

An Indexing, Browsing, Search and Retrieval System for Audiovisual Libraries

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Abstract

This paper describes an application which enables the computer-assisted generation of Dublin Core-based metadata descriptions and online digital visual summaries for videos. It is a Java application which integrates a video replay window with vcr-type controls and metadata input forms generated from an hierarchical RDF schema. The schema definition is also used to validate the descriptions input by the user and control the format of the output. The generated metadata descriptions can be saved as RDF, HTML or to a database. They can be used to enable metadata interchange, searching across the Internet or dynamic generation of detailed visual summaries for video browsing. This prototype system has been developed for the State Library of Queensland's (SLQ) Audiovisual unit to enable quick, easy, cost-effective generation of standardized metadata which can be used to create online detailed visual summaries of the latest video acquisitions.

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1. Introduction

Technological advances are changing the roles of libraries. They must learn to provide enhanced access through improved reference services. Librarians today need to analyze, interpret and evaluate the vast array of information sources available. Developments in information technology are providing librarians with the opportunities to add value through continuous effective evaluation of information sources. Whitlach [[REF1](#)] suggests that libraries are migrating through three generations:

1. The first generation introduced automated online catalogs and CD-ROM indexes;
2. The second generation added enriched records which include tables of contents, summaries for books, abstracts for periodicals;
3. The third generation will incorporate evaluative elements into records e.g. notes on the type of audience, author's qualifications, purpose and scope of the work, links to reviews and other related resources.

Audiovisual collections traditionally lag behind textual collections in terms of basic services such as online access, search and retrieval. A book or periodical can be browsed by glancing through its table of contents. Audiovisual resources provide no such simple and effective summarial information. In addition the complex hierarchical information-rich nature of audiovisual collections causes value-added services such as analysis, interpretation and evaluation which librarians are expected to provide, to become much more difficult, subjective and time consuming.

Hence the goal of this project is to provide computer-based tools which will enable first-generation audiovisual libraries to catch up to third-generation text-based libraries by providing enhanced services through the generation of online summaries for quick browsing and links to reviews for evaluation and interpretation. We achieve this through the application of standardized Dublin Core metadata contained within an RDF schema. This approach enables existing Dublin Core-based search engines to be extended to search across different media types and also within specific video segments.

2. Objectives

This prototype was designed, implemented and tested using some the latest video documentaries acquired by the State Library of Qld's audiovisual collection [[HREF1](#)]. The objectives of this research project were:

- to provide a tool which enables standardized metadata and video summaries to be generated though a simple cost-effective, computer-assisted process;
 - to increase the usage of the audiovisual collection by providing Internet access to visually impressive detailed summaries using a combination of text, still images and video clips;
 - to reduce the time required by film and media researchers to locate particular, relevant video content;
 - to automate links to related interpretive and evaluative resources such as reviews, articles, papers or other works by the same creators;
 - to investigate qualifiers for the basic Dublin Core element set [[HREF2](#)] that extend its descriptive semantics to the specific characteristics of video objects and enable their resource discovery;
 - to investigate the utility of the Resource Description Framework (RDF) [[HREF3](#)] for expressing this qualification framework, by developing an RDF schema and validating descriptions against this schema;
 - to extend an existing Dublin-Core based search engine (DSTC's HotMeta) [[HREF4](#)] so that it can handle video metadata and investigate its ability to search and retrieve different media types.
-

3. Video Indexing

3.1 Traditional Video Cataloguing

Currently only bibliographic type indexing, based on US MARC tags, is performed on new video acquisitions at the State Library of Qld. Table 1 below shows the catalogue record, accessible via the library's OPAC, for one of the recently acquired documentaries from the NetPAC series. We use this particular video throughout the remainder of the paper as an example for illustrative purposes.

Table 1: MARC Record for Example Video

MARC TAG	DESCRIPTION	VALUE
082	Dewey Decimal Classification	305.89921
245	Title	The Sex Warriors and the Samurai (videorecording)
260	Publication Details	London: Formation Films for Channel Four, 1995
300	Physical Description	1 videocassette (27 min.) : sd., col. ; 1/2 in
514	Language	In Tagalog with English subtitles
522	Credits	Producer, Parminder Vir; Written and directed by Nick Deocampo.
545	Summary	Documentary about Jo-an who works in bars in Manila performing a drag act, and as a prostitute to support himself and his impoverished family. He works to get a work visa to enable him to go to Japan where he can earn money.
650	LCSH	Female impersonators - Philippines - Manila
651	Geographic SH	Manila (Phillipines) - Social Conditions

3.2 Digital Video Indexing

Typically the indexing of a digital video program consists of the following steps:

1. Segment the video hierarchically into sequences, scenes, and shots. (A *shot* is a continuous sequence of frames captured from one camera. A *scene* is composed of one or more shots which present different views of the same event, related in time or space. A *segment* is composed of one or more related scenes.)
2. Describe the complete video using bibliographic information (title, creator, dates, subjects, item numbers, publisher details, names, synopsis etc.) plus format, framerate, duration etc.
3. Describe each sequence - id, start time/frame, end time/frame, brief textual summary.
4. Describe each scene - id, start time/frame, end time/frame, brief textual summary, transcript (ideally derived from a closed caption decoder).
5. Describe each shot - id, start time/frame, end time/frame, keyframe (first frame of the shot, ideally derived from an automatic shot detection algorithm).

If closed captions are available then a closed caption decoder may be used to extract the transcript. However the majority of the videos which are acquired by the audiovisual unit do not contain closed captions. And when they do, the method by which the closed captions are encoded varies from country to country, often making their extraction highly problematic. Assuming closed-captions have been extracted, then there is still a need for the time-consuming step of generating scene summaries from the transcript.

Software is available [[HREF5](#)], [[HREF6](#)] which is capable of detecting scene changes (the first frame from each new scene) and saving them as image files e.g. GIF or JPEG images. However there are a number of problems with this automated approach. Scene change detection methods are improving but they can experience difficulties when there are fades, pans between scenes or fast motion within scenes. But more importantly, scene changes are often not the most visually impressive, aesthetic, evocative or even representative images for a particular scene.

For our particular application, we propose that the best method is a computer-assisted, interactive, human-controlled approach, at least until the following technologies become available:

- Image processors which are capable of measuring aesthetics or visual impact;
- An international closed caption encoding standard or decoders capable of handling the different video formats (PAL, NTSC) and closed-caption encoding methods;
- Software which can automatically generate summaries from transcripts.

3.3 Video Metadata

An earlier paper [[HREF7](#)] compares various alternative approaches to video metadata and concludes that the ideal approach is to combine Dublin Core [[HREF2](#)] and MPEG-7 [[HREF8](#)] metadata descriptions within an aggregated RDF description [[REF2](#)],[[HREF3](#)]. Dublin Core can be used for high level generic searching across both text and multimedia objects whilst the MPEG-7 (Multimedia Content Description Interface) standard will eventually enable the low-level fine grained media-specific search and retrieval. Since MPEG-7 is still at such an early stage of development, we have decided to investigate the capabilities of a pure (qualified) Dublin Core approach. The additional advantage of this approach is that existing Dublin-Core based search engines can be used with very little modification.

Below we show how Dublin Core can be applied to index the documentary described above. For the search and retrieval requirements of most of the users of the audiovisual collection, it is sufficient to provide only a bi-level metadata structure. Complete video documents sit at the top level and each video document contains a number of consecutive scenes which sit at the secondary level. Below are the descriptions for the complete video and the first scene. The descriptions for the other scenes use the same elements as for scene 1 but the content is different.

Most of the metadata for the complete video document can be retrieved directly from the existing MARC records by mapping MARC tags to Dublin Core elements. Some fields require simple reformatting or pre-processing.

The metadata generator application described in section 4, enables the descriptions to be input into forms displayed alongside the actual video replay window.

- **Complete Video Documentary**

Title = The Sex Warriors and the Samurai
Creator = Producer, Parminder Vir; Written and directed by Nick Deocampo.
Subject = Female impersonators - Philippines - Manila

Description = "Documentary about Jo-an who works in bars in Manila performing a drag act, and as a prostitute to support himself and his impoverished family. He works to get a work visa to enable him to go to Japan where he can earn money."
 Publisher = London: Formation Films for Channel Four, 1995
 Date = 1995
 Type = "Image.Moving.Film.Documentary"
 Format = 1 videocassette (27 min.) : sd., col. ; 1/2 in
 Identifier = QVC 305.89921 sex vhs
 Source = QVC 305.89921 sex vhs
 Language = In Tagalog with English subtitles
 Relation.HasPart = scene1, scene2, scene3, scene4, scene5,...
 Coverage = Manila (Philippines) - Social conditions

• **Scene1**

Description.transcript = "Jo-an has worked for 10 years in bars like this in Manila. Now with the Government's crack-down on the flesh industry, Jo-an finds it difficult to support a family. The yen is luring Filipinos away and Jo-an has been determined to leave for Jin Ch Pui, Japan's entertainment capital. I wanted to find out what Jo-an has to go through to make the journey to the land of the samurai."
 Description.keyframe = "http://www.slq.qld.gov.au/av/scene1.gif"
 Description.clip = "http://www.slq.qld.gov.au/av/scene1.mpg"
 Type = "Image.Moving.Film.documentary.scene"
 Format.length = 2min 25 secs
 Coverage.t.min scheme=SMPTE content= 19:31:57;1
 Coverage.t.max scheme=SMPTE content= 19:32:07;1
 Relation.IsPartOf = video_doc

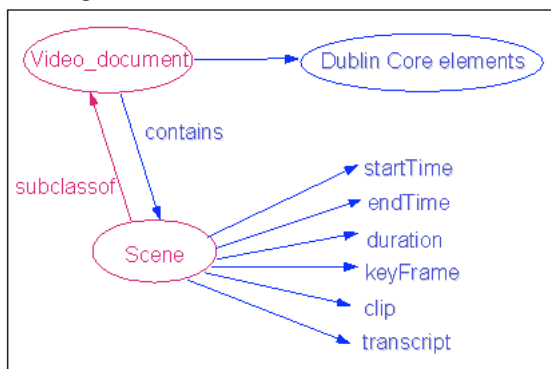
3.4 The RDF Schema and Description

An RDF Schema is used to define the hierarchical structure of the video documents and the attributes associated with each level. It is used to generate the form fields for inputting and editing the metadata for both the complete video document and each of the scenes. It is also used to constrain and validate the input and to define the RDF output file format.

In the schema, the fifteen Dublin Core properties are associated with the top-level *Video_document* class. In addition, there is a *contains* property, whose domain is the *Video_document* class and whose range is the *Scene* class. The *Scene* class is defined as a sub-class of *Video_document* so that it inherits all of the Dublin Core properties. In addition the *Scene* sub-class has its own additional descriptive properties: *duration*, *startTime*, *endTime*, *keyFrame*, *clip* and *transcript*.

Figure 1 below illustrates the RDF data model for the video documents in this application. Classes are drawn in red and properties are blue. The complete RDF schema is shown in Appendix A.

Figure 1: RDF Data Model for Video_document



4. The "Veggie" Video Metadata Generator

The original idea behind the Video Metadata Generator was to extend DSTC's Reggie application [HREF9], a metadata generator and editor for textual documents, to video documents. Two key differences between the Reggie application and the "Veggie" application had a major impact on design considerations:

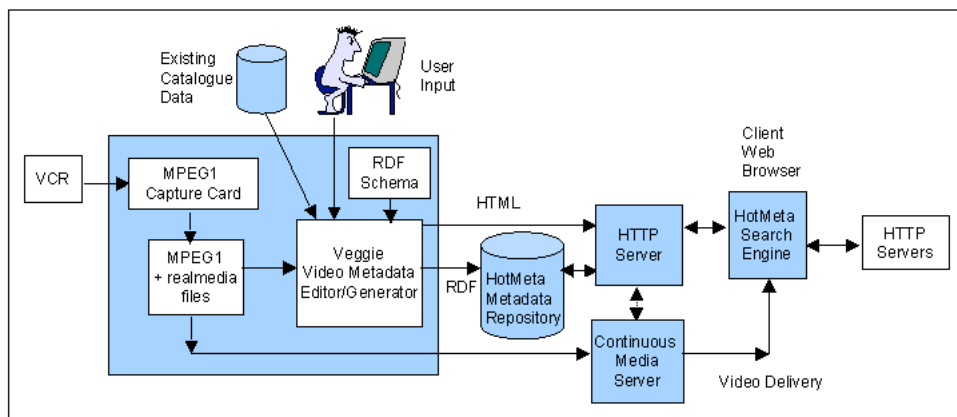
- The need for an integrated video replay window. This enables the user to simultaneously view the video and edit the metadata descriptions, and to segment and index the video via vcr controls and links between the video window and the metadata fields.
- The hierarchical, layered nature of video documents which demand different metadata forms for each layer. For example the top level video document has different metadata fields to the lower level scene segments.

4.1 The System Architecture and User Interface

Figure 2 below illustrates the overall system architecture.

A number of recent acquisitions from the SLQ Audiovisual Unit's video collection were digitized using a Broadway video capture card. Both mpeg1 and realmedia formats were captured. Metadata for a particular video is created by running the Veggie (Java) application and opening the corresponding mpeg1 video file. This displays the video file in a video window and reads an RDF schema file to generate a form containing fields for the metadata entry.

Figure 2: System Architecture



The metadata for the complete video document is entered first. Alternatively this can be read from the existing catalogue by mapping the US MARC records into the Dublin Core fields. The user interface is shown in a screen capture in Figure 3 below.

Figure 3: Video-level Metadata Form

File	View
Video details	
Title	Sex Warriors and the Samurai
Creator	Nick Deocampo
Subject	Female Impersonators – Phillipines
Description	Documentary about Jo-an who works in a bar in Manila performing a drag act and as a prostitute to support himself and his family. He wants a work visa to go to work in Japan.
Publisher	Formation Films for Channel Four
Contributor	Parminder Vir
Date	1995
Type	16mm, NTSC U-matic video
Format	mpeg1
Identifier	clip3.mpg
Source	

After the metadata for the complete video document is entered, the Veggie application enables users to segment the video into "scenes" using the vcr controls and a timeline on the video window and to enter the metadata for each scene.

A scene-level metadata form (Figure 4) is generated from the RDF schema file and the temporal (startTime, endTime, duration) and keyFrame values can be specified in the vcr window and inserted automatically into the relevant metadata fields via links between the form fields and the vcr window. Users can also enter the transcript for the current scene.

Figure 4: Scene-level Metadata Form

File	View
Scene 1	
StartTime	3.579995815
EndTime	
Duration	
KeyFrame	scene1.jpg
Clip	clip1.mpg
Transcript	Who needs to pas de deux in bed?

Once the metadata description for the current video is complete, then users have a choice of saving it as RDF or HTML 4.0. Examples of output are shown in Section 4.3 below.

4.2 The Output

Currently users can save their metadata descriptions as RDF or HTML 4.0. Ideally, the system could also be configured so that Veggie is integrated directly with HotMeta and the metadata is saved directly into the HotMeta repository. Alternatively, the SLQ may want to save the metadata into their own database and generate the HTML summaries dynamically from this database using CGI or Java scripts.

4.2.1 RDF Output

Below is the RDF metadata description for the SLQ video "The Sex Warriors and the Samurai" described above. The description has been generated from the video metadata generator using user input and the RDF schema described above. Only the metadata for the first scene is shown. The metadata for the other eight scenes is similar and can be deduced from this.

```
<?xml version="1.0" ?>
<RDF xmlns="http://www.w3c.org/TR/WD-rdf-syntax#"
  xmlns:dc="http://purl.org/metadata/dublin_core#"
  xmlns:dq="http://purl.org/metadata/dublin_core_qualifiers#"
  xmlns:videoschema="http://www.dstc.edu.au/video-schema">

  <Description About="http://www.dstc.edu.au/videos/sex_warriors.mpg">
    <rdf:type resource="#Video"/>
    <DC:Title>The Sex Warriors and the Samurai</DC:Title>
    <DC:Creator>Producer, Parminder Vir; Written and directed by Nick Deocampo.</DC:Creator>
    <DC:Subject>Female impersonators - Philippines - Manila </DC:Subject>
    <DC:Description>Documentary about Jo-an who works in bars in Manila performing a drag act,
      and as a prostitute to support himself and his impoverished family. He
      works to get a work visa to enable him to go to Japan where he can earn
      more money. </DC:Description>
    <DC:Publisher>London : Formation Films for Channel Four, 1995 </DC:Publisher>
    <DC>Date>1995</DC>Date>
    <DC:Type>Image.Moving.Documentary</DC:Type>
    <DC:Format>1 videocassette (27 min.) : sd., col. ; 1/2 in</DC:Format>
    <DC:Identifier>QVC 305.89921 sex vhs </DC:Identifier>
    <DC:Language>In Tagalog with English subtitles</DC:Language>
    <DC:Coverage>Manila (Philippines) - Social conditions </DC:Coverage>
    <videoschema:contains>
      <Seq>
        <LI ID="scene1" Resource="http://www.dstc.edu.au/videos/sex_warriors.mpg#scene1"/>
        <LI ID="scene2" Resource="http://www.dstc.edu.au/videos/sex_warriors.mpg#scene2"/>
        <LI ID="scene3" Resource="http://www.dstc.edu.au/videos/sex_warriors.mpg#scene3"/>
        <LI ID="scene4" Resource="http://www.dstc.edu.au/videos/sex_warriors.mpg#scene4"/>
        <LI ID="scene5" Resource="http://www.dstc.edu.au/videos/sex_warriors.mpg#scene5"/>
        <LI ID="scene6" Resource="http://www.dstc.edu.au/videos/sex_warriors.mpg#scene6"/>
        <LI ID="scene7" Resource="http://www.dstc.edu.au/videos/sex_warriors.mpg#scene7"/>
        <LI ID="scene8" Resource="http://www.dstc.edu.au/videos/sex_warriors.mpg#scene8"/>
        <LI ID="scene9" Resource="http://www.dstc.edu.au/videos/sex_warriors.mpg#scene9"/>
      </Seq>
    </Description>

    <Description About="http://www.dstc.edu.au/videos/sex_warriors.mpg#scene1">
      <rdf:type resource="#Scene"/>
      <DC:Type>Image.Moving.Documentary.scene</DC:Type>
      <startTime>00:00:00</startTime>
      <endTime>00:03:19;25</endTime>
      <duration>3 mins 20 secs</duration>
      <keyFrame>"http://www.dstc.edu.au/images/sex_warriors1.gif"</keyFrame>
      <clip>"http://www.dstc.edu.au/videos/sex_warriors.ra"</clip>
      <transcript>"Jo-an has worked for 10 years in bars like this in Manila. Now with the
        Government's crack-down on the flesh industry, Jo-an finds it difficult to
        support a family. The yen is luring Filipinos away and Jo-an has been
        determined to leave for Jin Ch Pui, Japan's entertainment capital. I wanted
        to find out what Jo-an has to go through to make the journey to the land of
        the samurai."</transcript>
    </Description>

    etc.....

  </RDF>
```

4.2.2 HTML Output

If the metadata is saved as HTML, then a web page is created automatically which represents a visual summary of the video. The HTML output for the video example "Sex Warriors and the Samurai" can be found at [\[HREF1\]](#). The metadata for the overall video document is saved as metatags in the header of the HTML file, as shown below. This complies with the Internet Draft by John Kunze [\[HREF12\]](#) which specifies how Dublin Core can be encoded in HTML. The keyframes for each scene are laid out sequentially and below each keyframe are the corresponding time stamps and transcript. Clicking on a keyFrame causes the associated realmedia clip to be played.

```
<META NAME="DC.Title" CONTENT="The Sex Warriors and the Samurai">
<META NAME="DC.Subject" CONTENT="Female impersonators - Philippines - Manila">
<META NAME="DC.Creator" CONTENT="Producer, Parminder Vir; Written and directed by Nick Deocampo">
<META NAME="DC.Description" CONTENT="Documentary about Jo-an who works in bars in Manila performing a drag act, and as a prostitute to support
<META NAME="DC.Publisher" CONTENT="London: Formation Films for Channel Four, 1995">
<META NAME="DC.Date" CONTENT="1995">
<META NAME="DC.Type" CONTENT="Image.Moving.Film.Documentary">
<META NAME="DC.Format" CONTENT="1 videocassette (27 min.) : sd., col. ; 1/2 in ">
<META NAME="DC.Identifier" CONTENT = "305.89921">
<META NAME="DC.Source" CONTENT="QVC 305.89921 sex vhs">
<META NAME="DC.Language" CONTENT="In Tagalog with English subtitles">
<META NAME="DC.Coverage" CONTENT="Manila (Philippines) - Social conditions">
<META NAME="DC.Rights" CONTENT="Copyright Formation Films Ltd 1995">
```

4.3 The Search Engine

DSTC's existing HotMeta Search Engine [[HREF4](#)] crawls over specified sites, extracts and indexes metadata from embedded HTML Meta tags and saves it in a metadata repository.

If the output from Veggie is saved to HTML 4.0 and added to a site covered by HotMeta, then the metadata will be added to the HotMeta repository. HotMeta searches which match the video metadata will retrieve the video summary page.

Certain extensions could be made to both Veggie and HotMeta to improve the integration between them. It is possible to insert the video metadata descriptions directly into the HotMeta repository and to retrieve links to the actual video clips rather than the summary pages.

We would also like to investigate replacing the existing GIF keyFrame images with PNG [[HREF13](#)] images in which the metadata is embedded and extending HotMeta to extract metadata from the PNG images and add it to the repository.

5. Conclusions and Future Work

We have developed an application which can be used by audiovisual librarians to quickly and easily create detailed, visually-stunning summaries of their latest video acquisitions. At the same time, the application generates standardized metadata descriptions which can be used by existing Dublin Core-based Internet search engines to enable the resource discovery of video documents. We believe that this tool will enable librarians to provide third-generation, value-added services for audiovisual collections, such as they are currently providing for textual resources.

Future Work includes:

- Integrating the digitization process and the metadata input process. Currently these are two separate processes which ideally would be carried out within a single application.
 - Installing and testing the prototype within the SLQ Audiovisual unit. So far the system has only been tested at DSTC using SLQ content. We would like to investigate the system's feasibility within a real library environment. In particular, we are interested in determining the average time it will take an experienced video cataloguer to generate the metadata for each new acquisition.
 - Determining whether the online visual summaries generate increased interest and usage of the audiovisual collections by monitoring the number of hits to the SLQ Audiovisual web site and the borrowing statistics before and after deployment of this system.
 - Integrating Veggie with HotMeta by enabling the metadata to be added directly into the HotMeta metadata repository.
 - Extending HotMeta to enable viewing of retrieved realmedia video clips.
 - Replacing GIF and JPEG scene changes with PNG images containing embedded metadata.
 - Automating the search over authoritative film review sites to automatically retrieve related reviews, articles and links to other works by the same creators.
-

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- HREF13

Appendix A: The RDF Schema

```
<rdf: RDF
  xmlns:rdf = "http://www.w3.org/TR/WD-rdf-syntax#"
  xmlns:rdfs = "http://www.w3.org/TR/WD-rdf-schema#"
  xmlns:dc = "http://purl.org/metadata/dublin_core#">

<rdfs:Class ID="Video_document">
<rdfs:comment>Class for representing a generic video document</rdfs:comment>
</rdfs:Class>

<rdfs:comment>Define all of the DC elements for Video_document </rdfs:comment>

<rdf:PropertyType ID="Title">
<rdfs:comment>This is the DC Title element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Title"/>
</rdf:PropertyType>

<rdf:PropertyType ID="Creator">
<rdfs:comment>This is the DC Creator element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Creator"/>
</rdf:PropertyType>

<rdf:PropertyType ID="Subject">
<rdfs:comment>This is the DC Subject element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Subject"/>
</rdf:PropertyType>

<rdf:PropertyType ID="Description">
<rdfs:comment>This is the DC Description element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Description"/>
</rdf:PropertyType>

<rdf:PropertyType ID="Publisher">
<rdfs:comment>This is the DC Publisher element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Publisher"/>
</rdf:PropertyType>

<rdf:PropertyType ID="Contributor">
<rdfs:comment>This is the DC Contributor element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Contributor"/>
</rdf:PropertyType>

<rdf:PropertyType ID="Date">
<rdfs:comment>This is the DC Date element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Date"/>
</rdf:PropertyType>

<rdf:PropertyType ID="Type">
<rdfs:comment>This is the DC Type element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Type"/>
</rdf:PropertyType>

<rdf:PropertyType ID="Format">
<rdfs:comment>This is the DC Format element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Format"/>
</rdf:PropertyType>

<rdf:PropertyType ID="Identifier">
<rdfs:comment>This is the DC Identifier element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Identifier"/>
</rdf:PropertyType>

<rdf:PropertyType ID="Source">
<rdfs:comment>This is the DC Source element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Source"/>
</rdf:PropertyType>

<rdf:PropertyType ID="Language">
<rdfs:comment>This is the DC Language element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Language"/>
</rdf:PropertyType>

<rdf:PropertyType ID="Relation">
<rdfs:comment>This is the DC Relation element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Relation"/>
</rdf:PropertyType>

<rdf:PropertyType ID="Coverage">
<rdfs:comment>This is the DC Coverage element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Coverage"/>
</rdf:PropertyType>

<rdf:PropertyType ID="Rights">
<rdfs:comment>This is the DC Rights element </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="http://purl.org/metadata/dublin_core#Rights"/>
</rdf:PropertyType>

<rdfs:comment>Define the Scene class and its properties </rdfs:comment>

<rdfs:Class ID="Scene">
<rdfs:comment>Class for representing a scene from a video document. It is a subclass of Video_document</rdfs:comment>
<rdfs:subClassOf rdf:resource="#Video_document"/>
</rdfs:Class>
```

```
<rdf:PropertyType ID="contains">
<rdfs:comment> Property related to a video asset stating that a video consists of a number of sequences. </rdfs:comment>
<rdfs:domain rdf:resource="#Video_document">
<rdfs:range rdf:resource="#Scene">
</rdfs:PropertyType>

<rdf:PropertyType ID="duration">
<rdfs:domain rdf:resource="#Scene">
<rdfs:range rdf:resource="http://www.w3.org/TR/datatypes/#Time"/>
</rdf:PropertyType>

<rdf:PropertyType ID="startTime">
<rdfs:domain rdf:resource="#Scene">
<rdfs:range rdf:resource="http://www.w3.org/TR/datatypes#Time"/>
</rdf:PropertyType>

<rdf:PropertyType ID="endTime">
<rdfs:domain rdf:resource="#Scene">
<rdfs:range rdf:resource="http://www.w3.org/TR/datatypes#Time"/>
</rdf:PropertyType>

<rdfs:PropertyType ID="keyFrame">
<rdfs:domain rdf:resource="#Scene">
<rdfs:range rdf:resource="http://www.w3.org/TR/datatypes#Image"/>
</rdfs:PropertyType>

<rdf:PropertyType ID="clip">
<rdfs:domain rdf:resource="#Scene">
<rdfs:range rdf:resource="http://www.w3.org/TR/datatypes#realvideo"/>
</rdfs:PropertyType>

<rdf:PropertyType ID="transcript">
<rdfs:domain rdf:resource="#Scene">
<rdfs:range rdf:resource="http://www.w3.org/TR/WD-rdf-schema#Literal">
</rdfs:PropertyType>
```