

Using Semantic Commonsense Resources in Image Retrieval

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CEA - LIST

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Context

- **Images represent a hefty chunk of the information existing on the Internet**
- **The existing image search engines (ISE) are fast and robust but do not include any semantics**
- **There is a lot of interest for the introduction of high level semantics in the image retrieval frameworks**
- **Proposition of a combined method for image retrieval: ontologies + image processing techniques**

Ontologies

- **Ontologies provide means to formally organize knowledge in a domain**
- **“IsA” as fundamental relation to structure a hierarchy of concepts**
- **The construction of large scale ontologies are time costing effort (Cyc, WordNet) – reusability**
- **The choice of a particular resource is directed by the envisioned application**



WordNet in Image Retrieval

○ WordNet description:

- ⇒ Lexical database organized as a hierarchy
- ⇒ Meant to capture knowledge about terms in American English
- ⇒ Versions in several languages
- ⇒ Ongoing project (for more than 15 years)
- ⇒ Captures information for most of the English terms
- ⇒ Specialized concepts are less ambiguous than higher order ones (Rosch)

○ Nouns hierarchy:

- ⇒ Basic relation – “IsA”
- ⇒ Root concept - “entity”
- ⇒ Sense separation for ambiguous terms

WordNet in Image Retrieval

○ WordNet translation to OWL

- ⇒ Simplified version: only a part of the information is retained – choice of the design directed by the application
- ⇒ Meant to enable reasoning over concepts in the lexical hierarchy
- ⇒ 1 synset = 1 owl class
- ⇒ The name of the class is given by the first term in a synset, with its associated synset (e.g.: Dog__1)

○ WordNet is employed in 2 phases of the IR process:

- ⇒ Image gathering from the Internet – use of leaf concepts in the hierarchy
- ⇒ The “IsA” relation enables the association of pictures for all the classes in the ontology starting from those associated to leaf concepts
- ⇒ Image search – the user can find images for all the terms the hierarchy

Image Clustering

○ Steps

- ⇒ Gather images associated to leaf concepts in WordNet from the Internet
- ⇒ Segment, index and cluster the pictures gathered for each term in the hierarchy

○ Results

- ⇒ Visually similar images are clustered together
- ⇒ A structured presentation of pictures for a concept is proposed to the user

○ Image database

- ⇒ About 5000 picture classes for animals and artifacts
- ⇒ 1200000 images in the database

Image Clustering

○ Images for grizzly

⇒ (source: AlltheWeb.com)



○ Clustered images for grizzly

⇒ (source: AlltheWeb.com)



Evaluation

○ Precision test

- ⇒ Use of 4 well-known concepts: dog, cat, bear, dolphin
- ⇒ Comparison between AlltheWeb and the use of an ontology
- ⇒ Rationale – image content is the most often described using familiar terms (Hollink)
- ⇒ 200 pictures/concept were used for each of the evaluated approach
- ⇒ Binary appreciation – an image is either relevant or not
- ⇒ The pictures are evaluated by a naïve tester

Evaluation

- **Numeric results – precision in image sets when using a familiar term and its hyponyms**

	Precision[%]	
	Concept merging	Alltheweb query
Bear	44,5	31
Cat	55	46
Dog	77	62,5
Dolphin	52	38,5
Mean	57,1	44,5

Conclusions

- We discussed the context of our work
- Some generalities about ontologies were discussed
- We presented the use WordNet in image retrieval tasks
- Image clustering techniques employed in the present IR framework were described
- A preliminary evaluation of the utility of ontologies in image retrieval was presented

Perspectives

- **User adaptation – study the users' preferences and propose a presentation of results in accord to them**
- **Render the picture associated to the most frequent categories in priority**
- **Proactive image search engine – with the use of an ontology, for each query we can propose related queries**
- **Refine the image clustering techniques**

References

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