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To the call for Common Multimedia Ontology Framework Requirements
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Proposal "SWeMPs": Semantic Web enabled Multimedia Presentation system

Since the late 80s/early 90s a research area has developed focused on the modelling and implementation of computer systems capable of taking digital objects of various media types and ordering them into coherent multimedia presentations. From initially manual and domain specific systems, Intelligent Multimedia Presentation Systems (IMMPS) have increased in automation, adaptivity and domain independence. A key paper in this research area was the Standard Reference Model by Bordeghoni et al (1997) which also foresaw the use of a Knowledge Base to provide the means for "intelligent" decision making by the system. In the past decade many IMMPS have exhibited the use of metadata in guiding the selection, adaptation or presentation of media but in internal, proprietary ways. The emerging Semantic Web and the knowledge that will be generated to populate it, e.g. domain knowledge or media annotation, raises the potential of an IMMPS to leverage existing knowledge sources to dynamically create multimedia presentations.

The idea of SWeMPs is to provide a system whose knowledge for the multimedia generation process is expressed formally and explicitly in a Knowledge Base and which integrates with other knowledge sources on the Semantic Web to provide for a truly automatable, adaptive and intelligent multimedia generation process. As part of the research work, two ontologies have been created:

(1) The SWeMPS ontology provides a high level formalization of the desired multimedia generation process
(2) The ZyX[1] ontology provides an ontological description of an abstract multimedia presentation model

Publications:

L.J.B. Nixon, "Integrating knowledge, semantics and digital media into the multimedia generation process", 2nd European Workshop on the Integration of Knowledge, Semantic and Digital Media, London, November 2005.
L.J.B. Nixon, "A conceptual framework for Semantic Web-enabled multimedia", European Workshop on the Integration of Knowledge, Semantics and Digital Media Technology, London, November 2004.
L.J.B. Nixon, "Intelligent information services - the marriage of multimedia presentation and the Semantic Web", Berlin XML Days 2004, Workshop 'Semantic Web Technologies in Electronic Business', Berlin, October 2004.

A presentation on SWeMPs (from EWIMT 2005) is online at
http://page.mi.fu-berlin.de/~nixon/swemps/swemps.ppt
In due course, a dedicated Web page will be available with details and project code.

[1] ZyX is a multimedia model by Suzanne Boll (Uni Oldenburg) and Wolfgang Klas (Uni Vienna). See "ZYX: A Multimedia Document Model for Reuse and Adaptation" in IEEE Transactions on Knowledge and Data Engineering, 13(3): 361-382, 2001.

Ontology Scope and Usage:

SWeMPs is intended to model a multimedia generation process. A knowledge-based system can query a SWeMPs knowledge base in order to make decisions in the process (e.g. which resources to select, how to adapt them, how to present them coherently)
ZyX is intended to model an abstract multimedia model. It allows the model to be checked for validity as multimedia constraints can be applied to the OWL classes it contains (we find that these constraints require the expressive power of a rules language, e.g. to state that the spatial location of a media item can not exceed the dimensions of the ZyX model which contains it).

Core Classes and Properties:

In SWeMPs, the multimedia generation process is modelled as involving three core types of object: a **Subject**, a **Resource** and a **Service**. Each can be associated to Metadata about it which is in turn associated to an Ontology which it uses. Both Metadata and Ontologies have Namespaces (the URIs from which their concepts are drawn). Resources and Services also have Occurrences (the URLs where representations of that resource/service can be found) and Media Types (e.g. MIME type identifying the data format used).
This forms a minimal upper level representation of the multimedia generation process in terms of the concepts that may be addressed in the multimedia presentation, the resources which may represent those concepts to the user and the services which provide additional computational capabilities such as mediating between two different Ontologies.

In ZyX a **ZyXModel** instance represents an empty model with properties that apply to the whole model (e.g. height, width) and other concepts represent the elements within that model and their bindings to one another. **PresentationElement**s include MediaItems such as Text, Image, Audio, Video or Animation as well as segmentation of spatial and temporal areas, dynamic selectors between a group of media items and interactive elements that can be applied to a media item. **ProjectorElement**s define the properties of media items, e.g. the spatial location or typographic appearance. **Binding**s connect elements together (e.g. a spatial location to an media item); they are modelled as classes rather than properties because they themselves have properties e.g. priority (for a sequence of bindings on a single element). The ZyX ontology is based on the ZyX model specification by Suzanne Boll and Wolfgang Klas.

Links to other domains:

Other domains are referenced in Metadata instances and the domain ontologies used referenced in Ontology instances. Hence the retrieval of and reasoning over other knowledge can be isolated from the SWeMPs ontology – the purpose of the ontology is to guide the system in the selection and appropriate usage of that knowledge.
Mappings can be made between the SWeMPs/ZyX ontologies and other common multimedia annotation vocabularies (see the next page) to enable interoperability.

Tools:

Currently protégé is used to populate the SWeMPs ontology. A dedicated tool is a possibility for non-expert users which would hide the ontological detail.

Languages:

SWeMPs is expressed as OWL-DL. ZyX is expressed as OWL Full.

Characteristics to be represented:

In the multimedia generation process it is necessary to provide for the conceptual distinctions between Subject, Resource and Service as well as between these concepts and their metadata[2].

ZyX Media Items are subclassed by Text, Image, Video, Audio and Animation. In SWeMPs Resource could be a superclass of (ZyX) MediaItem and MediaType could use MIME Types as instances. I would suggest MIME Types are officially recognised as Semantic Web concepts by standardising a set of (IANA namespaced?) URIs.

Other core characteristics of the ZyX multimedia model:
Segmentation of the presentation (spatial-s, temporal-s)
Media Item properties: spatial, temporal, textual, acoustic
Interactive elements (provide a link from a media item to something)
Temporal elements (enabling some Allens constraints e.g. par, seq..)

Harmonization:

SWeMPs is seen as a core ontology which exists at a higher level than the individual subject, resource and service metadata ontologies. However in working with the resources and their metadata a mapping is provided between SWeMPs/ZyX properties and other vocabularies so that the multimedia generation process can operate with heterogeneously annotated resources. An initial mapping is given below to some other known resource annotations:

SWeMPs: represents	mp7: hasMedia-PerceptionOf, hasMedia-RepresentationOf	foaf: depicts vua: subject-matter dc: title[3] dc: subject/relation tech: depicts
SWeMPs: Occurrence	mp7: MediaLocator/ MediaUri	an: annotates dc: identifier/coverage tech: hasLocation
SWeMPs: is-of-type	mp7: Format	dc:format vua: format
ZyX: height	mp7: Height	svg: height
ZyX: width	mp7: Width	svg: width
Height and width		dc: format.dimensions vua: size
ZyX: colorDepth	mp7: Pixels/bitsPer	
ZyX: duration	mp7: MediaTime/ MediaDuration	tech: hasDurationSeconds
ZyX: frameRate	mp7: Frame/rate	
ZyX: bitRate	mp7: BitRate	

The EWIMT 2005 paper discusses this and offers an example of a common mapping.

[2] This was also mentioned as a requirement in Joost Geurts, Jacco von Ossenbruggen and Lynda Hardman. "Requirements for practical multimedia annotation" in the workshop "Multimedia and the Semantic Web", ISWC 2005, Crete, May 2005, pages 4-11

[3] Dublin Core elements expect literals, i.e. strings, as values: either plain text or a list of keywords is given