Facilitating Information Access through Visual and Intelligent Assistance

Songhua Xu
(xus1@ornl.gov)
Oak Ridge National Laboratory

Introduction

- Limitations of present work
  - Principally *text based*
  - Overlooking *personal* needs and preferences
- My research approaches
  - Visual assistance for intuitive information access
  - Intelligent assistance for personalized information access

Motivation: Information Explosion

**PubMed: 19.3 million articles**

The Exploding Number of MEDLINE Articles over Years, Yoo et al. 2007.

Importance of Images in Biomedical Publications

Images often summarize a paper’s key ideas and findings

Image-guided visual literature search and navigation

Limits of Caption-Based Image Search

- Not comprehensive
- Could be too verbose

Captions may not be comprehensive
Figure 7: Functional studies of the host proteins in an in vitro RdRp assay. In vitro RdRp assay reactions described in Materials and Methods were performed with RNA templates, r138/40A (lanes 1±4) and Ba-77 (lanes 5±8). The p51-enriched (lanes 2 and 6) and p43-enriched fractions (lanes 3 and 7) were added to the reactions as indicated above each lane. In some of the reactions (lanes 4 and 8), the p43-enriched fraction was pre-incubated with the RNA for 10 min before the addition of the p51-enriched fraction into the reaction. The percentage of RNA synthesis was shown under each lane with the SD based on at least three independent experiments. The intensity of the RdRp products without the addition of protein fractions (lanes 1 and 5) was defined as 100%.

Figure 4: RSV induced-inflammation and mucus production in the lung is affected by selective expansion of cDC and pDC. (A) Eight days after infection, lung sections were stained with H&E and PAS. Shown are representative sections of control (Cont), RSV-infected (RSV), Flt3L treated and RSV-infected (Flt3L+RSV) and Flt3L treated, pDC depleted, RSV infected (Flt3L+120G8+RSV) mice in a 200× (H&E) or 400× (PAS) magnification. (B) To quantify the mucus production in the lung, PAS sections were randomized, examined in a blinded fashion and scored on a scale from 1 to 4, with 1: representing no mucus cell content, 2: one airway with PAS staining, 3: Multiple airways with strong PAS staining, 4: Multiple airways with strong PAS staining and mucus filled airways. In addition, RNA was isolated from the lungs of control (Cont), RSV-infected (RSV), Flt3L treated and RSV-infected (Flt3L+RSV) and Flt3L treated, pDC depleted, RSV infected (Flt3L+120G8+RSV) mice and transcribed into cDNA. Samples were analyzed for Muc5ac and GOB-5 mRNA levels using quantitative real-time PCR by Taqman. Each sample was normalized using a GAPDH control and the figure shows average fold increase to RNA obtained before infection ±SEM. * P<0.05 compared to control mice, # P<0.05 compared to RSV LQIHFWHGPLFHQ±6 mice.

The Yale Image Finder (YIF)

Yale Image Finder
Search the actual image content of eLife and growing open access images and figures from PubMed Central.

Search: Image Text (High Recall) Image Text (High Precision) Caption Abstract Title Full-Text

Some example queries from the Bioinformatics paper:
- "fig2A" or "fig2B": Caption, Caption & Image Text
- "appendix A: figure 10.3": Caption, Caption & Image Text
- "fig5" AND "tan and here": Caption, Caption & Image Text

http://krauthammerlab.med.yale.edu/imagefinder/
## Three Aspects of My Work

<table>
<thead>
<tr>
<th>Algorithmic Technologies</th>
<th>Evaluation Efforts</th>
<th>Software System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text Region Detection</td>
<td>Performance Evaluation</td>
<td>The YIF System</td>
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<tr>
<td>Associated Image Elements Detection</td>
<td>OCR Error Correction</td>
<td>Text Region Detection</td>
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### Iterative and Pivoting Text Region Detection

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<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<td><img src="image2.png" alt="Text detection result by my algorithm" /></td>
<td><img src="image3.png" alt="Vowel amplitude graph" /></td>
<td><img src="image4.png" alt="Tone amplitude graph" /></td>
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</tbody>
</table>

- **A**: Frequency (Hz) over time (ms) for vowel
- **B**: Frequency (Hz) over time (ms) for tone
- **C**: Vowel amplitude graph with response
- **D**: Tone amplitude graph with response
Image Retrieval Performance

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Find Images about “Env” & “Infection”

SAIME Detection Result
Image Retrieval Example: “Env” and “Infection”

Correctly retrieved with SAIME Detection

Image Retrieval Example: “Env” and “Infection”

Correctly filtered out with SAIME detection

Three Aspects of My Work

Text Region Detection

Associated Image Elements Detection

Performance Evaluation

The YIF System

Algorithmic Technologies

Evaluation Efforts

Software System

Context-Based OCR Error Correction

- Two types of text context
  - Near scope context
  - Far scope context
- Two versions of context-based OCR error correction
  - Article-based correction
  - Corpus-based correction
- Word frequency and edit distance based correction

Image Text Extraction Options
Three Aspects of My Work

Precision
Recall
F-rate

Performance of YIF

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Publications

Q & A

Thank you for your attention, time and patience!

Offline questions are also welcome.

xus1@ornl.gov