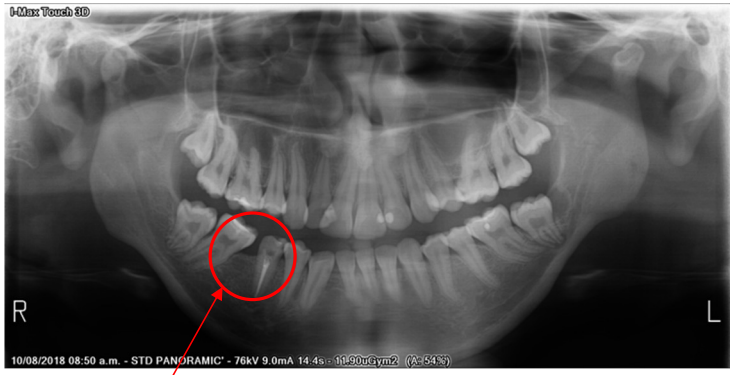
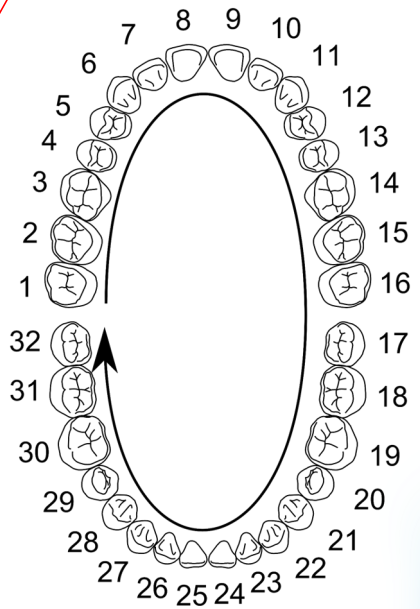
Applications of Foundation Models and Efficient Diffusion Models to Dental Radiography to Assist Dental Treatment Planning

Matthew Lewis, Melody Halbert, MS and Laura Brattain, PhD
University of Central Florida

Introduction

- Missing teeth can be common in dental radiographs, but manual charting of missing tooth spaces can be inconsistent and time intensive.
- We aim to improve this by automating teeth charting, which would improve patient safety and optimize clinical workflows.
- Additionally, realistic modification of dental radiographs such as generation of synthetic teeth to fill in the empty spaces would be a valuable tool for patient education, treatment planning and dental education.

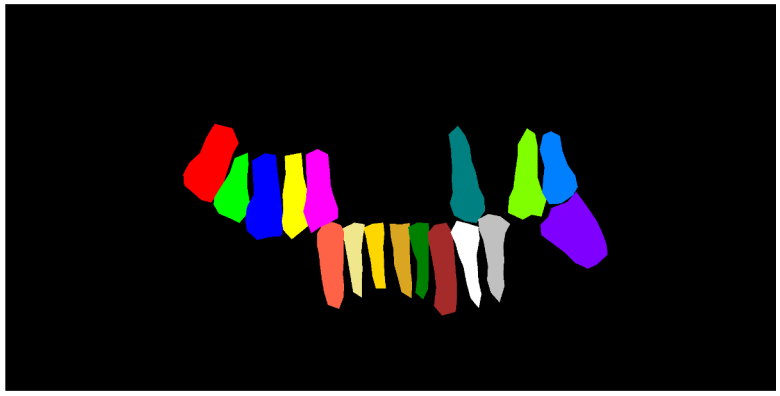




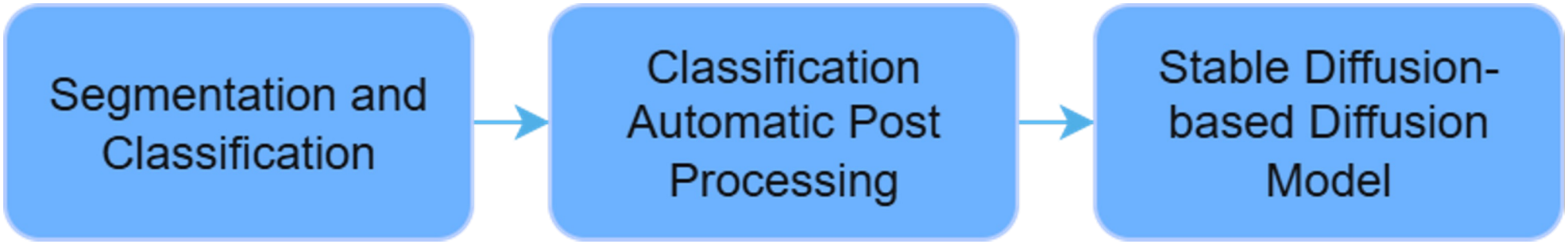
Dataset

- Humans in the Loop Teeth Segmentation on Dental X-ray Images
  - 598 images
  - All from Paraguay
- Tufts Dental Database
  - 1000 images
  - More variety, from various hospitals





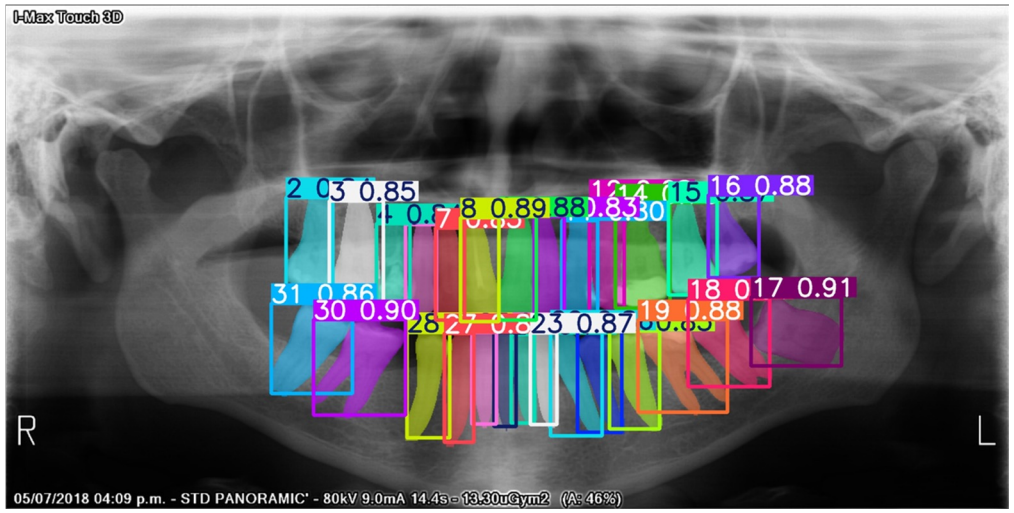
Method



For segmentation, we evaluated 3 different methods on each dataset individually and combined:

1. Fine tuned MobileSAM
2. YOLOv8 bounding box generation followed by YOLOv8 segmentation
3. YOLOv8 bounding box generation followed by fine tuned MobileSAM

Segmentation Results

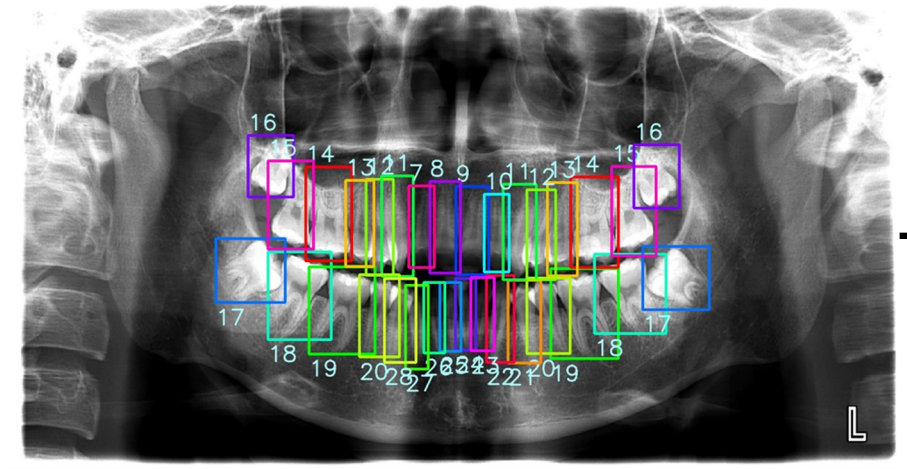


Example of YOLOv8 Segmentation and Classification

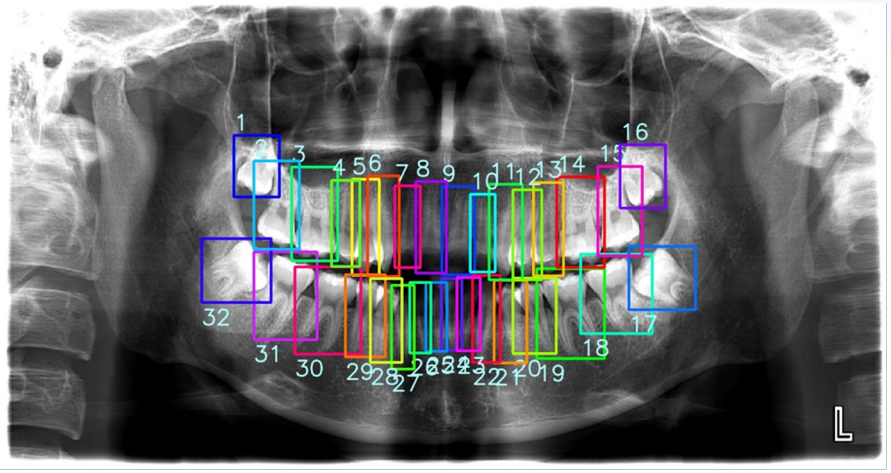
Segmentation Method	Metric		
	Dice	IoU	Recall
Humans In The Loop Dataset			
Fine Tuned MobileSAM	0.8939	0.8083	0.8512
YOLOv8	**0.9121**	**0.8388**	**0.9336**
YOLOv8 + FT MobileSAM	0.8396	0.724	0.8111
Tufts Dataset			
Fine Tuned MobileSAM	0.9147	0.8431	0.8959
YOLOv8	**0.9358**	**0.8801**	**0.9485**
YOLOv8 + FT MobileSAM	0.8667	0.7667	0.845
Combined Dataset			
Fine Tuned MobileSAM	0.9152	0.844	0.8972
YOLOv8	**0.9277**	**0.8661**	**0.942**
YOLOv8 + FT MobileSAM	0.7629	0.6504	0.7348

Teeth Classification Results

A post processing script was created to remove duplicate classifications and reclassify severely out of place teeth.



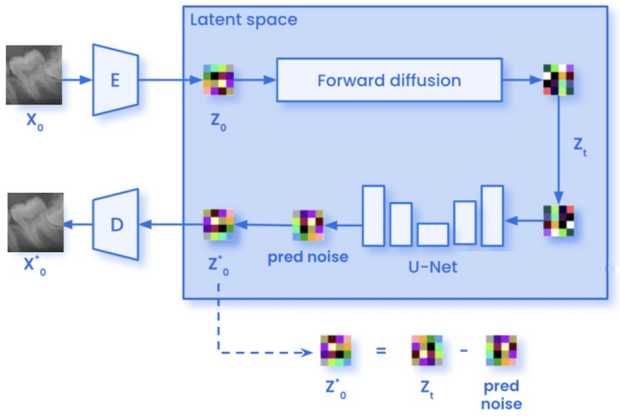
Before post processing, our classification accuracy was **0.951.**



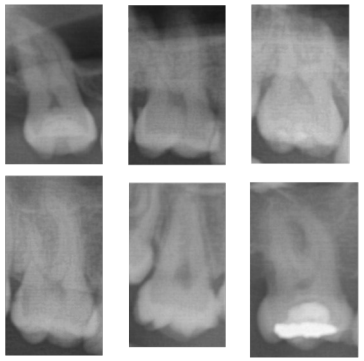
After post processing, our classification accuracy was **0.967.**

Diffusion Results

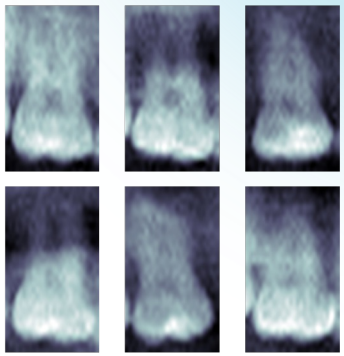
Using the bounding boxes and classifications from the previous methods, the cropped images were used to train a Stable Diffusion-based architecture.



Diffusion Training Process



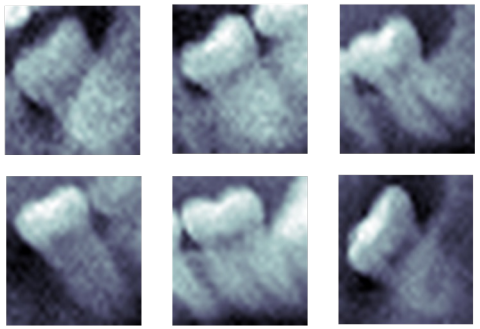
actual teeth #3



generated teeth #3



actual teeth #18



generated teeth #18

References

[1] Jocher, G., Chaurasia, A., & Qiu, J. (2023). Ultralytics YOLOv8 (Version 8.0.0) [Computer software]. https://github.com/ultralytics/ultralytics

[2] Panetta, K., Rajendran, R., Ramesh, A., Rao, S. P., & Agaian, S. (2021). Tufts Dental Database: A Multimodal Panoramic X-ray Dataset for Benchmarking Diagnostic Systems. IEEE Journal of Biomedical and Health Informatics. http://tdd.ece.tufts.edu/

https://www.kaggle.com/datasets/humansintheloop/teeth-segmentation-on-dental-x-ray-images/data

Matthew Lewis
University of Central Florida

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Thanks!