Institute of Information Systems &
Information Management

Content Analysis and MPEG-7 Description Tools

Peter Schallauer
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Overview

- Video Analysis Modules
  - Cut, Key Frame, Visual Features
  - Camera Motion
  - Take/Setting/Object Re-detection
  - Face
  - Persons and other Objects
  - Video Quality

- media.analyze Video Analysis Tool

- AV Media Metadata / Content Description
  - JRS focus
  - MPEG-7 DAVP Profile
  - MPEG-7 Library

- Video Annotation Tool/Suite
Video Analysis Modules (I)

- **Automatic analysis tools**
  - Shot detection
  - Cuts and gradual transitions
  - Extraction of key-frames and stripe image
  - Characteristic camera motion
    - Pan right/left, tilt up/down and zoom in/out

- **Visual Keyframe Features**
  - Global Color Distribution and Texture
  - Local Interest Points (SIFT)

- **Ongoing & Future Research**
  - Retake detection, Setting Redetection, Object Re-detection
    - Similar takes / setting /object by visual key-frame features
Video Analysis Modules (II)

- Faces detection
  - Face Locations
  - Faces per shot

- Ongoing Research on Persons detection
  - Appearance based (HOG)
    - Full body
    - Partial body
  - Contour based (ASM)
    - Head/Shoulder contour

- Future Research
  - Other object classes, e.g. vehicles (car, bus, …)
Video Analysis Modules (III)
Video Quality Analysis

- Current Research
  - Noise level per shot
  - Dust level per shot
  - Blocking level per shot
  - Black frames

- Future Research
  - Unsteadiness
  - Freezed Frames
  - Lost Frames
  - Test patterns
  - Flicker
media.analyze
Video Analysis Tool

- Media import & analyze
- Manual text annotation
  - Production Information (Title, Year,…)
- Automatic Annotation
  - Technical Media Information extraction
- Automatic analysis modules
- Input: Video DV, MPEG-1, MPEG-2, WMV-9 or still image (~30 formats)
- Output: MPEG-7 XML compliant to DAVP
- Operates on Win32
AV Media Metadata

- Identification
  - IDs, titles, ...
- Production
  - creation of the content, e.g. location and time
  - persons and organisations contributing
- Process-related
  - production and post-production history of the essence, e.g. information about capture, digitisation, encoding and editing
- Content-related
  - descriptive metadata in the narrowest sense
  - structure of the content (e.g. shots, scenes)
  - textual and semantic description of the content, keywords, classification, etc.
- Relational/enrichment information
  - links between content and external data sources, e.g. other content or related textual sources
- Publication
  - previous use (e.g. broadcasting) and related information (e.g. contracts, revenues)
- Rights

[Smith, 2006]
AV Media Content Description

- Many ‘professional’ standards with different target
  - Dublin Core, MXF DMS-1, SMPTE RP210, EBU P_Meta, MPEG-7, MPEG-21, RDF/OWL based ontologies

- For JRS content analysis is focus on
  - Identification of, Production
  - Detailed spatio-temporal content description & summarisation
  - Use of controlled vocabulary
  - Media content semantic

MPEG-7 XML for detailed content description

RDF/OWL for global semantics of a media item
Detailed Audiovisual Profile (DAVP)
a MPEG-7 Profile

- **Functionalities**
  - description of single image, audio, video or audiovisual content entities (one content – one description)
  - arbitrary, hierarchical structure descriptions (spatial, temporal, spatio-temporal)
  - description of media, creation and usage information
  - description of textual and semantic annotations
  - description of visual and audio features
  - support for browsing and summarization
  - exclusion of content organization and user interaction tools

- **Tool Selection**
  - MPEG-7 part 3 and 4 fully included
  - required tools of part 5 included

- **Description Validation**
  - Syntactically by XSD
  - Semantically by validation service http://vamp.joanneum.at
Detailed Audiovisual Profile (II)

- **Target application fields**
  - AV content analysis, summarization, metadata exchange between systems e.g. to search and retrieval

- **Projects and Users (R&D)**
  - **DirectInfo** - Media Monitoring/Sponsorship Tracking
    - Fraunhofer IGD, DFKI, Idioma, JRS
  - **PrestoSpace** – AV Preservation, Restoration, Documentation, D&Q
    - RAI Research, Uni Sheffield, Ontotext, JRS
  - **NM2** – Automatic Content Production for IP TV
    - BT Exact, JRS
  - **MECiTV** – Video/Still Image Archive for iTV production
    - LMR, JRS
  - **Mistral** – Multimodal, Semantic Indexing and Retrieval of Presentations (Video)
    - Know-Center, Tech Uni Graz, Sail Labs, JRS
  - **IP-RACINE** - Digital Cinema Workflow
    - DVS, Uni Hasselt, Uni Glasgow, JRS
  - **Portivity** – Mobile iTV Production and Delivery
    - IRT, ..., JRS
  - **K-Space** – From Low level up to semantic media analysis and retrieval
    - TUB, EURECOM, ..., JRS

- **Info at** [http://mpeg-7.joanneum.at/](http://mpeg-7.joanneum.at/)
MPEG-7 Library

- C++ API for creation and manipulation of MPEG-7 documents
- implements part 3, 4, 5 (visual, audio, MDS)
- generated from MPEG-7 schema files
- object oriented, typed data model
- extensible with new and custom types
- XPath access support
- Creation of entire description fragments by XPath
  - Easier description creation, much less code
- C++, Win32 and UNIX, MSVC 6 and MSVC.NET 2003 (7.1)
- freely available
  http://mpeg-7.joanneum.at

Application

JRS MPEG-7 API

Serialize, Parse

MPEG-7 XML (File or String)
Current MPEG-7 Research Topics

- DAVP extension
  - E.g. define how to use MPEG-7 for quality description
- Metadata Editing
- Semantic Description validation
  - Model and Validate descriptions structure and consistency
- MPEG-7 Library extension
  - Quality description
Semantic Video Annotation Suite

- Temporal Video Structure Annotation
  - Temporal structuring into segments
  - Any structuring criteria
    - e.g. Video Lectures
      - in Chapters
      - in Topics
  - Semantic Annotation on segments
    - Person, Organisation, Event Info
    - Use controlled vocabulary
  - Ground Truth annotation?

Free Trial Version at http://www.joanneum.at/?id=374&L=1
Thank you!

Peter Schallauer

JOANNEUM RESEARCH
Institute of Information Systems
& Information Management
Steyrergasse 17
A-8010 Graz / AUSTRIA

Voice: +43 316 876-1202
Fax: +43 316 876-1191
E-mail: Peter.Schallauer@joanneum.at
Web: http://www.joanneum.at/iis
Reasons for using MPEG-7

- designed as a data model, not just as an exchange format
- broad range of applications
- flexible, fine-grained description
- structuring capabilities
- use of XML schema
  - document oriented approach:
    - one media item – one metadata document
  - easy mapping to object model
  - many tools for XML processing
References

AV Media Life Cycle

[Smith, 2006]
Interoperability Issue 2: Semantic Constraints of MPEG-7 Profiles

- Validation Service
  - http://vamp.joanneum.at

XML well-formed?
MPEG-7 XML Schema?
MPEG-7 Profile XML Schema?

XSL Transformation
Rule Engine
SPARQL Query Engine

MPEG-7 Document (XML) ➔ MPEG-7 pre-processing ➔ MPEG-7 to RDF/OWL Conversion ➔ Semantic Constraints Check ➔ Query Service ➔ Query Results

- MPEG-7 Schema (XSD)
- MPEG-7 Profile Schema (XSD)
- Conversion Stylesheet (XSLT)
- Profile Constraint Rules
- Result Filter (SPARQL)
- Profile Ontology (OWL)
Interoperability Issue 2: Semantic Constraints of MPEG-7 Profiles

A Semantic Validation Service for MPEG-7 Profiles Description

1. Type the MPEG-7 Document URL:
   - http://vamp.joanneum.at/vamp/data/examples/violation_1.davp.mp7.xml
   - or use the following demo example

2. Select a profile:
   - SMP
   - DAVP
   - TRECVID

3. Advanced option >>
   - Profile Constraint Rules (N3 file):
     - http://vamp.joanneum.at/Vamp/data/rules/MPEG7_rules.n3
   - MPEG-7 to OWL conversion (XSLT file):
     - http://vamp.joanneum.at/Vamp/data/xsl/files/davp2owl.xsl

Result:
- violation_1.davp.mp7.xml is a valid MPEG-7 document but does not conform to the selected profile (DAVP).
- Following errors have been detected:
  1. MisplacedKeyframeError
  2. http://www.joanneum.at/mpeg-7/davp/example/#shot1_296_NREF_1
Interoperability Issue 3: Deployment of Multimedia Metadata
Conclusion

- Interoperability between metadata standards is necessary
  - mapping
  - “Metadata Standard Mashups”
- Yet another standard won’t solve the problem
  - there are already many (cf. W3C Multimedia Semantics XG)
  - semantic technologies are not optimal for all types of data and there are limitations w.r.t. scalability
- Ontologies
  - provide explicit knowledge representation
  - allow automation
  - can be jointly used with other metadata standards to solve interoperability problems