Retrieving Film Heritage content using an MPEG-7 Compliant Ontology

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Introduction
Objectives
The CINeSPACE project
The CINeSPACE MPEG-7 Compliant Ontology and Knowledge Base
The CINeSPACE Multimedia Retrieval System
Evaluation of the system
Conclusions and future work
The availability of huge amounts of multimedia documents requires a careful design and an efficient implementation of multimedia retrieval systems.

- Storage, retrieval and browsing of not only textual, but also image, audio and video files
- MPEG-7 standard for describing multimedia documents using machine-consumable metadata descriptors

Multimedia retrieval systems have always forced humans to describe their query in terms of a written language.

- There are systems that are aware of multimedia semantics
- Users can specify a set of keywords or concepts used to search for multimedia contents containing those concepts.
- This is already a big step towards more semantic search engines from previous approaches, but it still may be too limiting in some cases.
Introduction

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Conclusions and future work
Designing and implementing a MPEG-7 Compliant Ontology based Multimedia Retrieval System for Film Heritage

- Annotation of multimedia content using an Annotation Tool based on MPEG-7 standard
- Development and instantiation of the MPEG-7 Compliant Ontology
Introduction
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Designing and implementing a mobile rich media collaborative information exchange platform, scalable, accessible through a wide variety of network, interoperable and location-based for the promotion of Film Heritage.
A new way for cities to access and promote their Cultural Heritage, collective memory and tourism in a mobile virtual environment

Three main target groups of users

- Citizens and collective memory in Glasgow
- Film lovers and film-induced tourism in Venice
- Cinema professionals and shooting locations in San Sebastian

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Architecture of the CINeSPACE project
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The methodology for the creation and instantiation of the CIneSPACE MPEG-7 Multimedia Compliant Ontology includes seven steps.
Step 1: Selection of MPEG-7 metadata

- Selection of the metadata required regarding the CINeSPACE requirements
  - Structural, classification and semantic descriptions have been considered
  - Points of Interest (PoI) to inform about any part of the city with some tourist or cultural attractions
Step 2: Annotation using the CINeSPACE Annotation Tool

- Multimedia content indexed with the tool
- Outputs as pairs of XML files and multimedia content
- Three main parts in a XML file
  - Description metadata (all specific CINeSPACE descriptors)
  - User description (user preferences)
  - Content entity (multimedia items)

```
<xml version="1.0" encoding="UTF-8" >
  <mpeg7 xmlns="urn:mpeg:mpeg7:schema:2001" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
    <DescriptionMetadata>
      <Identifier>0000000001</Identifier>
    </DescriptionMetadata>
    <UserPreferences>
      <ImagesInFolder>0</ImagesInFolder>
      <BlackAndWhite>FALSE</BlackAndWhite>
      <ThumbnailFile>/C:/CINESPACE_WS_CONTENT/CONTENT/SanSebastian/Image/0000000001.jpg</ThumbnailFile>
    </UserPreferences>
    <POI>
      <id>0000000001</id>
      <idCity>0000000001</idCity>
      <GeoPoint>
        <Longitude>1.985556</Longitude>
        <Latitude>-43.321114</Latitude>
      </GeoPoint>
    </POI>
  </mpeg7>
```
Step 3: Generation of the Java Classes

- Generation of the Java classes related to the selected metadata of Step 1
- Castor framework selected
  - Combination of Java objects, XML documents and relational tables
  - Castor XML Code used
Step 4: Java Objects

- Instantiation of Java Classes from Step 3 into Java Objects with the XML outputs from Step 2
- Java Objects are instances of the selected metadata from Step 1
Step 5: Design of the MPEG-7 Compliant RDFS Ontology

- Design based on the descriptions made with the CINESPACE Annotation Tool
- MPEG-7 descriptions connected in a plain tree structure
- Establishment of other relationships among concepts
Step 6: Update of the MPEG-7 Compliant OWD-DL Ontology
- Update from RDFS to OWL-DL
- Development using Protegé Ontology Editor
Step 7: Combination of the final MPEG-7 Compliant Ontology Individuals

- Instantiation of the OWL-DL ontology with the Java Objects from Step 4
- MPEG-7 Compliant Ontology individuals is characterised by
  - 45 classes
  - 41 object-type properties
  - 33 data-type properties
  - 63 individuals
Introduction
Objectives
The CINeSPACE project
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Queries are made over the CINeSPACE MPEG-7 Compliant Ontology to retrieve semantically the multimedia content.

The Multimedia Retrieval System is implemented as a Web Service developed with Eclipse 3.2.
- The client sends the queries to the Web Service.
- The Web Service processes the queries.
- It returns the answers to the client.

Some queries can be answered:
- Give me all the multimedia content…
  - … around this geo-reference data
  - … in black and white colour
  - … visualized by the user\textsubscript{x}
  - … created yesterday by user\textsubscript{x}
Example of the queries

Location-Based nature of CINEspace Project

\[ Q = \{ q_1 \cup q_2 \cup q_3 \cup q_4 \cup q_5 \cup q_6 \} \]

- \( q_1 = \text{CLASS Geographic Point with the PROPERTY Latitude GREATER A} \)
- \( q_2 = \text{CLASS Geographic Point with the PROPERTY Latitude SMALLER B} \)
- \( q_3 = \text{CLASS Geographic Point with the PROPERTY Longitude GREATER C} \)
- \( q_4 = \text{CLASS Geographic Point with the PROPERTY Longitude SMALLER D} \)
- \( q_5 = \text{CLASS Geographic Point with the PROPERTY LatOrientation EQUALS E} \)
- \( q_6 = \text{CLASS Geographic Point with the PROPERTY LongOrientation EQUALS F} \)

\( \beta_1 = 0.0035 \), the radius in degrees around the current latitude

\( \beta_2 = 0.0035 \), the radius in degrees around the current longitude

- \( x \), queried latitude
- \( y \), queried longitude
- \( A < x < B, A = x - \beta_1, B = x + \beta_1 \)
- \( C < y < D, C = y - \beta_2, D = y + \beta_2 \)
- \( E = \{ \text{North, South} \} \)
- \( F = \{ \text{West, East} \} \)
Introduction
Objectives
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Pilot user study than 30 users of Glasgow, Venice and San Sebastian to demonstrate the effectiveness of the retrieval.

Multimedia Content Database includes:
- 8 videos of Glasgow
- 17 videos and 12 images of Venice
- 4 videos and 22 images of San Sebastian
Use case

- The user logins into the CINESPACE system and he/she starts moving around the city.
- The Application Layer receives a query informing that the user is physically located at the position 43.3205º N, 1.9883º W (Playa de la Concha, San Sebastian), with a CINESPACE compliant device.
- The system checks the multimedia content associated to that location.
- The Application Layer retrieves the multimedia content (images and videos) and renders them on the CINESPACE device.
EVALUATION OF THE SYSTEM

- Interface of the client with the results of the query
Introduction
Objectives
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This paper has presented the design and implementation of an MPEG-7 Compliant Ontology based Multimedia Retrieval system for Film Heritage.

Process of obtaining the MPEG-7 Compliant Ontology:
- Selection of the metadata required regarding CINESPACE requirements
- Multimedia content indexing with the CINESPACE Annotation Tool
- Generation of the Java classes related to the selected metadata
- Instantiation of Java Classes from Java Objects with the metadata values of the multimedia content
- Designing of the CINESPACE MPEG-7 Compliant Ontology based on the descriptions made by the CINESPACE Annotation Tool
- Update from RDFS to OWL-DL
- Instantiation of the OWL-DL ontology with the Java Objects
CONCLUSIONS AND FUTURE WORKS

- Extension of the Multimedia Retrieval System
  - Personalization of the retrieved multimedia content regarding the profile of the user
  - High level semantic queries support
  - Mapping of the CINeSPACE MPEG-7 Compliant Ontology to other standard domain ontologies such as the CIDOC Conceptual Reference Model (CIDOC-CRM) or the Geoconcepts ontology
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