

A Web-Based System for Biomedical Image Storage, Annotation, Content-Based Retrieval and Exploration

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Semana de la BVS. Marzo 8 al 12, 2010

Outline

- 1 The Problem
- 2 What For?
- 3 The System
- 4 Ongoing Work

Outline

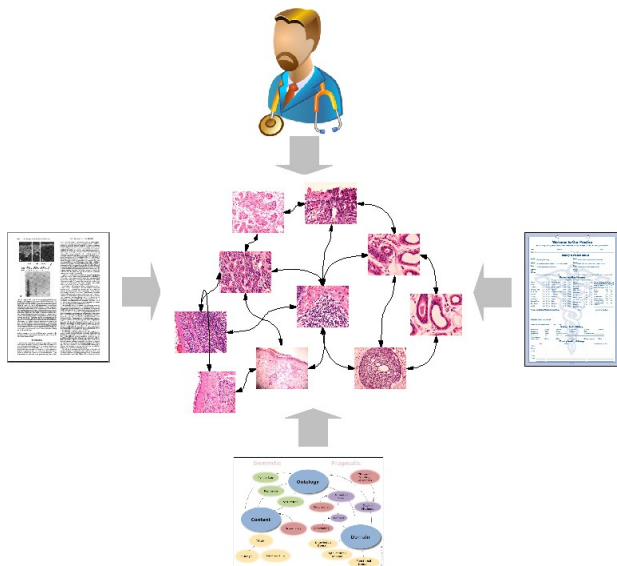
- 1 The Problem
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Biomedical Information

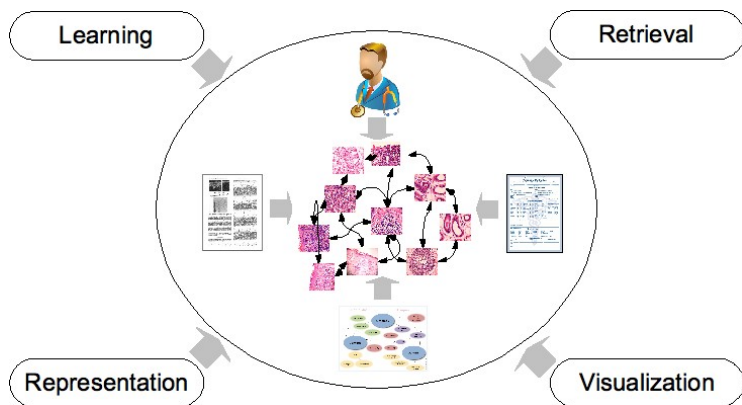
- Huge volume of different types of data
- It is difficult to find specific information
- Complex objects comprising visual and non-visual information
- Important resource for diagnosis support, teaching and research



Biomedical Image Collections



Computational Problems



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Supporting Research (1)

Cell Biology Center (biophysics and biology of membrane),
National University of Colombia, CIF

- Nerve regeneration: In vitro culture of peripheral nerve component cells
- Thyroid function: Functional thyroid follicles
- Parasite-host cell relationship: Impact of Leishmania infection on the three membrane system found between the parasite and its host cell, the macrophage

Supporting Research (2)

- Digital images are an important asset for this kind of research
- Advantages of an image management system:
 - material reuse
 - collaborative work
 - information integration
 - knowledge dissemination
 - teaching support

D. Celdrán-Morales et al. / Journal of Neuroscience Methods 114 (2002) 1–8

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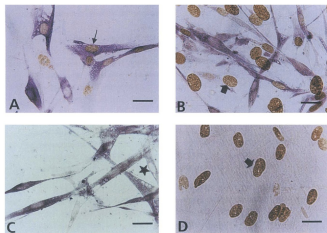


Fig. 4. Action of Ara-C on adult human peripheral nerve culture. Double immunolabeling technique was used for both S-100 cytoplasm labeling of Schwann cells (anti) and BrdU (nuclear labeling of cells in S phase (filled arrow)). (A) Corresponds to primary culture in the presence of one (24 h) pulse of Ara-C; double immunolabeling cells are observed (arrow heads). (B) Corresponds to primary culture in the absence of Ara-C at the same time. A large number of fibroblasts incorporating BrdU are observed. (C) Represents wells of primary culture of adult human peripheral nerve, in absence of Ara-BrdU; nuclear labeling of cells in S phase; and (D) represents wells in absence of antibody against S-100 protein; cytoplasm labeling of Schwann cells. Scale bar = 20 μ m.

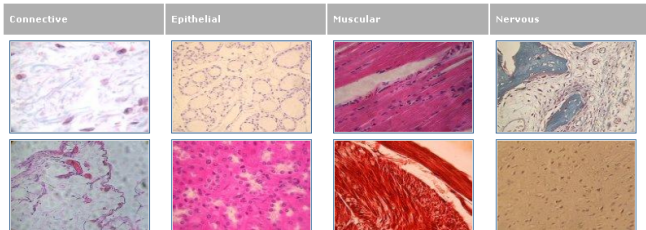
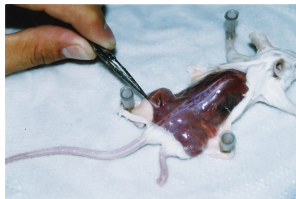
In the case of fibroblasts incorporating BrdU (Fig. 3B) we observed a significant difference when comparing initial values and values after first pulse of Ara-C (24 h pulse), 40 and 12% (Fig. 4A), respectively ($P < 0.05$). During the application of the second pulse this percentage remained constant (no differences between first and second pulse). Between the third and fourth Ara-C pulses, the percentage quickly decreased to values less than 5%. In the absence of Ara-C (Fig. 4B)

stains were not found among samples in respect to the cell number obtained, viability cell percentage, as well as difficulties during the culture process. However, an influence of donor age on cultured cells can not be discarded.

In terms of viability, using the same *in vitro* Wallerian degeneration process, but a different enzymatic dissociation protocol (dissociation time and enzyme concentration), we observed that the viability level ob-

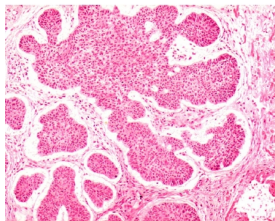
Supporting Research (3)

- Data:
 - Different tissues extracted from mice
 - 20,000 histological images collected
 - 9,000+ images annotated



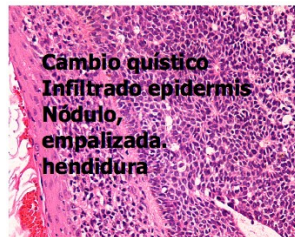
Supporting Medical Diagnosis (1)

- Pathology Lab at the National University of Colombia:
 - Histopathology, cytopathology, immunopathology
 - Relies heavily in microscopical imaging
- Advantages of an image management system:
 - evidence-based medicine
 - collaborative and remote work
 - support to clinical studies and trials
 - physician training

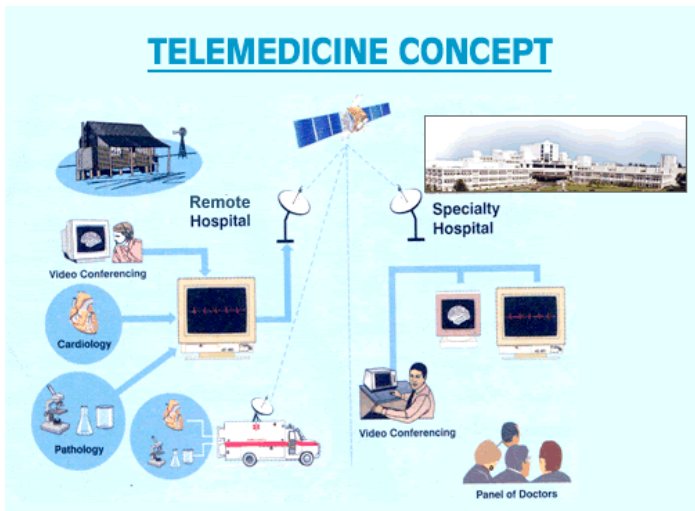


Supporting Medical Diagnosis (2)

- Real samples for diagnosing basal-cell carcinoma
- 5,995 images at $1,280 \times 1,024$ pixels, acquired under a Nikon microscope at the Pathology Lab
- A subset of 1,502 images was studied and annotated by a pathologist
- 30 visual structures associated to tissue and cell properties identified and grouped in 18 concepts



Telemedicine



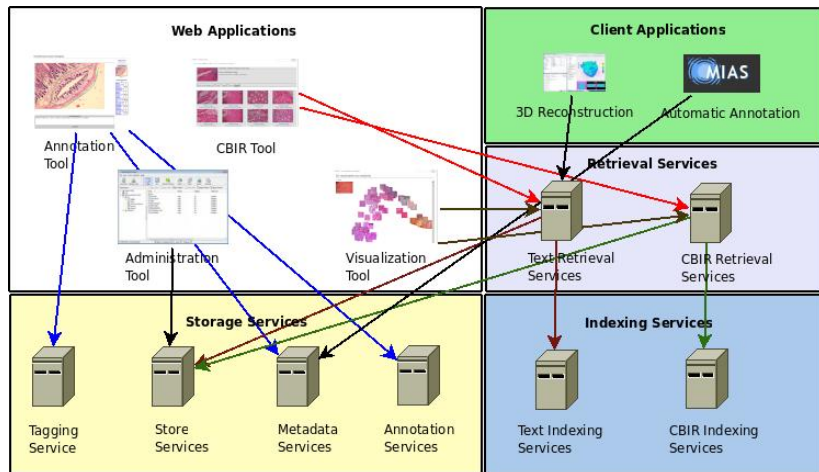
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Requirements

- Image management:
 - addition, deletion, updating
- Image annotation:
 - global annotation, region annotation
- Image search:
 - text keywords, query by example
- Collection exploration:
 - visualization, summarization, interaction

System Architecture

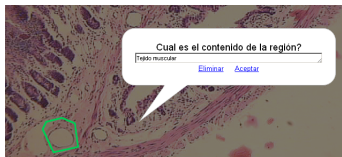


Supporting Technology

- Architecture: SoA, XML/SOAP standard
- Application Server: Java EE, JBoss, GlassFish
- Software components: Apache Solr/Lucene (text indexing and search), ImageJ (image edition), Colt (linear algebra library)
- DB server: MySQL
- Languages: Java, PHP, Python

Image Annotation

Herramienta para Anotación de Imágenes



Comentario general:

Sistema digestivo. Canal colédoco atravesando la muscular del duodeno.

Guardar

Listado de Casos
[Volver al Caso 1](#)

Nueva Región



Zoom: 7X

Regiones Existentes

Sistema digestivo, canal colédoco	<input checked="" type="checkbox"/>	
Medio de la capa muscular del duodeno	<input checked="" type="checkbox"/>	
Sistema digestivo, músculo a nivel del canal colédoco	<input checked="" type="checkbox"/>	
Tejido muscular liso	<input checked="" type="checkbox"/>	
Tejido muscular liso, Corte longitudinal, No estiraciones, Muñido de histiocitos	<input checked="" type="checkbox"/>	
Tejido muscular liso, Corte transversal	<input checked="" type="checkbox"/>	

Text search

Home > Text search

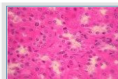
Results 2 - 21 of 1277 for tejido epitelial (18 milliseconds) 2D visualization by similarity



Similar images



Similar images



Similar images
Riñón.



Similar images
Tejido epitelial glandula...



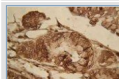
Similar images
Tejido epitelial glandula...



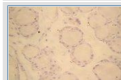
Similar images
Tejido epitelial glandula...



Similar images
Tejido epitelial Glandula...



Similar images
Tejido epitelial Glandula...



Similar images
Tejido epitelial glandula...



Similar images
Tejido epitelial glandula...



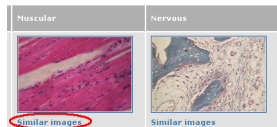
Similar images
Tejido epitelial glandula...



Similar images
Tejido epitelial glandula...

tejido epitelial

Content-Based Image Search











Home > Visual search

Result 1 - 21 of 19338 for (146 in 0.000000) 2D visualization by slidekitty

Showing similar images to this one

CD41_IMG09417.bmp
Tejido muscular estriado voluntario

Show similar images by: Color Edges Texture Search

 Similar images Tejido muscular estriado ...	 Similar images Sistema nervioso periféri...	 Similar images Raton.	 Similar images Tejido epitelial glandula...
 Similar images Tejido epitelial glandula...	 Similar images Sistema nervioso periféri...	 Similar images Tejido muscular estriado ...	 Similar images Tejido muscular estriado ...

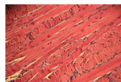
2D Visualization of Image Collection

Home > 2D visualization by similarity

 >>

2D visualization by similarity

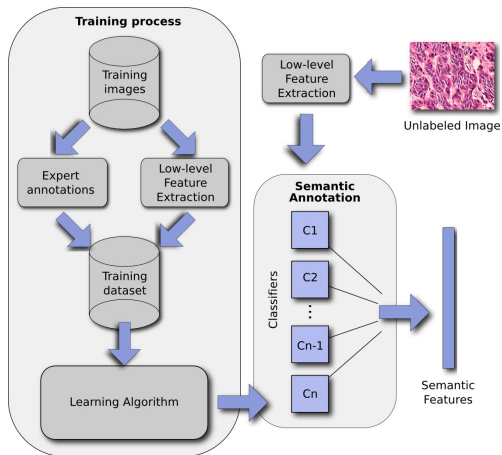
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Semantic Content-Based Image Retrieval



Semantic Image Retrieval Performance

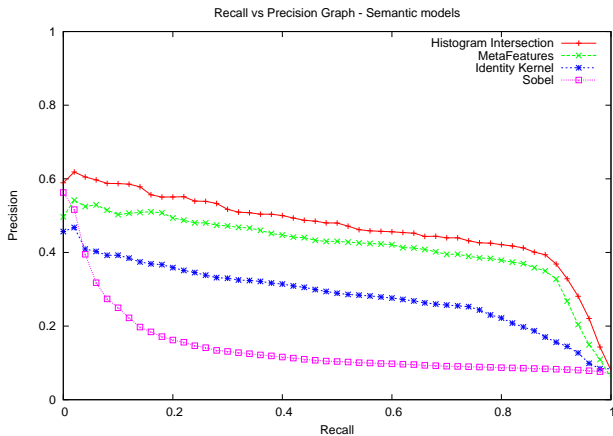
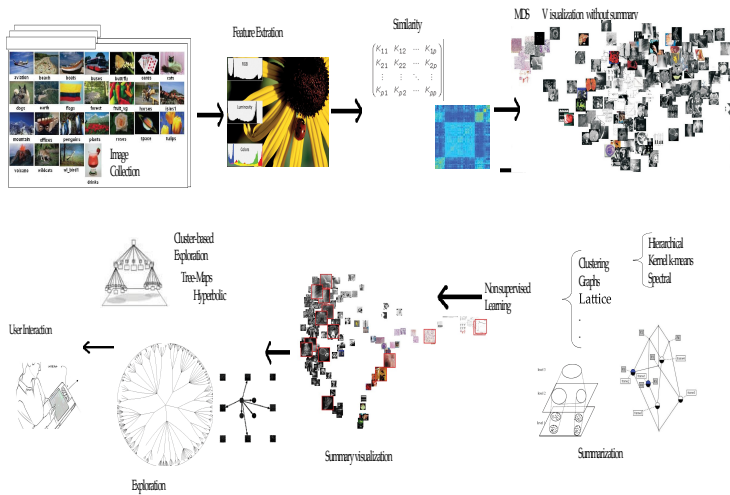


Image Collection Summarization and Visualization



Interactive Machine learning

The screenshot displays the MedViz 9.05 web application interface. At the top, a browser window shows the URL `http://localhost:8080/webVisualizer/Controller`. The interface includes a navigation menu with options like "File", "Edit", "View", "History", "Bookmarks", "Tools", and "Help".

On the left side, there are several interactive controls:

- Dataset:** A dropdown menu set to "Carcinoma".
- Method:** A dropdown menu set to "Isomap".
- Feature:** A dropdown menu set to "Weighted Kernel".
- Action:** A dropdown menu set to "sumarization and visualization".
- A "Submit Query" button.
- A "Zoom" control with a slider and a magnifying glass icon.

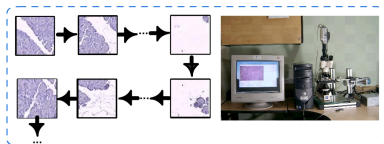
The main area features a large visualization of a "Content-based relationship among images". This is represented as a dense cluster of small, pinkish-red image thumbnails. Some thumbnails are highlighted with red rectangular boxes. To the right of this main cluster is a smaller, less dense cluster of blue thumbnails labeled "Overview".

Below the zoom control, there is a "Details" section showing a larger, zoomed-in view of a histological image. At the bottom left, an "Extracted images" section displays a horizontal row of six small image thumbnails.

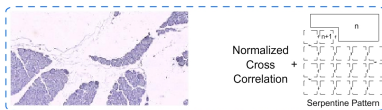
The status bar at the bottom of the browser window shows "Done" on the left and the "zotero" logo on the right.

Virtual Microscope

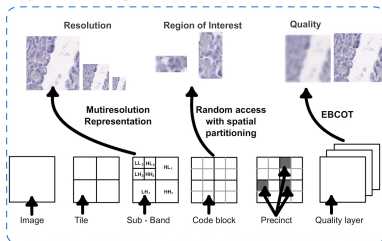
(1) Acquisition



(2) Reconstruction



(3) JPEG2000 Storage



(4) Navigation

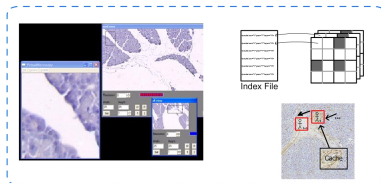
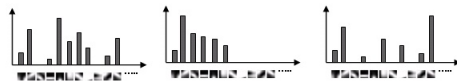
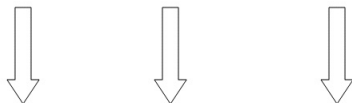
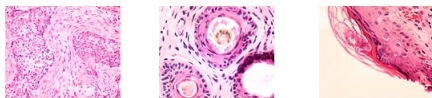


Image Pattern Analysis Tools

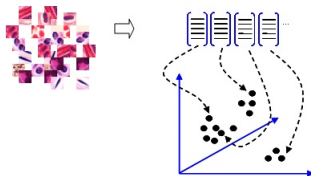
Using Bag of Features for Histology Image Analysis

Histopathological images

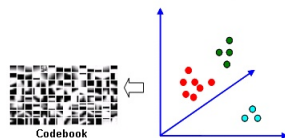


(iii) Bag of features representation

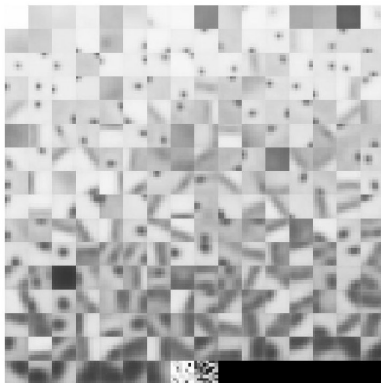
(i) Feature detection and description



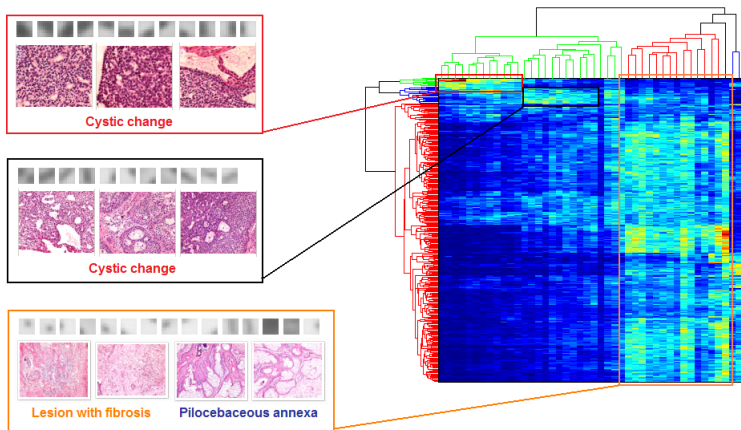
(ii) Codebook construction



The Codebook



Visual Words vs. Concepts



Summary

- A web-based application for biomedical image management
- Enhanced functionality for collection search and exploration
- Easily extensible to support new functionalities and underlying technologies
- A testbed for novel image-collection-management technologies
- Big question: what is the real impact of this type of technologies on research and clinical tasks?

Acknowledgements

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Thanks!

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