and diamond engagement ring." ;
ma-ont:hasGenre category:News ;
ma-ont:locator <http://www.youtube.com/v/80ciGezyUDg> ;
ma-ont:duration "113"^^xsd:long ;
ma-ont:img <http://i.ytimg.com/vi/80ciGezyUDg/hqdefault.jpg>;
ma-ont:frameHeight "360"^^xsd:integer ;
ma-ont:frameWidth "480"^^xsd:integer ;
ma-ont:date "2010-11-16T21:22:21.000Z"^^xsd:dateTime .
```

On the other hand, two services are developed for scraping metadata of products. One is dedicated to processing the HTML pages that embed the micro-format of hProduct[3]. The other one is a generic service of transforming HTML pages into RDF triples by applying XSLT. With the generic transformation service, the "Watch 'n' Buy" system can find out and employ a suitable screen scraper

[2] http://code.google.com/apis/youtube/2.0/developers_guide_java.html
[3] http://microformats.org/wiki/hproduct

to generate RDF statements. The idea was inspired by a website called ScraperWiki[4], which aims to enable the sharing of "screen scrapers" in a wiki-like way. A screen scraper is a piece of code that can extract useful data from Web pages. Currently, we have developed scrapers for Amazon, eBay and hProduct. Third-party developers are allowed to upload new scrapers to extend the capability of the transformation service.

For example, with the help of the screen scraper, the metadata of a cluster ring being sold at Amazon is extracted from the HTML page[5], and presented as follows. It worth noting that the GoodRelations vocabulary is used as the data model of products and offerings.

```
offer:ex1 a gr:Offering ;
 gr:includes product:ex1 ;
 gr:hasPriceSpecification price:ex1 ;
 foaf:page <http://www.amazon.co.uk/gp/product/B004NYB67A> .

price:ex1 a gr:UnitPriceSpecification ;
 gr:hasCurrency "GBP" ;
 gr:hasCurrencyValue "22.47"^^xsd:float ;
 rdfs:label "£22.47" .

product:ex1 a gr:SomeItems ;
 gr:name "Silver Saphire/White CZ Cluster Ring" ;
 foaf:img <http://ecx.images-amazon.com/images/I/418UbP53OLL._SL500_AA280_.jpg> ;
 gr:category "Jewellery" ;
 gr:description "..." ^^rdf:XMLLiteral .
```

2.2. Data Enrichment

The "Watch 'n' Buy" system enriches the metadata by invoking the service of DBpedia spotlight[6], which can help the end-users to understand the descriptions of videos the specification of products. For example, the specification of the cluster ring mentioned before is sent to DBpedia spotlight.

```
Jewellery Information
Metal stamp: 925 Sterling Silver
Metal: Sterling Silver
Gem Type: Cubic Zirconia
Setting: Cluster Setting
Height: 1.6 centimetres
Width: 1.5 centimetres
Total Metal Weight: 3.5 grams
Ring Size: P
Resizable: No
Number Of Stones: 15
Cubic Zirconia Information
Minimum Colour: Blue
```

As a result, several links to the resources on DBpeida are added into the specification. Some of them explain the concepts such as "sterling silver", "centimetre", "ring size", etc.

```
Jewellery (http://dbpedia.org/resource/Jewellery) Information
Metal stamp (http://dbpedia.org/resource/Postage_stamp): 925 Sterling Silver
(http://dbpedia.org/resource/Sterling_silver)
Metal: Sterling Silver (http://dbpedia.org/resource/Sterling_silver)
Gem Type: Cubic Zirconia (http://dbpedia.org/resource/Cubic_zirconia)
Setting: Cluster (http://dbpedia.org/resource/Cluster_bomb) Setting
Height: 1.6 centimetres (http://dbpedia.org/resource/Centimetre)
Width (http://dbpedia.org/resource/Length): 1.5 centimetres
(http://dbpedia.org/resource/Centimetre)
Total Metal Weight: 3.5 grams (http://dbpedia.org/resource/Gram)
Ring Size (http://dbpedia.org/resource/Ring_size): P
Resizable: No
```

[4] https://scraperwiki.com/
[5] http://www.amazon.co.uk/gp/product/B004NYB67A
[6] http://dbpedia.org/spotlight

```
Number Of Stones (http://dbpedia.org/resource/Rock_%28geology%29): 15
Cubic Zirconia (http://dbpedia.org/resource/Cubic_zirconia) Information
Minimum Colour: Blue (http://dbpedia.org/resource/Color)
```

3. User Interface

This section describes the user interfaces of "Watch 'n' Buy", covering the Web portal and the video player. In short, the former is a microblog-like Web 2.0 application, and the latter is a Rich Internet Application (RIA) that performs the playback of video clips as well as the annotations on them.

3.1. Web Portal

One of the objectives of "Watch 'n' Buy" portal is to set up an online community to encourage annotating video clips and TV programmes with the semantically enhanced descriptions of products. Therefore, the annotations are treated as micro-blogs and presented as a timeline view on the portal (see Figure 2). More than that, the portal also provides social networking functionalities such as followers, feeds and the connectivity to other social websites. Clicking the screenshot of video, the user can watch it, while clicking the product image, the user can buy it.

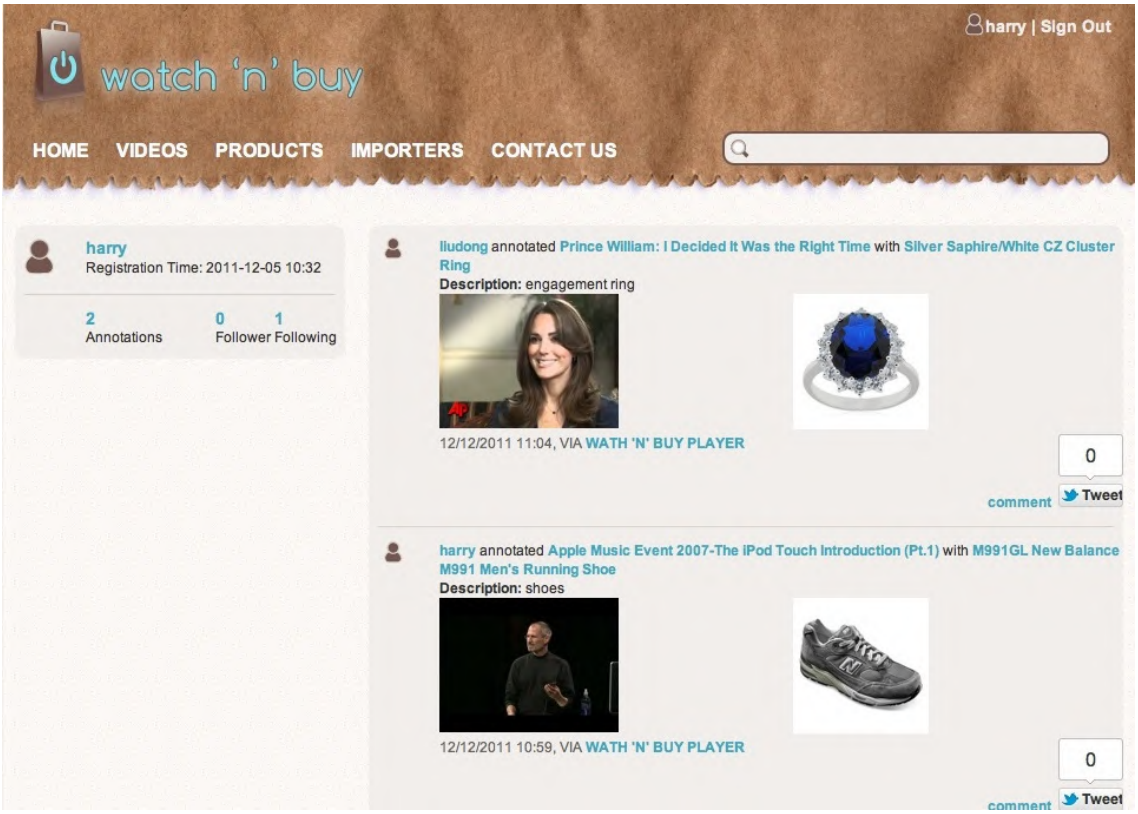

Figure 2. The Web portal of Watch 'n' Buy.

3.2. Video Player

The "Watch 'n' Buy" video player is essentially a Rich Internet Application (RIA) that helps in online video watching and annotating. The user can watch videos as usual. When he or she finds some interesting products and pauses the video, annotations will be shown on the screen and also listed on the right-hand side (see Figure 3).

Figure 3. The playback of annotations on a video.

On the other hand, the following steps show how to add an annotation to a video using the "Watch 'n' Buy" player:

- Pause the video and select a position on the screen (see Figure 4)
- Choose one from the three verbs, i.e. "saw", "sell" and "seek"
- Describe the products with several words
- Paste a URL pointing an offer of the product, if possible

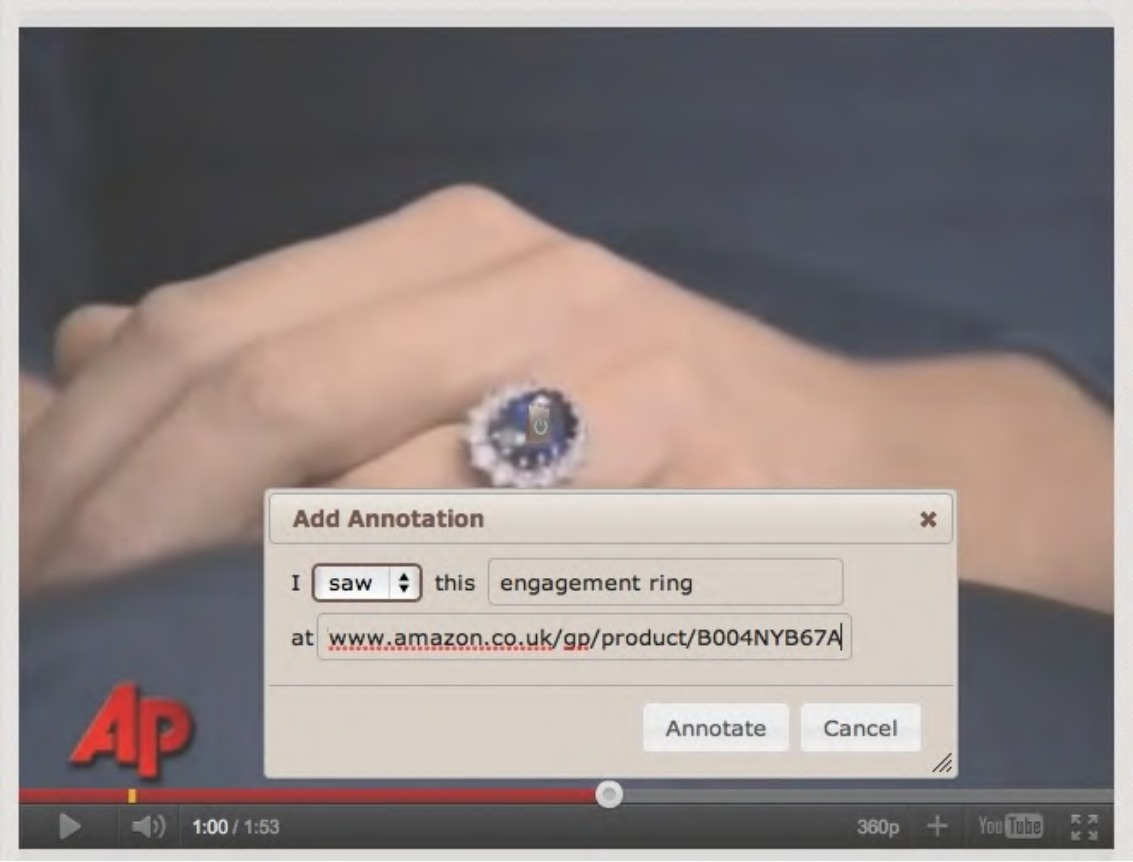

Figure 4. The playback of annotations on a video.

4. Integration with TEAPlayer

Two other NoTube prototypes, provisionally named "TEA" (Tv Extras Authoring) and "TEAPlayer" (Tv ExtrAs Player) have been created to demonstrate, respectively, real-time drag-and-drop collaborative annotation of video, and playback of those annotations on a second screen device synchronised with a larger video viewing screen. This section summarises the work on the integration of "Watch 'n' Buy" with the TEAPlayer, which covers the data model mapping and the results of the integration.

4.1. Data Model Mapping

TEA and TEAPlayer use a file format called LIMO[7] (Lightweight Interactive Media Objects) to describe the timing of annotations: LIMO was developed in the P2PNext[8] EU project. In contrast, as stated in deliverable 5.3, the conceptual model of "Watch 'n' Buy" is constructed by re-using several widespread ontologies and vocabularies, e.g. W3C Media Ontology [2], Timeline Ontology [3], GoodRelations [4], etc. Thus, the data model of "Watch 'n' Buy" is mapped to LIMO in the way shown in Table 1.

Table 1. Mapping between the data model of "Watch 'n' Buy" and LIMO.

Watch 'n' Buy	LIMO	
ma-ont:title of ma-onto:MediaResource	Index	title
ma-ont:date of ma-onto:MediaResource		date
ma-ont:img of ma-onto:MediaResource		depiction
ma-ont:hasCreator of ma-onto:MediaResource		owner
ma-ont:duration of ma-onto:MediaResource	Manifest	duration
ma-ont:locator of ma-onto:MediaResource		uri of media
ma-ont:img of ma-onto:MediaResource		image
gr:name of wnb:reference of wnb:Annotation	Event	title
foaf:page of wnb:reference of wnb:Annotation		link
tl:beginsAtInt of tl:onTimeline of wnb:Annotation		start
dc:nick of dc:creator of wnb:Annotation		display_name of user

The following data in the format of JSON show a video annotation that is created using "Watch 'n' Buy" player and transformed into LIMO.

```
{
  "results": [
    {
      "title": "Prince William: I Decided It Was the Right Time",
      "date": "2011-09-21T10:34:16.838Z",
      "id": "9999",
      "manifest": "http://dev.notu.be/2011/11/tea_limo/api/api/manifest
                   ?filename=dong_9999.json",
      "depiction": "http://i.ytimg.com/vi/80ciGezyUDg/hqdefault.jpg",
      "owner": "dong"
    }
  ]
}

{
  "duration": 113,
  "pid": 9999,
  "title": "Prince William: I Decided It Was the Right Time",
  "id": 9999,
  "media": {
```

[7] http://www.p2p-next.org/download.php?id=E7B1A7AAA6DAE914C981F89B638E6ABB
[8] http://www.p2p-next.org/

```
    "3gpp": {
      "uri":
"rtsp://v4.cache5.c.youtube.com/CiILENy73wIaGQk4UPLsGSJH8xMYDSANFEgGUgZ2aWRlb3MM/
0/0/0/video.3gp",
      "type": "video/3gpp"
    }
  },
  "image": "http://i.ytimg.com/vi/80ciGezyUDg/hqdefault.jpg"
}

{
  "limo": {
    "video_id": "9999",
    "media-resources": [
      {
        "limo-types": [
          "media"
        ],
        "id": "media1",
        "link": "http://dev.notu.be/2011/09/ted/api/about?fmt=js&q=9999",
        "transport": "download"
      }
    ],
    "version": "1.0",
    "event-resources": [
      {
        "limo-types": [
          "weblink",
          "comment"
        ],
        "id": "links1",
        "link":
"http://dev.notu.be/2011/11/tea_limo/api/events?filename=dong_9999.json",
        "transport": "download"
      }
    ],
    "updated": 1321733788.458,
    "created": 1321733788.458
  }
}

{
  "events": [
    {
      "data": {
        "format": "text/html",
        "title": "Silver Saphire/White CZ Cluster Ring",
        "link": "http://www.amazon.co.uk/gp/product/B004NYB67A"
      },
      "start": 62,
      "user": {
        "display_name": "dong"
      }
    }
  ],
  "id": "9999"
}
```


4.2. Watch 'n' Buy on TEAPlayer

We have been experimentally re-using “Watch ‘n’ Buy” annotations in the TEAPlayer second screen environment by using the LIMO file format as an integration point, with some success (see Figure 5). TEAPlayer allows the user to play video on an XBMC video player, using their smart phone as a remote control. TEAPlayer also loads the web pages referenced in the annotations on the second screen at the point in the video at which they are relevant, as specified in the LIMO file. Clicking on the link automatically pauses the video.

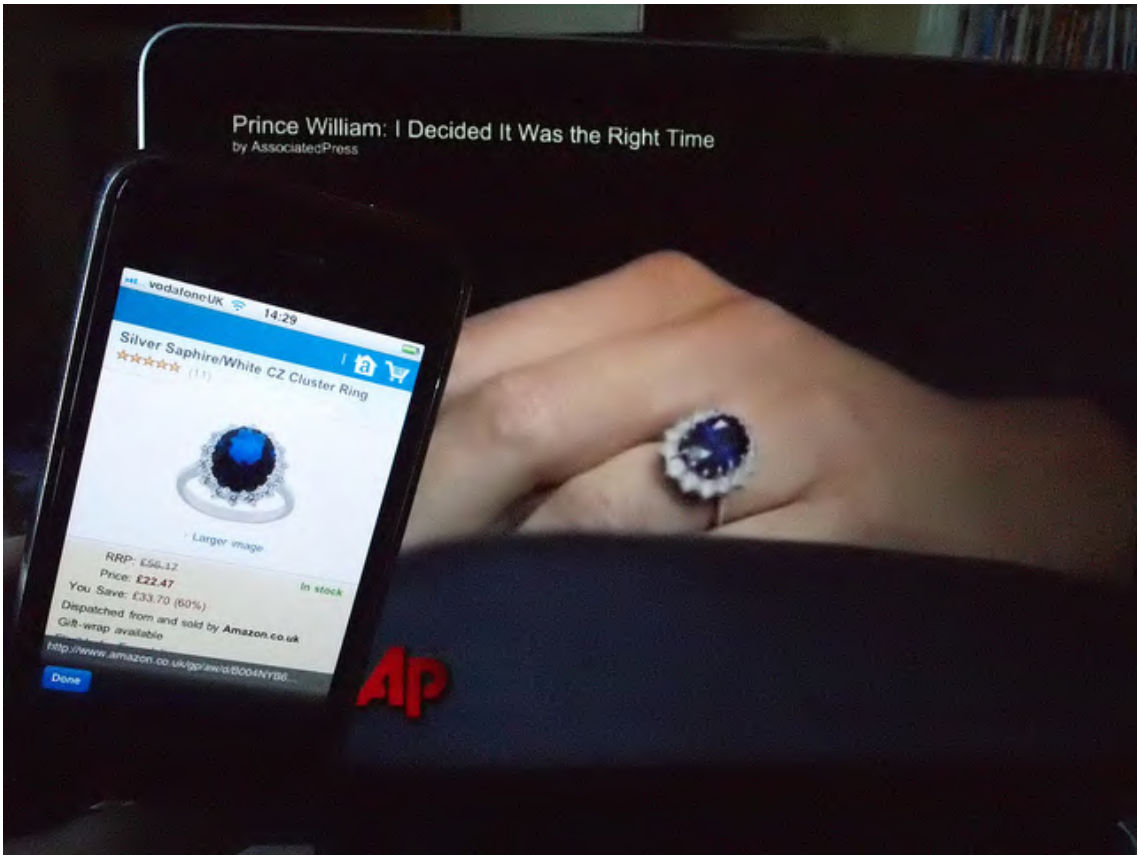

Figure 5. Watch ‘n’ Buy on TEAPlayer.

5. Conclusion

In this deliverable, we present the implementation of "Watch 'n' Buy", an eCommerce-oriented video annotation environment on the social semantic Web. Firstly, we describe the underlying services support to the harvesting, scraping and enrichment of the metadata about videos and products. Secondly, we introduces the current state of the Web portal and online video player of "Watch 'n' Buy". Finally, we discuss the integration with the TEAPlayer. We will carry out some case studies on the business model and compare with traditional advertisement insertion methods in terms of the advertisement effect. In addition, we will also improve the quality of video annotations and metadata enrichment.

6. References

[1] Pedrinaci, C., Domingue, J. (2010). Toward the Next Wave of Services: Linked Services for the Web of Data. Journal of Universal Computer Science 16(13), 1694–1719.
[2] W3C. (2011). Ontology for Media Resources 1.0, http://www.w3.org/TR/mediaont- 10/.
[3] Raimond, Y., Abdallah, S. (2007). The Timeline Ontology, http://purl.org/NET/c4dm/timeline.owl.
[4] Hepp, M. (2008). GoodRelations: An Ontology for Describing Products and Services Offers on the Web. In Proceedings of 16th International Conference on Knowledge Engineering and Knowledge Management Knowledge Patterns (EKAW 2008). Gangemi, A. and Euzenat J. eds. LNCS 5268, pp. 329–346.