Tutorial on Medical Image Retrieval

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Overview

• Who are we?
• Materials and Methods
• Subjects
  • Introduction
  • Content-based image retrieval
  • Image processing and pre-processing
  • Visual features (descriptors), matching & classification
  • Medical applications
  • Demonstration, system aspects
  • User interaction
  • Evaluation of systems (imageCLEF)
  • Examples (medGIFT, IRMA)
• Dipl. (Master) Computer Science, RWTH Aachen
  • Thesis: Features for Image Retrieval in 2003
• RWTH Aachen University, Germany
  • Computer Science faculty & PhD student since 2004
• Member of the IRMA project
  • IRMA = Image Retrieval in Medical Applications
• Research interests
  • Image retrieval & medical imaging
  • Pattern recognition & statistical modeling
  • Image object recognition & computer vision
Henning Müller

- Master in Medical Informatics of the University of Heidelberg (1997)
  - DICOM Implementations in teleradiology at the German Cancer Research Centre
- PhD on image retrieval at the University of Geneva (2002)
  - Viper project, outcome is the GNU Image Finding Tool
  - Main areas are user interaction and performance evaluation
- medGIFT project at the University and University Hospitals of Geneva since 2002
  - imageCLEF medical task
Materials

- **DVD** containing some material on image retrieval
  - Casimage database
    - 8751 images with case descriptions
    - Used for the imageCLEF competition
  - Source codes
    - Gift
    - Interface in Java
    - RWTH-i6 (IRMA) retrieval engine, Fire
- Articles
- Links

- **Printed articles**
  - Limited due to copyright problems
The need for content-based visual IR

- **Rising amount of visual data** is produced digitally
  - Digital cameras at consumer prices
  - Publications on the Internet
    - Billions of images
  - Journalists (Millions of images produced every day)
  - Trademarks (>100,000 visual marks in Switzerland alone)
  - **Hospitals** (Geneva radiology: >30,000 images per day)
- **Only small part of the images is annotated**
  - Annotation is expensive, subjective, task dependent
  - Not everything can be described by text
The problems

• How to formulate a query visually?
  • Sketch
  • Colored regions
  • Example image
    • But how to get a good example?
  • Regions in example images
    • Pre-segmented
    • Marked with a pencil

• How to represent an image with «features»
  • Without knowing what someone is looking for
  • Features need to be extracted automatically
The solution
Some concepts

- **Query by image example(s) - QBE**
  - « page zero problem »
- **Relevance feedback**
  - Positive and negative feedback
- **Semantic gap**
  - Gap between the extracted visual features and the semantic concepts a user searches for
- **Sensory gap**
  - Gap between reality and the images
    - Through limited resolution, projection, ...
Other multimedia data for retrieval

- Text (web pages mixed with other media)
- Images, graphics, ...
- Signals (ECG, EEG)
- Sound
  - Music retrieval
- Video
  - Mix of media sound and temporal series of images
- 3D data
  - Tomographic images
  - Constructions
Questions, Desires ?