An Interactive Region-Of-interest (ROI)-Based Image Retrieval Approach of Biomedical Articles in a Local Concept-Based Feature Space

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Introduction

Authors of biomedical publications frequently use images to illustrate various medical concepts.

Use annotation markers: arrows, letters, or symbols overlaid on figures to highlight ROIs.

Annotations are then referenced and correlated with concepts in the caption text.

Users often seeking images similar with respect to ROI, but are limited to similarity of the entire image.

Objectives:

Perform semantic search without knowing the concept keyword or the specific name of the visual pattern.

Involve Users in the Retrieval Loop (RF).

Cross-Modal Image Search.

Use Spatial Information in Images.

Concept Classification

"Concept" refers to perceptually distinguishable image patches.

Visual ROI Feature Extraction:

Table: Features, Dimensionality

<table>
<thead>
<tr>
<th>Feature</th>
<th>Dimensionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image moments</td>
<td>3</td>
</tr>
<tr>
<td>GLCM moments</td>
<td>10</td>
</tr>
<tr>
<td>Angular Correlation Coefficients (ACC)</td>
<td>20</td>
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<tr>
<td>Edge Frequency (EF)</td>
<td>25</td>
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<tr>
<td>Color Filter descriptors</td>
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<tr>
<td>Texture descriptors</td>
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<td>CEDD</td>
<td>144</td>
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<tr>
<td>Fuzzy</td>
<td>112</td>
</tr>
<tr>
<td>Contoured Tumor-Focus</td>
<td>487</td>
</tr>
</tbody>
</table>

Multi-Class SVM: Automatically mapping the appearance of visual entities within the selected query image ROI those in the codebook.

Retrieval Process Diagram

Pointer Recognition

Utilized a combination of rule-based and statistical image processing techniques.

Represents shapes with both Markov Random Field (MRF) and Hidden Markov Model (HMM).

Input → Edge detection → Edge image binarization → Contour detection →

IBM shape classification → MRF line segment labeling → Line segment (polyline) approximation →

Schematic of the pointer recognition algorithm

Spatial Layout

4. Extracted local patches within an image: (80x80, 100x100 pixels).

5. Post-processing step to re-rank the retrieved images.

6. Consider five overlapping regions.

Experiment & Results

Dataset: 346 lung CT images appeared in journal articles from four different collections.

Manually annotated a total of 1201 ROIs with different concept categories.

Classification: Created a dataset of 842 ROIs of nine different concepts.

Concept Search Based on Spatial Layout

Summary

Propose an Interactive Biomedical Image Retrieval approach.

Focused on thoracic CT scans and their captions.

Preliminary retrieval results show effectiveness of the proposed retrieval approach.

Current results are promising toward our larger goal of creating a visual ontology of biomedical imaging entities.

Acknowledgement

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