

Film database: the future of digital cinema

Jane de Almeida
Mackenzie University
Rua da Consolação, 930
São Paulo, SP, 01302-907
janedealmeida@mackenzie.br

Denise Stringhini
Federal University of São Paulo
Rua Talim, 330, 12231-280
São José dos Campos, SP
dstring@gmail.com

Cicero Inacio da Silva
Federal University of São Paulo
Rua Sena Madureira, 1500, 4th floor
São Paulo, SP, 04021-001
cicero.silva@unifesp.br

Maria Amélia Eliseo
Mackenzie University
Rua da Consolação, 930
São Paulo, SP, 01302-907
mamelia@gmail.com

Fernanda Maria Oliveira Araújo
Mackenzie University
Rua da Consolação, 930
São Paulo, SP, 01302-907
fernanda.araujo@gmail.com

ABSTRACT

Nowadays there is an increasing appeal to systematize the archiving and the search of digital audiovisual content. On one hand, the Internet works like a huge repository. Although, to create an intelligent search method to work well all over the Internet media content is very complex. The web search engines typically rely on ranking algorithms that could be inefficient in some specific cases. On the other hand, there are some private collections that could rely in more efficient media management methods. One interesting perspective is to create shared media repositories among selected members like in a grid virtual organization approach. The goal of such grid initiatives, like Cinegrid, is to systematize the production, the storage and the distribution of original finished or unfinished digital content among members. The goal of the present research is to collaborate to such media grid environments in two ways. First, developing an intelligent distributed search engine based on ontology. This ontology will be built on strong metadata, creating relationships among objects based on content types, formats, year of production, copyright restrictions, etc. Second, this distributed ontology mechanism will be evaluated through the development of an application that will help a producer, director or editor to search related reusable content from a distributed media repository like Cinegrid.

Categories and Subject Descriptors

I.4.1 Digitization and Image Capture

General Terms

Standardization, Documentation

Keywords

film, database, ontology, 4k, 8k

1. INTRODUCTION

Scientific visualization is extremely important to support the comprehension of nature phenomena. Specialized equipments, like telescopes and microscopes, produce images that could be explored in documentary movies in order to disseminate science. On the same way, the artistic and cultural patrimonium could be preserved and shared through digitized image collections.

The ultra-high definition technology could already be used to produce such images or movies with more and more

ways. Projects like Cinegrid (www.cinegridbr.org) have the goal of create a distributed repository of such media contents, allowing ultra speed transmission among the distributed nodes.

This work foresees the the proliferation of such media collections and proposes tools that could be used to systematize the search and the effective use and dissemination of such rich material. The first challenge is to create a universal metadata model that will be associated to each media file in order to identify all the important characteristics related to its content, production and copyrights.

Considering the natural growing of the media collection and the possibility of reusing the unfinished media material, it would be interesting to provide an intelligent search that could explore relationships among media objects.

The second challenge is to develop a suitable ontology capable of create such logical connections. Since the distributed nature of repositories, like the one proposed by Cinegrid, the ontology based search engine must work using a distributed algorithm, which is the third challenge of the present research.

The fourth challenge is to develop an application to help the production of scientific and cultural documentary movies from, at least in part, the reuse of media objects. The challenge is to develop a suitable interface connected to the distributed ontology based search engine. The idea is that this interface could execute a search with strong results, which means strong relationships among selected media objects.

The preliminary results presented here are related to the second challenge, that is the development of the ontology. Nonetheless, this paper also describes the context of the research and it is organized as follows. First, we present the project's methodology, followed by the preliminary results defining the domain ontology and finally the conclusion.

2. METHODOLOGY

This research is divided in four components described bellow.

2.1 Definition of a universal open metadata

The standardization of audiovisual content of super high-resolution digital format has required a series of studies by the responsible sectors for the creation, distribution and promotion of this material. Various sectors of the audiovisual field have faced with an accelerated need to think about some patterns and reading systems, archiving and distribution of the contents stored in digital systems.

Several groups in several countries are discussing about standardization. However, we still need to break several technical and conceptual barriers to integrate databases of

details, helping scientists to analyse the images in deepest model, which is not purely commercial and not be guided only in the interests of large distributors of audiovisual content.

These models can also be used to think about archiving processes of content (movies and videos) generated by general public, including images and movies created by researchers.

The metadata proposed by this work will be defined through the analysis of models already in development by other locations such as European Union, Japan and United States models. The suggested model will take into account the scenario of digitization of audiovisual content that is quickly replacing the previous technical standards of cinema.

The metadata will take into account, for example, digital file formats, their features like read and write access patterns, shipping, registration, copyright and security. In order to help the creation of a domain ontology, fields with content characteristics will be also added to the standard. These items are not listed by any standardization body and there are still no standards developed for these processes.

The standardization suggested here takes into account the theoretical models of open source software. It is expected that companies who deal with films would want to keep the restrictions that were imposed on the distribution format on film before. However, these restrictions completely lose their meaning when the storage formats of content becomes digital, thus affordable and rapid to distribute and disseminate.

We are not saying that repositories should disregard the rights of exploitation and circulation of cinematographic works, but on the other hand, what we propose is the ability to store any format (JPEG 2000 , TIFF , RAW , MPEG4 , etc.), and this system can categorize and systematize the patterns of access and reading.

The metadata defined in this research will be open and will be available for the community.

2.2 Definition of a universal open domain ontology

Domain ontologies express conceptualizations that are specific for particular domains like arts, medicine or architecture. They are reusable in a given domain. They provide vocabularies about the concepts within a domain and their relationships and about the theories and elementary principles governing that domain [1]. The domain ontology puts constraints on the structure and contents of domain knowledge that describes factual situations in a certain domain [2]. Based on these principles, this research project proposes a domain ontology with concepts in audiovisual domain and their relationships [3]. This domain ontology will be developed based on the universal open metadata also proposed by this project and will be available for reuse by the community.

Typically, an ontology consists of a finite list of terms and the relationships between these terms. The terms denote important concepts (classes of objects) of the domain. Developing an ontology requires descriptions for the following:

a) Classes: describe concepts in the domain; it can have

digitized data, creating a more open and democratic access than the superclass. A class is a set of objects called individuals or instances;

b) Relationship: defines hierarchies of classes;

c) Properties: describe features and attributes of the concept;

Besides subclass relationships, ontologies may include information such as: value restrictions, disjointness statements and specifications of logical relationships between objects. In order to create a suitable ontology, a close integration between researchers of both areas proposed by this project will be required. Besides, we will explore some already published ontologies in the domain of Arts and Humanities in order to define our specific domain ontology.

2.3 Development of an ontology based distributed search algorithm

The distributed nature of grid based media repositories requires that the search engine be also distributed. Grid environments are composed by several certified and authorized nodes, meaning that only authorized members of a virtual organization are allowed to use the grid. The distributed algorithm will be developed to work on such environment. The distributed ontology based search engine will have the capability to access all target nodes, capture relationships among objects and present the search results.

Since we consider a distributed media repository organized as a grid of interrelated nodes the algorithm will have to work over a distributed catalog of media objects. The algorithm must respect some requirements of scalability, access transparency, location transparency, security, rights of access etc.

In order to develop and test its functionalities, a testbed grid environment will have to be constructed, with nodes located in the region of Sao Paulo connecting the participant institutions. Considering the relationship already established with Cinegrid, we intend to use the same open software for data grid used by the association: the iRods data grid middleware. As a consequence, we hope to collaborate in disseminating such a powerful tool for deploying data grids in our institutions.

2.4 Development of an open interface that helps in finding interesting media objects

This interface will be connected to the distributed ontology base search engine and will help a documentary producer, director or editor to find interesting objects in a distributed media repository. Its design will also require collaboration between the researchers involved in this project and some usability tests will be performed at the near end of its development.

The aim is that this interface could execute a search with strong results, which means strong relationships among selected media objects. Europeana is an inspiring portal with this resources.

Europeana is an internet portal that acts as an interface to millions of books, paintings, films, museum objects and archival records that have been digitised throughout Europe. It is a meta-aggregator site, the term aggregator refers to a software tool in combination with an internet portal that collates digital data from multiple online repositories. Semantic-searching is a research prototype created for Europeana by the Vrije Universiteit Amsterdam (vu.nl) that uses linked data, which gives machines the ability to make associations and put search terms into

subclasses that represent concepts that are more specific connected concepts such as items in the Louvre, a Paris-based institution, or paintings portraying people named Paris, such as the Greek prince who abducted Helen of Troy. From there, more links point the way to topics like the 'myth of Paris' or the mythical Apple of Discord - a golden apple that sparked a dispute and eventually led to the Trojan War - and then on to the forbidden apple eaten by Adam and Eve.

We want similar results with our proposed metadata and domain ontology, but in a multimedia grid based repository capable of managing ultra-high definition media files.

3.0 PRELIMINARY RESULTS IN DOMAIN ONTOLOGY

Describing the structure and the content of audiovisual work is very complex. The challenge is making the standardization of a description that can be used for retrieving relevant video sequences or for enhancing their content to produce other rich media documents. At the same time it must be flexible enough to be reusable, shareable and enable efficiently the access to the information. Efforts have been undertaken to develop tools suitable for audiovisual peculiarities.

3.1 Related work

The reference [4] built an ontology to enable the inclusion and exchange of multimedia content through a common understanding of the associated MPEG-7 multimedia content descriptions. MPEG-7 is a standard for describing multimedia content. The goal of this standard is to develop a rich set of standardized tools to enable both humans and machines to generate and understand audiovisual descriptions. These descriptions can be used to enable fast efficient retrieval from digital archives as well as to filter streamed audiovisual broadcasts on the Internet (push applications).

An audiovisual specific description language, modular, reduced, but designed to be extensible was introduced by [5]. The language is centered on the notions of descriptor and structure with a well-defined semantics. The descriptors can be combined into structures according to defined models that provide description patterns.

The CineGrid Description Language (CDL) developed by [6] describes the resources and services used within CineGrid Exchange. CDL concerns to define and categorize concepts that are used in CineGrid use cases. Describes the tasks a device can perform for the users of the Exchange.

To enable information exchange and integration between heterogeneous sources of cultural heritage information [7] had developed the CRM (Conceptual Reference Model), a formal ontology that describes cultural documentation in logical terms. It aims at providing the semantic definitions and clarifications needed to transform disparate, localized information sources into a coherent global resource.

Although its structure was based in cultural heritage and museum documentation the CRM is flexible and extensible for other applications. By its very structure and formalism it can be adapted to describe the narrative of audiovisual resources. It provides resources to describe temporal entity, objects and actors.

In order to develop a suitable ontology capable of create relationships among media objects that explore all the complexity of information comprised in the repositories like Cinegrid, we are analyzing the possibility of combine different ontologies and metadata. Table I shows the resources to be used in this combination and the contribution of each one.

TABLE I
RESOURCES USED TO COMBINED ONTOLOGIES

Resource	Description	Contribution related to describe
MPEG-7	set of standardized tools for describing different aspects of multimedia at different levels of abstraction like audiovisual descriptions	multimedia content
AVDL (Audio-Visual Description Language)	an audio-visual specific description language centered on the notions of descriptor and structure	features of the media (signals, taxonomies, structures)
CDL (CineGrid Description Language)	an ontology that describes the resources and services used within CineGrid Exchange	technical features of the CineGrid in terms of heterogeneous hardware
CRM (Conceptual Reference Model)	a formal ontology intended to facilitate the integration, mediation and interchange of heterogeneous cultural heritage information	narrative context

Table II shows the preliminary features need to be addressed by the semantic annotations to represents audiovisual domain in terms of narrative context. Thus, the CRM structure will be used. We had experimented the CRM to describe changes occurred in a building throughout time and space in a 3D animation. The semantic annotations and temporal relations have been efficient and effective to depict the narrative context in this case [8]. Due this we believe CRM will be also effective to portray the narrative context of audiovisual resources.

TABLE II
FEATURES COMPRISED BY THE SEMANTIC ANNOTATION TO REPRESENTS AUDIOVISUAL DOMAIN IN TERMS OF NARRATIVE

Dataset	Description
Classification	Identifies the classification of work
Category	Identifies the type of work
Genre	Identifies the similarities in the narrative elements from which the work are constructed
Author/Creator/ Production	Person, group or other entity that has contributed to the design, creation, production, manufacture, or alteration of the work
Title	The title or identifying phrase given to a work
Theme	The theme or subject which is treated at work
Language	The original spoken language
Creation Date	Date or range of dates associated with the creation, production, presentation, performance, construction, or alteration, etc. of the work
Creation Location	The geographic location or site-specific work or other entity whose boundaries include the creation work
Context/Content/Abstract	Terms or phrases that describe, identify, or interpret the work or and what it depicts or expresses
Context Date	Date or range of dates associated with the context of the work
Context Location	The geographic location or other entity whose boundaries include the context work
Characters	characters act at work
Format	Identifies the characteristics regarding image capture
Copyrights	Information about copyrights management

In this context the next steps to define an universal open domain ontology will be to analyze the suitable metadata for media content based in MPEG-7, merge the metadata, AVDL, CDL and CRM, verify the consistency and completeness of this combination and verify its adherence to CineGrid.

4.0 CONCLUSION

The relevance of this research resides in to develop software and tools to manage large distributed media repositories devoted to science and cultural media objects. The main innovation is to develop a domain specific ontology as well as to implement a distributed search engine based on this ontology. We hope the system will help to disseminate the production and digitization of scientific and cultural media material as well as to propagate it through the production and distribution of documentary movies.

The interdisciplinary nature of the project certainly brings contributions to both Computer Science and Arts and Humanities

domains. From the Computer Science (CS) point of view we have to manage distributed repositories of media content, including huge ultra-high definition images and movies. This managing activity includes the description of media files from a well-defined metadata and the development of a domain ontology to create strong relationships among media objects. Further, a distributed ontology based search engine will have to work over distributed media repositories which is another contribution to CS.

Specifically to the Arts and Humanities point of view, the contribution will be the development of an application connected to this search engine. As this application will help to produce scientific and cultural documentary movies, we consider it as a plus to scientific and cultural domains of knowledge. The possibility of reuse of scientific and cultural digitized media content is also another contribution to the field.

5.0 REFERENCES

- [1] A. G. Pérez and V. R. Benjamins. (1999, August, 2). "Overview of Knowledge Sharing and Reuse Components: Ontologies and Problem-Solving Methods", Proceedings of the IJ-CAI-99 workshop on Ontologies and Problem-Solving Methods (KRR5) Stockholm, Sweden, pp.1.4. Available: <http://sunsite.informatik.rwth-aachen.de/Publications/CEUR-WS/Vol-18/1-gomez.pdf>.
- [2] G. Van Heijst, A. TH. Schreiber and B. J. Wielinga. "Using explicit ontologies in KBS development". International Journal of Human-Computer Studies, 45, 1997, pp. 183–292.
- [3] G. Antoniou and F. van Harmelen, "*A Semantic Web Primer*". Massachusetts: The MIT Press Cambridge, 2008, pp. 10-13.
- [4] J. Hunter. (2001). "Adding Multimedia to the Semantic Web - Building an MPEG-7 ontology". In: Proceedings of the First Semantic Web Working Symposium, SWWS'01.
- [5] R. Troncy and J. Carrive. (2004). "A Reduced Yet Extensible AudioVisual Description Language". Proceedings of the 2004 ACM symposium on Document engineering, pp. 87-89.
- [6] R. Koning, P. Grosso and Laet C. de. "Using ontologies for resource description in the CineGrid Exchange". Journal Future Generation Computer Systems. Volume 27 Issue 7, pp. 960-965, 2011.
- [7] INTERNATIONAL COUNCIL OF MUSEUMS. Definition of the CIDOC conceptual reference model. Version 5.0.2. Jan. 2010. Disponível em: http://www.cidoc-crm.org/docs/cidoc_crm_version_5.0.2.pdf. Acesso em: 15/01/2011.
- [8] M. A. Eliseo, J. M. P. Oliveira and S. R. M. Pellegrino. Domain ontology with temporal descriptions for architectural buildings as a support for learning history of architecture. IEEE Multidisciplinary Engineering Education Magazine, v.6, no. 2, p.24 – 31, 2011.