



Project Number: **215219**
 Project Acronym: **SOA4All**
 Project Title: **Service Oriented Architectures for All**
 Instrument: **Integrated Project**
 Thematic Priority: **Information and Communication Technologies**

D2.8.1 Multimedia Semantic Search Tool

Activity N: 1	Fundamental and Integration Activities	
Work Package: 2	SOA4All Studio	
Due Date:	30/04/2011	
Submission Date:	30/04/2011	
Start Date of Project:	01/03/2008	
Duration of Project:	38 Months	
Organisation Responsible of Deliverable:	The Open University	
Revision:	1.0	
Author(s):	Hong Qing Yu	OU
	Maria Maleshkova	OU
	Carlos Pedrinaci	OU
Reviewers:	Guillermo Álvaro Rey	iSOCO
	Daniel Winkler	UIBK

Project co-funded by the European Commission within the Seventh Framework Programme (2007-2013)		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission)	
RE	Restricted to a group specified by the consortium (including the Commission)	
CO	Confidential, only for members of the consortium (including the Commission)	

Version History

Version	Date	Comments, Changes, Status	Authors, contributors, reviewers
0.1	15/04/2011	Document structure, table of contents	Hong Qing Yu (OU)
0.2	18/04/2011	Initial version	Hong Qing Yu (OU)
0.3	19/04/2011	Refined draft	Hong Qing Yu (OU) Maria Maleshkova (OU)
0.4	20/04/2011	Changes following the reviewers' recommendations and comments	Hong Qing Yu (OU)
1.0	29/04/2011	Final draft	Hong Qing Yu (OU) Maria Maleshkova (OU)

Table of Contents

1. INTRODUCTION	6
1.1 PURPOSE AND SCOPE	6
1.2 OVERALL ARCHITECTURE	6
2. DOCUMENTATION	8
2.1 ANNOMATION	8
2.1.1 <i>Video Annotation Ontology</i>	8
2.1.2 <i>Interface</i>	9
2.2 SUGARTUBE	10
2.2.1 <i>SugarTube Architecture</i>	10
2.2.2 <i>SugarTube Interface</i>	11
3. CONCLUSIONS	12
ANNEX A.	13

List of Figures

Figure 1: Overall Architecture of the Multimedia Semantic Search Application	6
Figure 2: Annotation Interface Snapshot.....	10
Figure 3: SugarTube Architecture	11
Figure 4: SugarTube Interface Snapshot.....	11

Glossary of Acronyms

Acronym	Definition
API	Application Programming Interface
D	Deliverable
EC	European Commission
EXT GWT	Extended GWT
FOAF	Friend Of A Friend
FP	Framework Program
FP7	The 7th Framework Program
GWT	Google Web Toolkit
SOA4All	Service-Oriented Architectures for All
SPARQL	SPARQL Protocol and RDF Query Language
SWS	Semantic Web Service
WS	Web Service

1. Introduction

This deliverable introduces a multimedia semantic search application that includes two components, namely Annomation and SugarTube (Semantics Used to Get Annotated video Recording) and each of the components can be seen as a separate tool. In particular, the deliverable documents the development of SugarTube, which uses the *iServe*¹ APIs and additional tools for service annotation, discovery and invocation in order to be able to mashup a wide range of data from the Web, especially aiming to support the semantic search of multimedia resources in the distance learning domain.

1.1 Purpose and Scope

The purpose of this deliverable is twofold. First, it serves as a documentation of the multimedia semantic search application with the Annomation and SugarTube components. Second, it represents detailed information about the application design and the relation between SugarTube and the *iServe* platform.

This deliverable is structured as follows: The rest of this section provides a general overview of the whole application. Section 2 includes detailed information about the components design and their interfaces. Finally, Section 3 provides a short conclusion.

1.2 Overall Architecture

Figure 1 shows the overall architecture of the multimedia semantic search application that mainly includes two components – Annomation and SugarTube. Annomation is only a supporting component that assists SugarTube in semantically searching the OU Video learning resources.

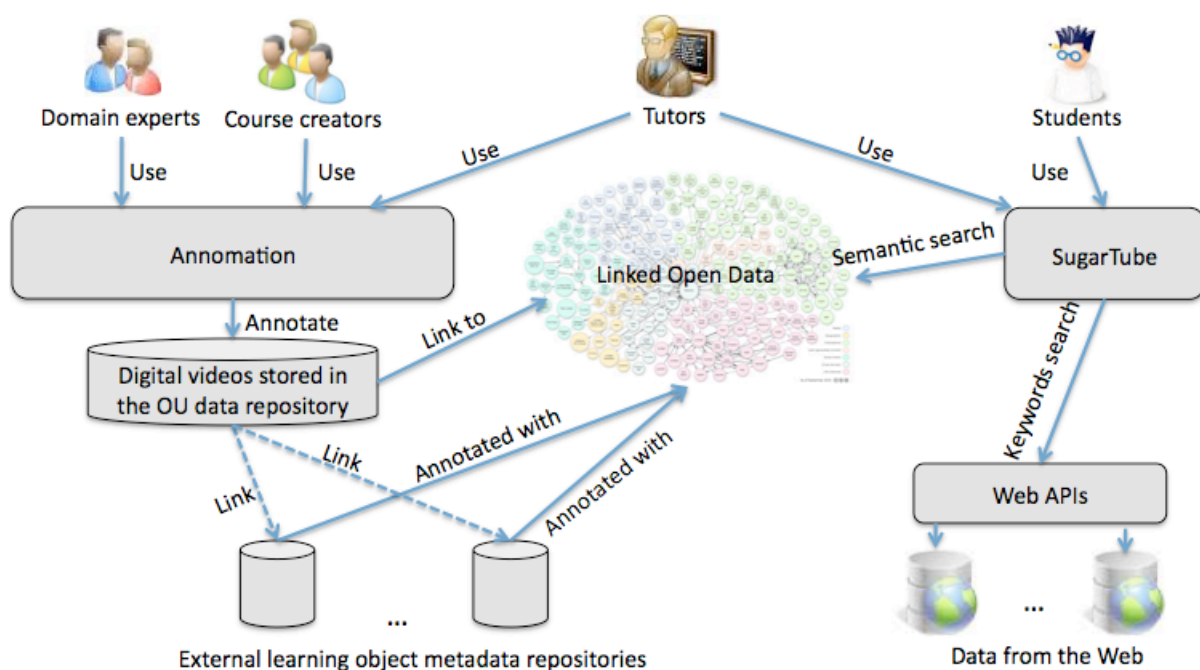


Figure 1: Overall Architecture of the Multimedia Semantic Search Application

¹ <http://iserve.kmi.open.ac.uk/>

Annomation², on the one hand is a collaborative Linked Data based online annotation platform that allows domain experts, course creators and tutors to annotate videos using vocabularies from the Linked Data cloud for different types of information (e.g. GeoName vocabularies for geo-location annotations). The usage of Linked Data makes annotations accurate, distinguishable and dereferencable. Furthermore, the result annotations are published as Linked Data as well; therefore, they are linked to other external related educational resources annotated with semantic related Linked Data vocabularies.

SugarTube³, on the other hand, provides an online browsing platform that allows tutors and students to browse the videos annotated by Annomation using both syntactic and semantic search functionalities. The semantic search does not only find video from the OU video repository but also delivers any linked resources from the Web. The syntactic search offers more syntax-based related resources from the Web. Typically, both the semantic and syntactic resources are provided by Web services. For this, SugarTube applies *iServe* APIs and tools that have been developed in *SOA4All*⁴ project as backend foundations.

² <http://annomation.open.ac.uk/annomation>

³ <http://sugartube.open.ac.uk>

⁴ <http://www.SOA4All.eu/>

2. Documentation

This section of the deliverable provides detailed information about Annomation and SugarTube in terms of design and interfaces. Since the SugarTube application is based on services/API-oriented architecture, the underlying technologies are based on the *iServe* platform that has been developed within the scope of the *SOA4All* project. We use *SWEET*⁵ for annotating relevant Web services, a *Service SPARQL endpoint API* (see deliverable D2.1.3 and D2.1.4) for discovering Web services and *Service invocation API* for invoking Web services.

2.1 Annomation

Annomation is a Semantic Web tool that allows users to collaboratively view a video, pause it, and add Linked Data annotations to instants or durations in the video.

2.1.1 Video Annotation Ontology

The video annotation ontology and annotation instances are stored in a Sesame quad store, and the ontology reuses a number of RDF vocabularies. These vocabularies include: FOAF⁶, Timeline ontology⁷ and Dublin Core⁸. To tie together the data described using these vocabularies, we designed a small vocabulary specific to the annotations, the core of which is:

```
@prefix : <http://annomation/annomation/ns/annomation#> .
@prefix owltime: <http://www.w3.org/TR/owl-time/#> .
@prefix foaf: <http://xmlns.com/foaf/spec/20100101.rdf/#> .

:MediaResource a rdfs:Class .

:Video a rdfs:Class .

:fronts a rdfs:Property ;

rdfs:domain :Video ; rdfs:range :MediaResource .

:Annotation a rdfs:Class .

:Mood a rdfs:Class .

:topic a :Mood ; rdfs:label "Topic of conversation"@en .

:inVideo a :Mood ; rdfs:label "In video stream"@en .

:inAudio a :Mood ; rdfs:label "In audio stream"@en .

:mood a rdfs:Property ;

rdfs:domain :Annotation ; rdfs:range :Mood .
```

⁵ <http://sweet.kmi.open.ac.uk/>

⁶ <http://xmlns.com/foaf/0.1/>

⁷ <http://purl.org/NET/c4dm/timeline.owl#>

⁸ <http://www.dublincore.org/schemas/rdfs/>


```

:annotates a rdfs:Property ; rdfs:domain :Annotation ; rdfs:range
:owltime:TemporalEntity .

:reference a rdfs:Property ; rdfs:domain :Annotation ; rdfs:range
:rdfs:Resource .

:creator a rdfs:Property ; rdfs:domain :Annotation ; rdfs:range
:foaf:Agent .

tl:onTimeline a rdfs:Property ; rdfs:domain :owltime:TemporalEntity; rdfs:range
:Video .

```

A simplified high level ontology explanation is that each annotation is created by a user for an instant time or time duration on a video. An annotation example is listed below:

```

<rdf:Description rdf:about=":/resource/2d917907a7d9">
  <rdf:type rdf:resource=":#Video"/>
  <anno:fronts rdf:resource=":/video/cu31648"/>
  <dc:title>Woods/ East Berlin</dc:title>
</rdf:Description>

<rdf:Description rdf:about=":/video/cu31648">
  <rdf:type rdf:resource=":#MediaResource"/>
  <anno:portal rdf:resource=":/"/>
  <anno:stream rdf:resource=":/video/cu31648"/>
</rdf:Description>

<rdf:Description rdf:about=":/resource/abae6b358da8">
  <rdf:type rdf:resource="timeline.owl#Interval"/>
  <tl:onTimeline rdf:resource=
"/resource/2d917907a7d9"/>
  <tl:at rdf:datatype="XMLSchema#duration">PT00.000S</tl:at>
  <tl:duration rdf:datatype="XMLSchema#duration">
PT01M56.000S</tl:duration>
</rdf:Description>

<rdf:Description rdf:about=":/resource/4b91890913d4">
  <rdf:type rdf:resource=":#Annotation"/>
  <anno:annotates rdf:resource=":/resource/abae6b358da8"/>
  <anno:reference rdf:resource="http://dewey.info/class/943"/>
  <anno:mood rdf:resource=":/ns/annomation#topic"/>
  <dc:creator rdf:resource=":/resource/519a723bf793"/>
  <dc:date rdf:datatype="XMLSchema#dateTime">2010-09-
16T15:01:26Z</dc:date>
</rdf:Description>

```

2.1.2 Interface

The Annotation interface (see Figure 2) is divided into four sections: a Flash video player (top left); a list of current annotations (top right); controls for the video player, and for entering new annotations (across the centre); and a set of panels to help the user find new Linked Data URLs (bottom). The bottom panels provide quick access to previously used tags, to the Dewey and Library of Congress classifications schemes, Open University course taxonomies, a service for suggesting URLs based on the Zemanta service⁹, and a visual map tool that uses GeoNames to find named geographical entities¹⁰.

⁹ <http://www.zemanta.com/>

¹⁰ <http://www.geonames.org/>

KMi The Open University **Annomation** You cannot make annotations until you [login](#)
Apollo 11 40th Anniversary

Videos | My Timeline | Group Timeline | Debug

01:28	00:14	http://www.astronautix.com/engines/j2.htm
01:42	00:11	http://dbpedia.org/resource/Neil_Armstrong
01:52	00:04	http://dbpedia.org/resource/Buzz_Aldrin
02:22	00:14	http://dbpedia.org/resource/Mission_Control_Center
02:24	00:06	http://dbpedia.org/resource/Mission_Control_Center
02:35		http://id.loc.gov/authorities/sh85078857
02:37	00:05	http://dbpedia.org/resource/Apollo_Lunar_Module
02:54		http://dbpedia.org/resource/Neil_Armstrong
03:14	00:29	http://dbpedia.org/resource/Richard_Nixon
03:45		http://data.open.ac.uk/topic/jacs2/f520
03:45		http://id.loc.gov/authorities/sh2010114279
04:12	00:06	http://dbpedia.org/resource/Michael_Collins_%28Astronaut%29
04:12	00:06	http://dbpedia.org/resource/Buzz_Aldrin

Show controls 2:19/4:51 Start Duration Tag Submit

Mood Note

Tags: Dewey | Library of Congress | OU Bluelist | OU JACS2 | Suggestions | Geographic

Show tags for
 This video All videos

Show tags from
 Everyone

Show tag names as
 Full URI Interesting bit

Order tags by
 Name Frequency

Use Tag

- <http://data.open.ac.uk/topic/jacs2/f520>
- http://dbpedia.org/resource/Apollo_Lunar_Module
- http://dbpedia.org/resource/Apollo_program
- <http://dbpedia.org/resource/Astronaut>
- http://dbpedia.org/resource/Buzz_Aldrin
- http://dbpedia.org/resource/Cape_Canaveral
- http://dbpedia.org/resource/John_F._Kennedy
- http://dbpedia.org/resource/Michael_Collins_%28Astronaut%29
- http://dbpedia.org/resource/Mission_Control_Center
- <http://dbpedia.org/resource/Moon>
- http://dbpedia.org/resource/Moon_landing
- http://dbpedia.org/resource/Neil_Armstrong

Figure 2: Annomation Interface Snapshot

2.2 SugarTube

SugarTube is developed to facilitate the searching of the OU educational video resources that are annotated by Annomation. Furthermore, it adopts the Semantic Web approach to search videos and explore their related online resources in a mashup navigation interface. Particularly, SugarTube uses *iServe* to discovery and invoke relevant services in order to obtain more related data from Web.

2.2.1 SugarTube Architecture

SugarTube mainly include 2 layers, namely the Mashup layer and the Linked Service layer (see Figure 3).

- *The Mashup layer* is the interface to communicate with users by understanding what users are looking for and presents the search results from all kinds of services to the users.
- *The Linked Service layer* is the data provider that allows upper layers to search for suitable services through *iServe*'s SPARQL query API and to invoke the suitable services to obtain relevant data through the *iServe* invocation API.

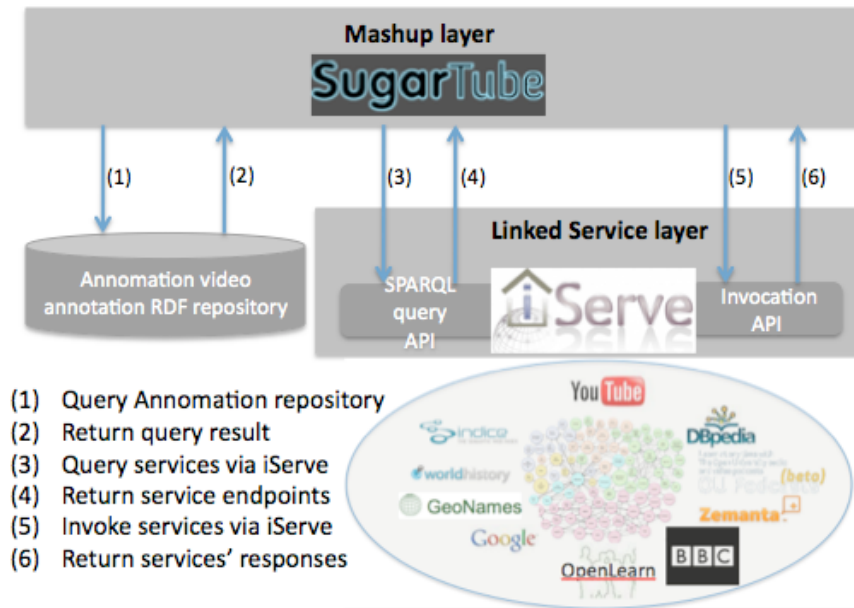


Figure 3: SugarTube Architecture

2.2.2 SugarTube Interface

Figure 4 displays the mashup results for a video search request. It consists of three main sections:

- The OU annotated video displaying section (Middle) that allows users to watch videos, see the annotation data and share the video with friends.
- The related knowledge section (right top) that includes the dereferencable data links from the Web, the geo-location map from GeoName and related learning resource metadata from the OU linked open datasets (via *iServe* platform).
- The related videos and TV programs section (right bottom) that contains all potentially related videos and TV programs metadata from YouTube, OpenLearn and BBC programs (via *iServe* platform).

The screenshot shows the SugarTube interface with the following sections:

- Search:** A search bar with the text "Cape Canaveral" and a "Search" button. Below it, there are options for "Person", "Event", "Place", and "Others".
- Search Results:** A video player showing "Apollo 11 40th Anniversary" with a duration of 4:52. Below the video, there are social media sharing options (Like, Facebook) and a list of 10 annotations with their corresponding URIs.
- Related Knowledge:** A section titled "Data from Web" and "OU Learning Resources" showing a list of linked resources with titles and URIs.
- Related videos/TV programs:** A section titled "Youtube", "OpenLearn", and "Coming TV programs" showing a list of video names and descriptions.

Figure 4: SugarTube Interface Snapshot

3. Conclusions

In this deliverable, we illustrated the multimedia semantic search application that use Linked Data technologies to semantically annotate and search educational video resources from the Open University video repository and link the videos to other educational resources on the Web. In particular, we show how *iServe* APIs and further SOA4All tools are used to provide SugarTube's application backend in order to be able to search for more useful data from the Web through relevant services dynamically.

Annex A.

This annex contains one publication about Annotation and SugarTube applications:

1. Lambert, Dave and Yu, Hong Qing. (2010) Linked Data Based Video Annotation and Browsing for Distance Learning, Workshop: SEMHE '10: THE SECOND INTERNATIONAL WORKSHOP ON SEMANTIC WEB APPLICATIONS IN HIGHER EDUCATION, Southampton, United Kingdom.

Abstract. We present a pair of prototype tools that enable users to mark up video with annotations and later explore related materials using Semantic Web and Linked Data approaches. The first tool helps academics preparing Open University course materials to mark up videos with information about the subject matter and audio-visual content. The second tool enables users, such as students or academics, to find video and other materials relevant to their study.