Multi-Objective Processing of Dental Panoramic Radiographs

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Background

- Dentists diagnose based on panoramic X-rays
- Time consuming and laborious process to count teeth and look for abnormalities
- Can we use AI to automate it?

Problem

- Problem: Given a panoramic radiograph, produce a semantic segmentation teeth mask and a binary label denoting if it has an abnormality
- Approach: DeepLabv3 Spatial pooling pyramid, with fusion and multi-task labelling
- Metrics: IOU, F1, Accuracy

Data

- Tufts Dental Dataset (April 2022)
- Largest publicly available dental dataset
- 1000 panoramic dental radiographs with teeth mask, abnormality mask, and gaze map

Methods

Model 1: Multi-Headed CNN Model

- ResNet50 backbone
- Atrous Spatial Pooling Pyramid on top of backbone to predict teeth mask
- FCN on backbone to do abnormality classification

Model 2: Fusion CNN Model

- Gaze map and radiograph are passed into two ResNet-18s
- ResNet output is fused and passed through a two layer FCN to produce abnormality classification

- Ablation performed on Jaccard, Dice, and BCE Loss

Results

<table>
<thead>
<tr>
<th>Segmentation</th>
<th>Detection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F1</td>
</tr>
<tr>
<td>Baseline</td>
<td>70.5</td>
</tr>
<tr>
<td>Multi-Headed</td>
<td>76.0</td>
</tr>
<tr>
<td>Fusion</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Conclusion

- Multi-headed Approach works best
- Most large dental datasets aren’t public
- Future Research
  - Exploring textual descriptions through Natural Language Processing
  - Vision Transformers
  - Self-Supervised Learning