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Putting the content into context – features and gaps in image retrieval

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Overview

- Features, content, and the semantic gap
- Currently used features
- Why this is not working
- How this could work
- Conclusions

Image retrieval

Represented by

Col 1	0.3
Col 2	0.25
Wav 1	0.01
Wav 2	0.2
…	…

Query by example(s)

Col 1	0.3
Col 2	0.25
Wav 1	0.01
Wav 2	0.2
…	…

Distance measure

Col 1	0.3
Col 2	0.25
Wav 1	0.01
Wav 2	0.2
…	…

Col 1	0.3
Col 2	0.25
Wav 1	0.01
Wav 2	0.2
…	…

Col 1	0.3
Col 2	0.25
Wav 1	0.01
Wav 2	0.2
…	…

Visual features currently used

- Color
  - Histograms, local, global, invariant, …
- Texture
  - Wavelets, cooccurence matrices, …
- Shape
  - After segmentation, moments, …
- Salient points
- Others
  - Patch histograms, …

The “semantic gap”

- Low level visual features automatically extracted do not correspond to high level concepts that a user has in his mind for searching.

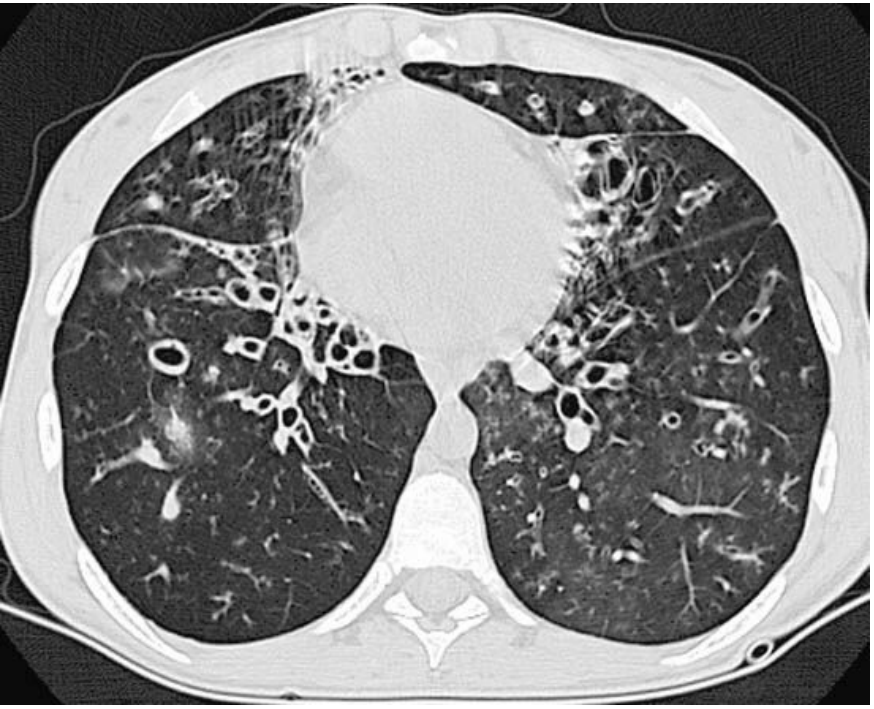
- Based on the query-by-example paradigm
  - User can not express his/her information need appropriately

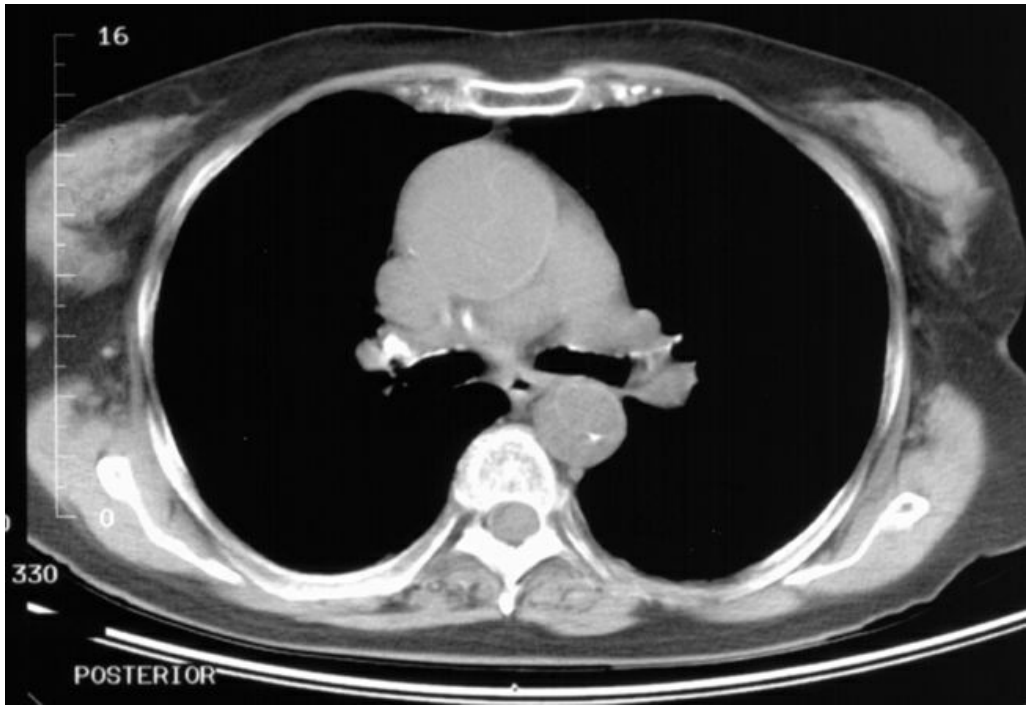
Why is it not working?

- Computer vision generally concentrates on purely visual problems
  - No MD would diagnose based on an image, only
  - Visual problems have to be seen in context
    - Goal of images taken, context of patient
- Visual features are in general rather global
  - General segmentation does not work
- Imaging equipment and protocols change

Example 1: lung texture changes with age

Example 2: goal of the image is important





Co-morbidities, changing equipment

- Heart problems change the lung tissue
  - Blood flow is changed in this case
- Medical imaging equipment changes increasingly quickly
  - Thinner slices, more slices
  - Higher resolution
  - Better contrast agents
  - Changed protocols, …

Other data used for retrieval

- Features of regions, manual intervention for extraction from regions of interest
- Free-text accompanying the images
  - Teaching files, medical journals, …
- Structured data explaining the context of the image
  - Electronic patient record

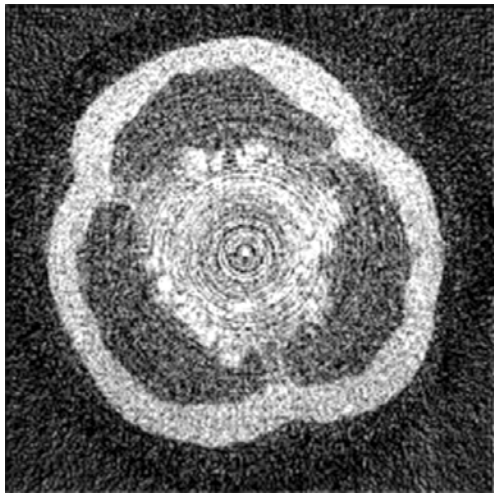
How could this work?

- Visual features need to be integrated with clinical data (age, lab results, anamnesis)
  - Dependencies can be found
- Incomplete data needs to be taken into account
  - Proactive for diagnostic aid
- Toolboxes need to be independent of equipment
- High quality datasets need to be made available
  - … and updated, plus well annotated

Conclusions

- CBIR has not yet lived up to the expectations
- Purely visual retrieval can be used for very precise applications
- Tendency has to go from image retrieval to case retrieval
  - Several images, text, structured data
- Knowledge sources need to be included
  - Ontologies such as SNOMED, literature, MIRC, …

More information ...



http://www.imageclef.org/

http://www.sim.hcuge.ch/medgift/

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