Utilizing Multimedia Ontologies in Video Event Recognition via Information Fusion and Automated Reasoning

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Multimedia Ontologies for Videos

Outline

• Formal representation of video scenes
• Standards and technologies used in video representation
• Combining ontologies for video scene representation
Representation of Video Scenes
Existing Approaches

• General statements in RDF and OWL
• Upper and domain ontologies
• Temporal segmentation / SWRL Temporal
• Spatial segmentation / Media Fragment URI
• Events formalized as SWRL rules
Representation of Video Scenes

Existing Approaches

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Combining Multimedia Ontologies Considerations

A. Intended semantics
B. Specificity
C. Quality of conceptualization
D. DL expressivity
E. Standards alignment
F. Namespace and documentation stability
G. Spatiotemporal annotation support
H. Annotation support for uncertainty
Representation of Video Scenes
Towards a Novel Methodology

- A1: capture intended semantics
- A2: term definition precedence order: standard, standard-aligned, de facto standard, proprietary
- B1: correct conceptualization + hierarchy
Representation of Video Scenes
Towards a Novel Methodology

• B2: rich axiomatization (reasoning potential)
• B3: rich semantics
• C1: clear ontology category
• C2: not overly generic terms
• C3: specific ontology terms
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Towards a Novel Methodology

- C4: ontology term precedence order: standard, standard-aligned, de facto standard, proprietary
- D1: formally grounded ontology
- D2: complex relations and constraints captured
- D3: ontology is as lightweight as possible
Representation of Video Scenes
Towards a Novel Methodology

• D4: the logical underpinning is decidable
• E1: standard terms are reused, not redefined
• E2: terms of standards via standard namespace
• E3: full coverage for standard terminology
• F1: physical URL preferred over symbolic URL
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Towards a Novel Methodology

- F2: permanent namespace URL
- F3: up-to-date documentation
- G1: support for qualitative spatial reasoning
- G2: point- and interval-based annotation
- G3: moving region annotation support
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Towards a Novel Methodology

- G4: visual + audio descriptors available
- G5: decidable audiovisual formalism
- H1: fuzzy concept and role axioms supported
- H2: decidable fuzzy formalism
- H3: preference given to general DLs
Representation of Video Scenes
A Task of the Experimental Case Study

Select an MPEG-7 ontology for the iconic scene of “Life of Pi”
Representation of Video Scenes
A Task of Case Study 1 – Candidates #1

Representation of Video Scenes
A Task of Case Study 1 – Candidates #2

• COMM: http://multimedia.semanticweb.org/COMM/visual.owl

• MPEG-7: http://mpeg7.org/mpeg7.ttl
Representation of Video Scenes
A Task of Case Study 1 – Comparisons #1

- Clear ontology category (C1)
- Formal grounding (D1)
- Complex relations and constraints (D2)
- Standard terms are reused, not redefined (E1)
- Standard terms via standard namespace (E2)
Representation of Video Scenes
A Task of Case Study 1 – Comparisons #2

- Full coverage for standard terminology (E3)
- Physical URL, not symbolic URL (F1)
- Permanent namespace URL (F2)
- Up-to-date documentation (F3)
- Support for qualitative spatial reasoning (G1)
Representation of Video Scenes
A Task of Case Study 1 – Comparisons #2

- Full coverage for standard terminology (F3)
- Physical URL, not symbolic URL (F1)
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Representation of Video Scenes
A Task of Case Study 1 – Comparisons #2

• Full coverage for standard terminology (E3)
• Physical URL, not symbolic URL (F1)
• Permanent namespace URL (F2)
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• Support for qualitative spatial reasoning (G1)
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Conclusions

• The selection of ontologies for video scene annotation is not straightforward
• The rigorous rules of the proposed methodology guide through the process + ensures favorable formalisms
Thank you.
Questions?