
Towards an Ontology Visualization Tool for Indexing DICOM Structured Reporting Documents

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- Context & problematic

- Our proposition

- State of art

- Preliminary solutions

- Conclusion & perspectives

Context

- Ontology reuse
(Modularisation approach)
- Content-Based Image Retrieval or CBIR systems
(Semantic indexing)
- Medical Imagery
(DICOM SR standard)

Problematic

- In general : **To adapt** the current reports relating to imagery examinations of the patients to the DICOM SR standard.
- More specific : **Indexing the reports** of imagery examinations of the patient.



Aim :

- To improve research inside or between imagery services (interoperability).

Difficulties :

- Various implied specialists (interns and experts)
- Various viewpoints for research

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Our proposition

- To reuse existing ontologies via a modularisation approach to represent the various viewpoints of specialists.
- To develop an ontology visualization tool to allow specialists to index their reports according their different viewpoints.

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State of art (...)

- DICOM SR standard
- Content-Based Image Retrieval or CBIR systems
- Ontology reuse

State of art (...) – DICOM SR standard

■ Patient report

- Patient report = examinations of imagery with comments
- Current patient reports have heterogeneous contents

■ DICOM (Digital Imaging and COmmunications in Medecine)

- One of the standards of medical imagery (1993)
- Communication protocol between heterogeneous equipments
- Format of an image with associated metadatas (information on the image + administrative information of the patient + information on the realization of the examination)

■ DICOM SR (DICOM Structured Reporting)

- Current evolution of the DICOM towards the structured report
- Structured report = links between images
- Format of images which are associated more complex metadatas (more information such as observations and diagnoses)
- Representation of all types of reports from the simplest one to the most complex

State of art (...) – CBIR systems

■ Aims

- Indexing : Associating to an image a set of descriptors of its contents
- Retrieval : Finding similar images following the query formulation

■ Indexing – Descriptor/Index

- Index = set of descriptors
- Low level or physical or symbolic descriptors
(taking values following an image processing → color, form, texture...)
- High level or semantic descriptors
(taking values following an image interpretation → entities and relations)

■ Retrieval – Query

- Various forms (*textual, image, sketch...*)
- Hybrid queries

State of art (...) – CBIR systems

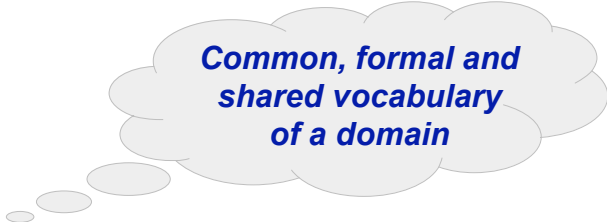
- Why an ontology ? « *Semantics is not registered in the image* ».
 - Formal representation (*comprehensible by the machine*)
 - Reuse (*knowledge of various fields*)
 - To increase the precision of the indexing
(*entities of an ontology with its relations is less ambiguous than terms*)

- CBIR and existing systems
 - Multiple domains (*art, medicine,...*)
 - Many systems on the symbolic content
 - Towards systems combining the symbolic and the semantic contents
(*Hyvonen et al. (2003), Hu et al. (2003), Behrenbruch et al. (2003), Golbreich et al. (2006), ...*)

State of art (...) – Ontology reuse

■ Ontology – Definition

« An ontology is an explicit specification of a conceptualization ». [Gruber, 1993]



Common, formal and shared vocabulary of a domain

■ Building an ontology – How ?

- Human expertise on the field
- Documentations
- Existing ontologies



Existing methodologies
*(Pinto et Martins. (2001),
Fernandez, Gomez-Perez et al. (1999),
Uschold et King (1996)...)*

■ Building by reuse – Why ?

- An increasing number of existing ontologies
- Saved times and human expertise

State of art – Ontology reuse

- Reuse – Which techniques ? (*Euzenat et Shvaiko, 2005*)
 - Integration (mapping, aligning and merging)
 - Refinement / Enrichment
 - Translation
 - Extraction

- Reuse – Difficulties (*Klein, 2001*)
 - Reuse possibilities
 - Heterogeneity of existing ontologies
 - Language level (*languages of representation*)
 - Terminological level (*denomination of entities*)
 - Conceptual level (*content*)
 - Pragmatic level (*contextual interpretation*)
 - Degree of automation of the process

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Preliminary works (...) – First step

- A model to represent the specialists viewpoints for the description of imagery examinations of the patient

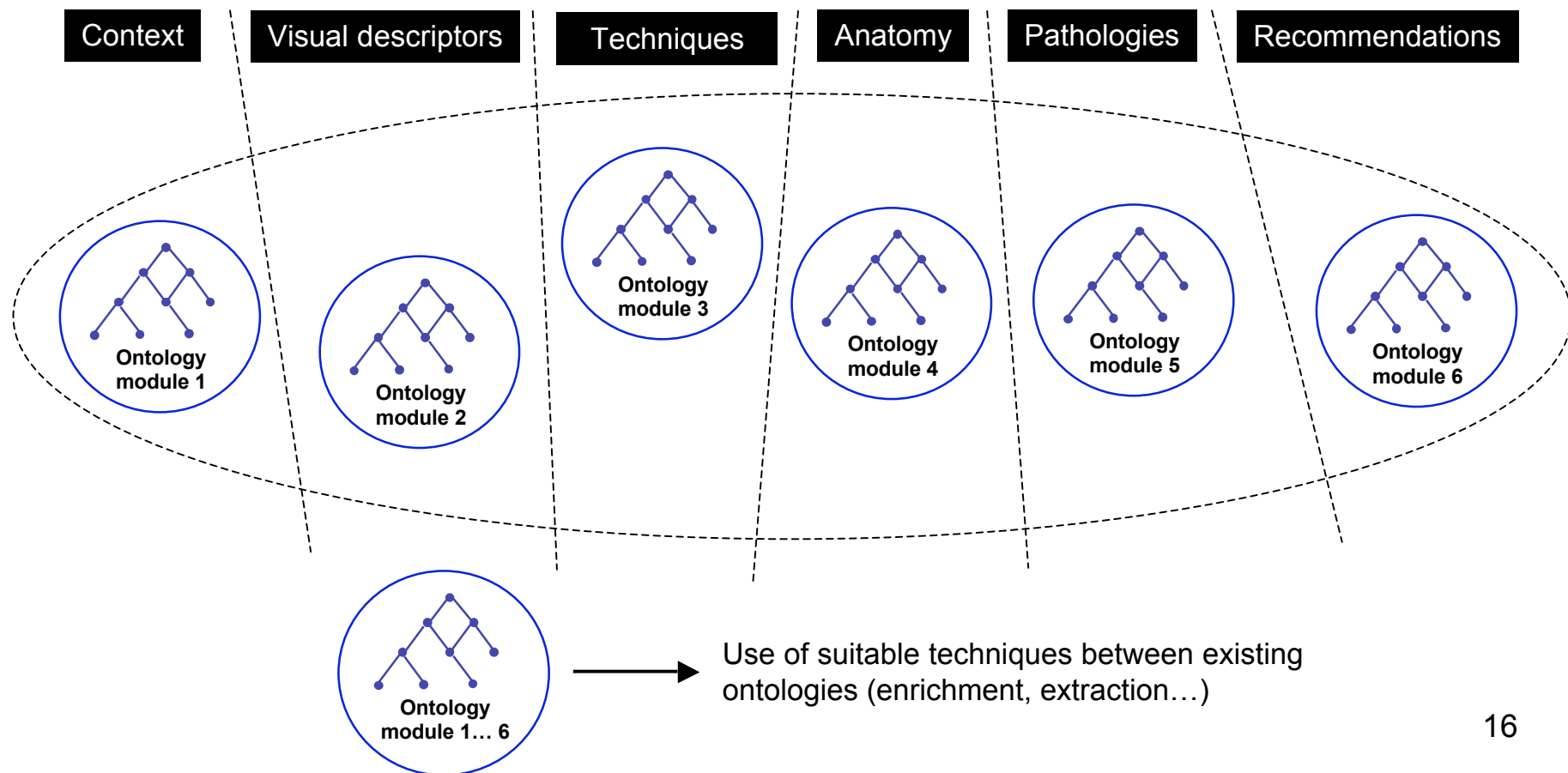


Several viewpoints to describe imagery examinations of the patient ?

Contextual viewpoint	Description related to the context of the patient (name, old, weight, types of modality...)
Visual viewpoint	Description in terms of visual descriptors (color, texture, form, spatial characteristics...)
Technical viewpoint	Description related to the techniques of image processing (area of interest, segmented zone...)
Anatomical viewpoint	Description in terms of organs anatomy, structure and functionality
Pathological viewpoint	Description relating to the observations and the established diagnoses (diseases, signs...)
Recommendation viewpoint	Description in terms of specialists recommendations

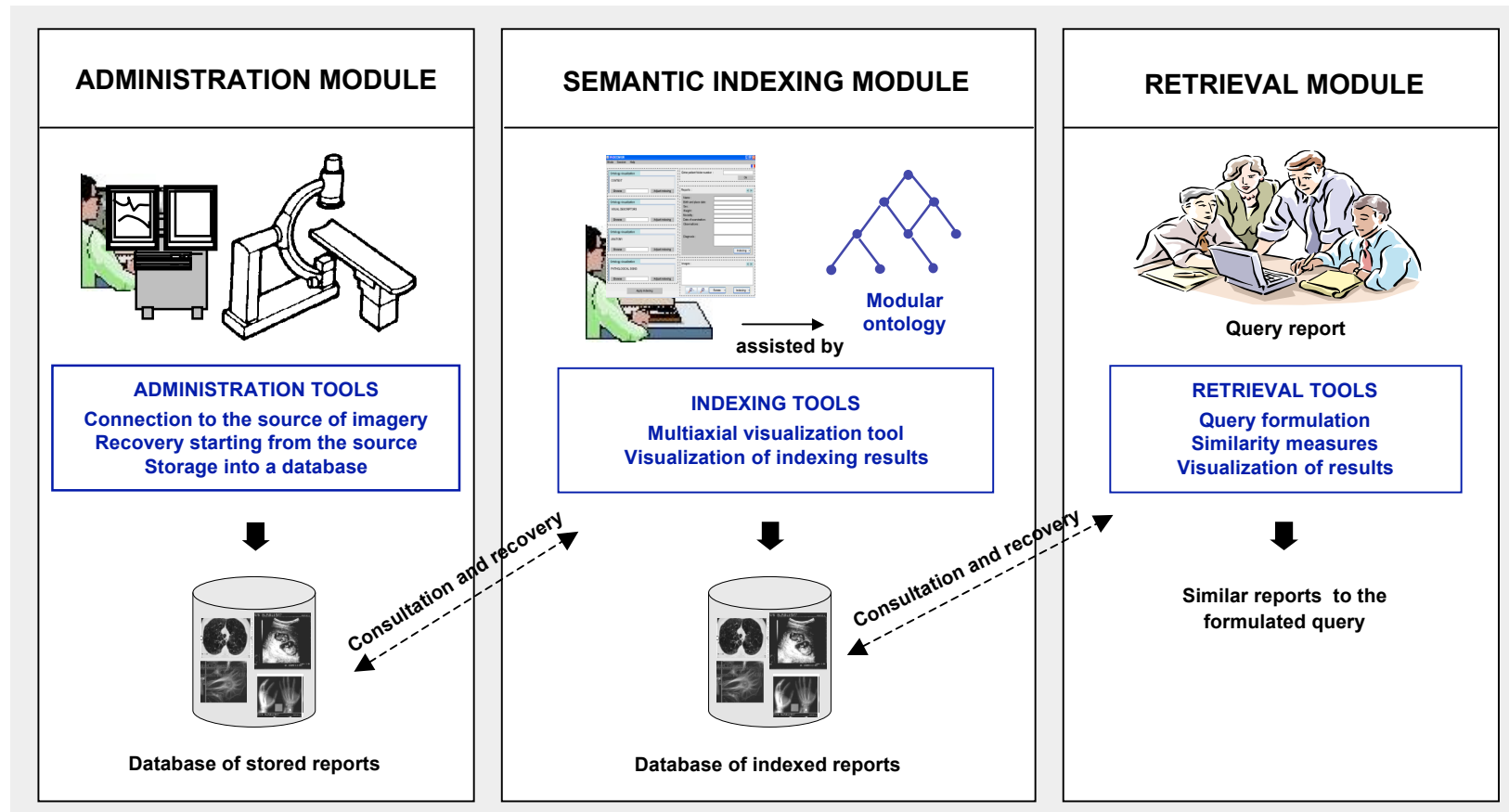
Preliminary works (...) – Second step

- Ontology reuse via ontology modularisation : A modular ontology resulting from the unification of existing ontologies relating to each viewpoint



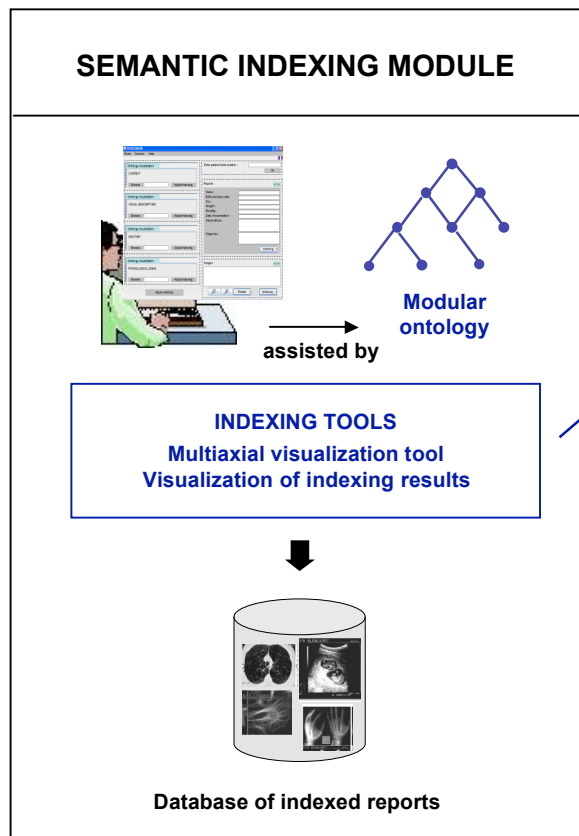
Preliminary works (...) – Third step

- A prototype system for indexing and retrieving standardized patient reports (...)



Preliminary works (...) – Third step

- A prototype system for indexing and retrieving standardized patient reports



Prototype

INDEXING TOOLS
Multiaxial visualization tool

- Bilingual interface (*french and english*)
- An axe for each ontology module
- Visualization of concepts



Visualization

CONTEXT

Visualization

VISUAL DESCRIPTORS

Visualization

ANATOMY

Visualization

PATHOLOGICAL SIGNS

URL:

images:

Selection

width height show

Management VDO-Ontology.owl

- owl:Thing
 - Adds
 - Visual_Descriptor
 - Color_Descriptor
 - ColorLayout_Descriptor
 - ColorQuantization_Desc
 - ColorSpace_Descriptor
 - ColorStructure_Descriptor
 - DominantColor_Descrip
 - GoFGoPColor_Descript
 - ScalableColor_Descript
 - Localization_Descriptor
 - Motion_Descriptor
 - Other_Descriptor
 - Shape_Descriptor
 - Texture_Descriptor

Description

Class : **Color_Descriptor**

- is a sub-class of Class : **Visual_Descriptor**
- is a super-class of Class : **ColorSpace_Descriptor**
- is a super-class of Class : **ColorStructure_Descriptor**
- is a super-class of Class : **GoFGoPColor_Descriptor**
- is a super-class of Class : **ColorLayout_Descriptor**
- is a super-class of Class : **DominantColor_Descriptor**
- is a super-class of Class : **ColorQuantization_Descriptor**
- is a super-class of Class : **ScalableColor_Descriptor**

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Conclusion & perspectives

■ Related works

- DICOM standard
Visualization tools of DICOM images (*Osiris, NIH Image, DICOM Eye...*)
Conventional databases (*Icono Tech...*)
- DICOM SR standard
In progress

■ Perspectives

- First experiments in osteo-articular imagery
(*existing reports, equipments of imagery...*)
- First evolutions of the indexing tool
(*visualization of properties, index system, semi-automatic indexing...*)