Information Access to Medical Image Data: from Big Data to Semantics - Academic and Commercial Challenges

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Overview

• Motivation & objectives
• eHealth research at the HES-SO in Sierre
  • VISCERAL
    • ETHZ vs. HES-SO
  • Khresmoi
    • HES-SO vs. ATOS, Ontotext, (ELDA, HON, GAW)
• Conclusions
Motivation for image management

• “An image is worth a thousand words”

• Medical imaging is estimated to occupy 30% of world storage capacity in 2010!

• Mammography data in the US in 2009 amounts to 2.5 Petabytes
Objectives of our work

• Better exploit visual information in medical imaging for decision support
  • Find similar cases, use these including outcomes for diagnosis support

• Develop scalable solutions that allow treating the volumes produced in hospitals
  • Detect small regions of interest in medical images
  • Map images to semantics, store only regions of interest

• Link information in reports with image data
  • Make work of radiologists more efficient
eHealth at the HES-SO in Sierre

- Many eHealth activities since 2007
  - eHealth unit since 2010
  - 20 persons and three professors
  - Michael Schumacher, Henning Müller

- Several types of projects
  - EU FP7 projects (Khresmoi, PROMISE, WIDTH, VISCERAL, MD-Paedigree, Commodity12, …)
  - FNS projects (MANY, NinaPro, …)
  - CTI, Hasler, COST, HES-SO, NanoTerra, mandates
Projet loop in MedGIFT

- MANY
  - technical aspects
  - networking
  - infrastructures, architectures

- VISCERAL
  - application, implementation
  - evaluation, validation

- Khresmoi
  - MD Paedigree
  - ELIAS
  - NinaPRO
  - ImageCLEF

- Chorus+

.promise
Big data challenges and opportunities

- **Signal** data in the images needs to be mapped to semantic **information**
  - Reduce amount of data to be kept accessible
  - Get information for decision support
  - Regions of interest can be extremely small

- **Simple and efficient tools are required**
  - And these might work better on big data (and need to be scalable)

- **Many** **rare diseases** could be analyzed
  - These are difficult as people do not know them, they are missed and incorrectly treated
  - Use all data instead of small scale studies
  - Use data across hospitals, quality is important
VISCERAL

• EU funded project (2012-2015)
  • HES-SO, ETHZ, UHD, MUW, TUW, Gencat
  • Coordination action, so not research in itself

• Organize competitions on medical image analysis on big data (10-40 TB)
  • All computation done in the cloud, collaboration with Microsoft
  • Identifying landmarks in the body
  • Finding similar cases

• Annotation by medical doctors
Objectives of VISCERAL

- Create a cloud-based infrastructure to test algorithms on big and potentially confidential data

- Annotate large amounts of medical image data for system evaluation (annotate once, reuse)
  - Annotation in Hungary to keep costs limited
  - 3D annotation and labels in the RadLex terminology

- Support the coordination of research work on relevant objectives in medical imaging
  - Including academic groups and companies such as Microsoft, Siemens, Toshiba, etc.
Evaluations in VISCERAL

Cloud

Small Data Set

Large Data Set

Instances

Participants

Organiser

Test

Small Data Set

Large Data Set

Instances

Participants

Organiser
KHRESMOI

- 4 year, 10’000’000 € budget
Khresmoi goals

- **Trustable** information adapted to each user group
  - All tools as open source
- **Extract** semantic information from all sources
  - LinkedLifeData
Current status

- Project at the beginning of year 3 of 4 years
  - Half-time
- User tests have started among the three user groups (much feedback on prototypes expected)
  - Different types of interfaces
  - Eye tracking
- Implement changes to adapt to the user groups
Software architecture
User tests

Khresmoi Radiology Usertests

This study configuration keypoints are:

Recording Details

- **File details:** Prompt for details
- **Recording start/stop:** AutoPilot start, AutoPilot stop
- **Observers:** Observers enabled

Capture options:
- Screen and PIP
- Screen text
- Keystrokes
- Mouse clicks
- Chat

Task logger:
- AutoPilot
- AutoPilot enabled

Video and Audio Sources

- **Main:** Screen (Primary Monitor)
- **PiP:** Camera (Not plugged in)
- **Audio:** Microphone VMware VMaudio VMA

Study Details

- **Task definitions:**
  - 2D Task 1A (Max 5 min)
  - 2D Task 1B (Max 5 min)
  - 2D Task 2 (Max 5 min)
  - 2D Task 3 (Max 5 min)
  - Article Task 1 (Max 7 min)
  - Article Task 2 (Max 7 min)
  - Free use of Khresmoi

Marker definitions:
- X - Bug of the program
- H - User needs help, is bl...
- O - Observations from ob...
- P - Inconsistencies (the pr...

Survey definitions:
- Demographic survey
- Article/2D image search
- 3D image search
- Usability questionnaire

To start, press Ctrl+Alt+Shift+F9
Public/private & academic collaborations

• Close collaboration between actors is beneficial
  • Different view points on the same problems
  • Different ways of being evaluated (publications, projects, $)
  • For larger projects the best partners are necessary

• Interdisciplinary work is enriching
  • Creates new ideas (and sometimes frustrations)
  • Is needed in most fields of computer science

• Innovation is often the goal of funding
  • HES has developers, PhD students and senior researcher collaborating on the same problems
Eye tracking

• http://www.youtube.com/watch?v=YWoICx3jdOo
Demo

- [youtube video](http://www.youtube.com/watch?v=cMoONC0Tz2c)
Questions?

• More information can be found at
  • http://medgift.hevs.ch/
  • http://publications.hevs.ch/
  • http://khresmoi.eu/
  • http://visceral.eu/

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