

Design of a Dental Imaging Device

AI-innovate



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Date: March 22, 2022

Project Goal(s)

- Develop a prototype which is improved by current prototype
- Build and train AI model to classify and detect various dental conditions
- Build and train AI model to classify and detect oral disease
- Hardware part can be developed if AI model has mostly been built and trained in good performance

Tasks and activities completed to date

- Changed the labeling method in Object detection Task
- Trained the initial model for oral condition dataset to find the bounding box around the decay part
- Applied Data Augmentation for object detection dataset
- Built and trained the model for image classification dataset to find out different oral disease, classification accuracy on testing data reach to 94%.

Dataset

Teeth dataset – 255 images

Object Detection, bounding box, localization, classification

Oral Lesions dataset – 2462 images

Image Classification – 8 Classes

This week's presentation content

- Confirmation about oral condition dataset labeling
- Discuss the next step of Image Classification Task

Oral Condition Dataset – Object detection task

- Labeling image to generate XML file to recorded the location
- Import image file and perform normalization as model Input
- Import xml file which recorded bounding box location and perform normalization as model output
- Loss function: MSE + IoU
- Evaluation: IoU
- Train the model – Common CNN
- Predict and evaluation

Loss function:

Combine the Mean Square Error and Intersection over Union

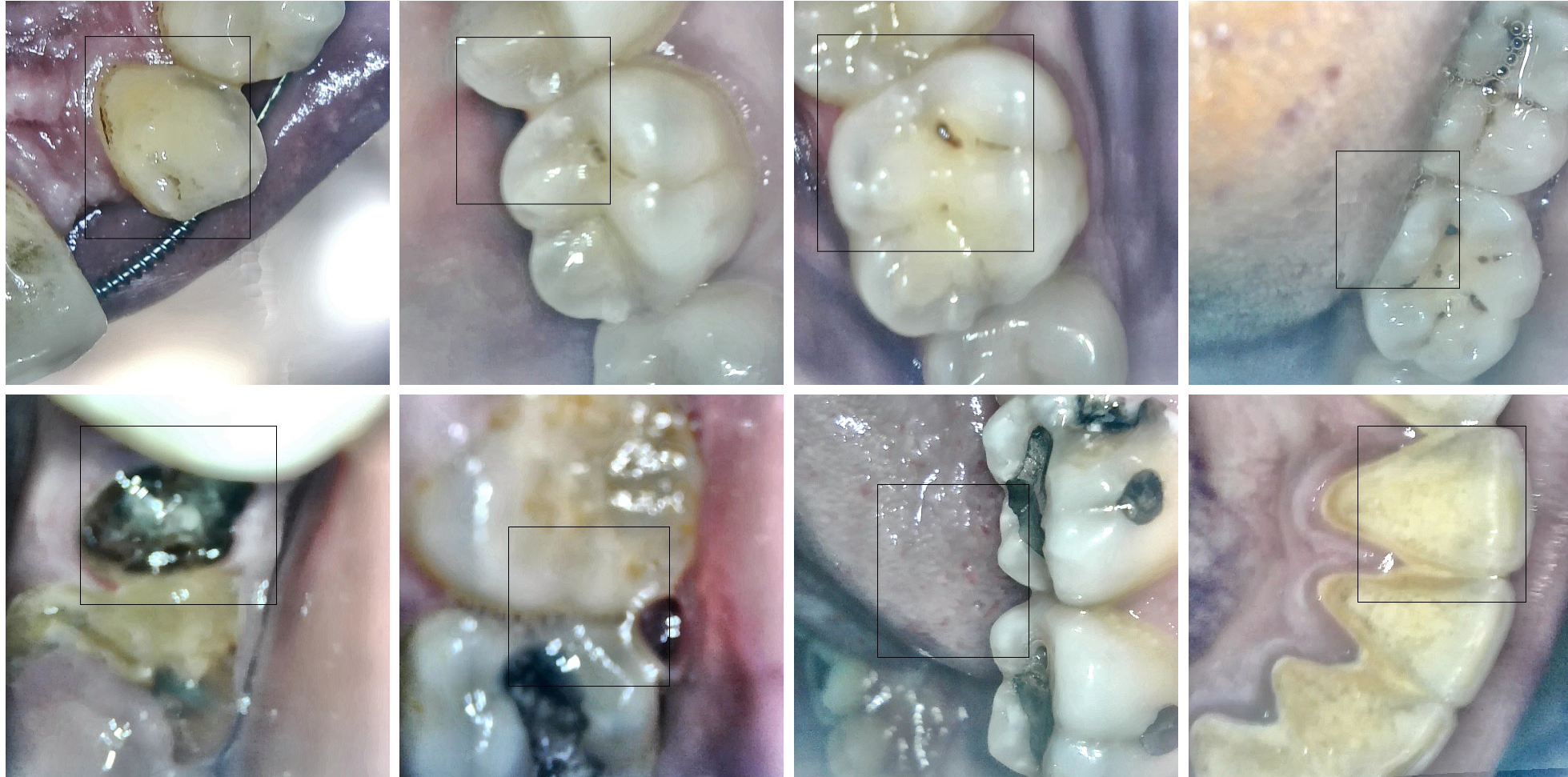
$$L(x, x') = MSE(x, x') + (1 - IOU(x, x'))$$

$$IOU(x, x') = \frac{x \cap x'}{x \cup x'}$$

Evaluation Metrics

$$IOU(x, x') = \frac{x \cap x'}{x \cup x'}$$

Result



Result

Over Fitting – IoU in training set already 0.8, IoU in validation set still 0.3

Three possible reasons:

1. Image Labelling problem
2. The volume of the dataset is too small
3. The model need to improve

Three pathway to improve the result

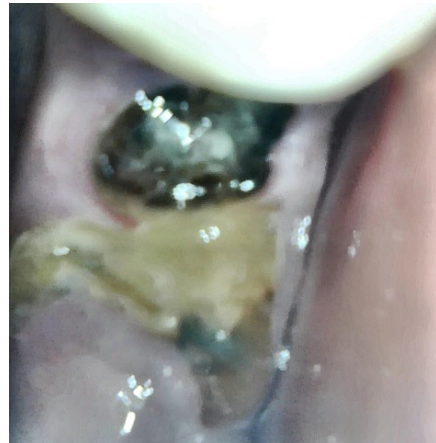
- Change the Image labeling method
 - Multiple labels in one image
 - Add label classification
- Data augmentation
 - Increase the volume of the dataset
- Hyperparameter tuning and try other object detection model

Oral Condition Classification

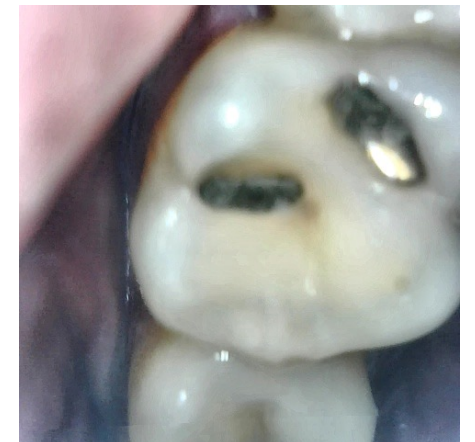
Plaque



Decay



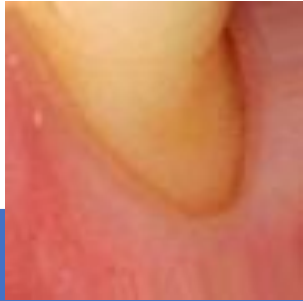
Fillings



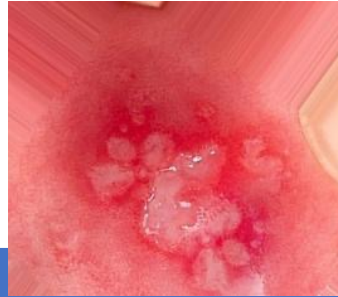
No Bounding Box is needed in follow Images?



Oral Lesions – Image Classification Task



1. Abfraction



2. Canker Sores



3. Cold Sores



4. Gingival Cyst

5. Gingivitis



6. Periodontitis



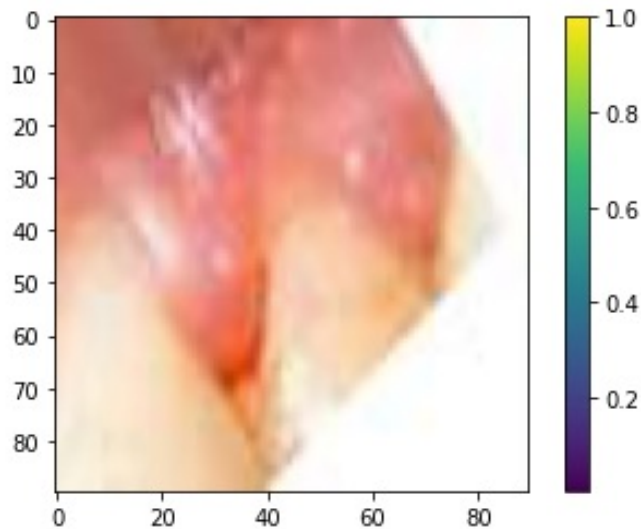
7. Receding Gum



8. Thrush

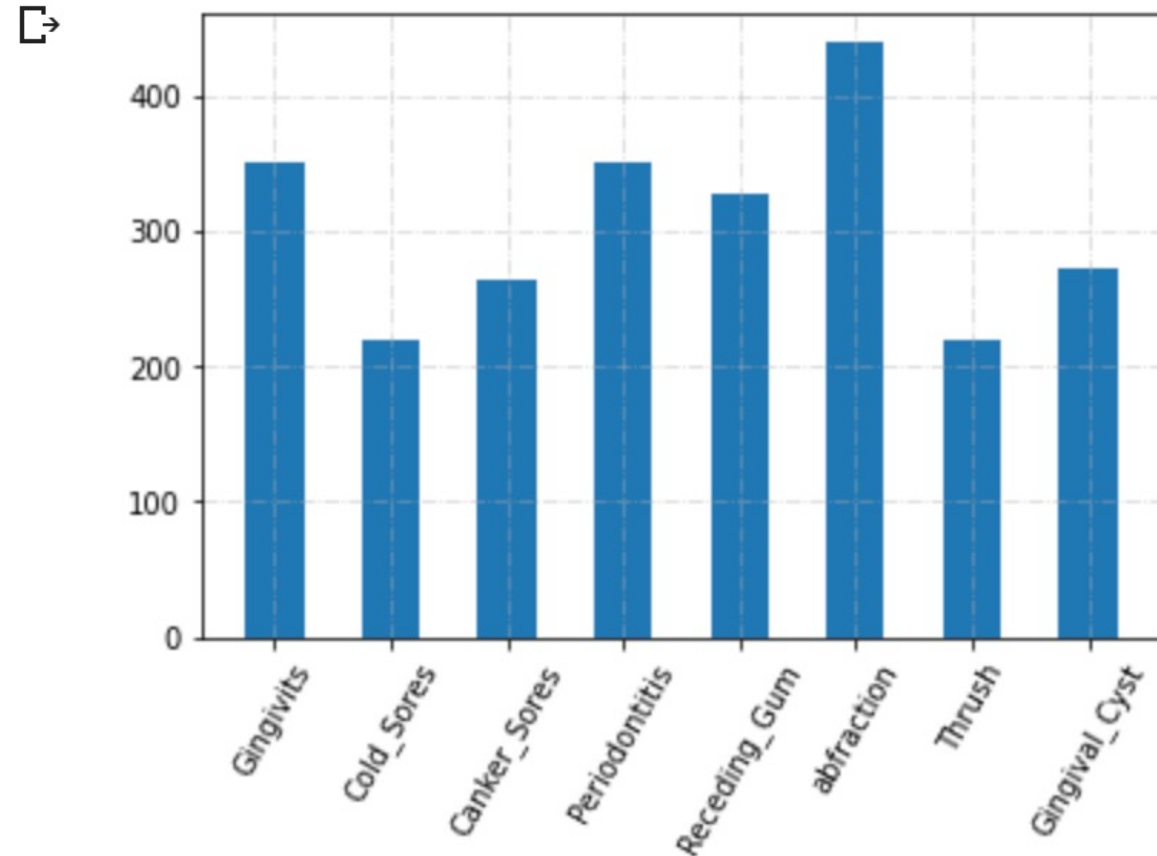


Data was processed for build the model and training



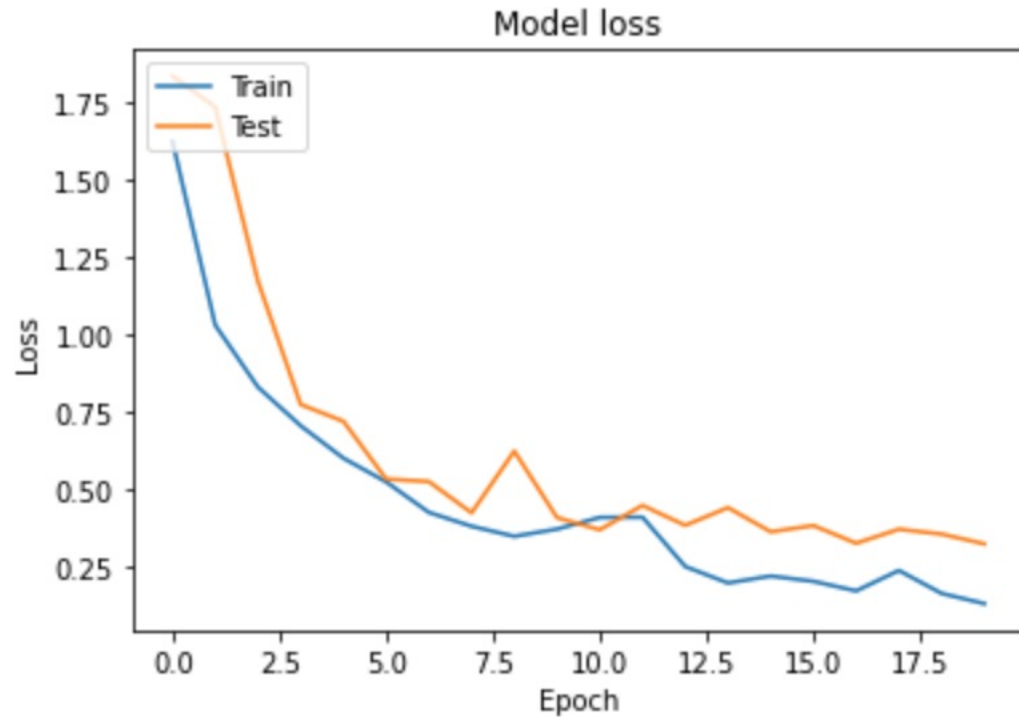
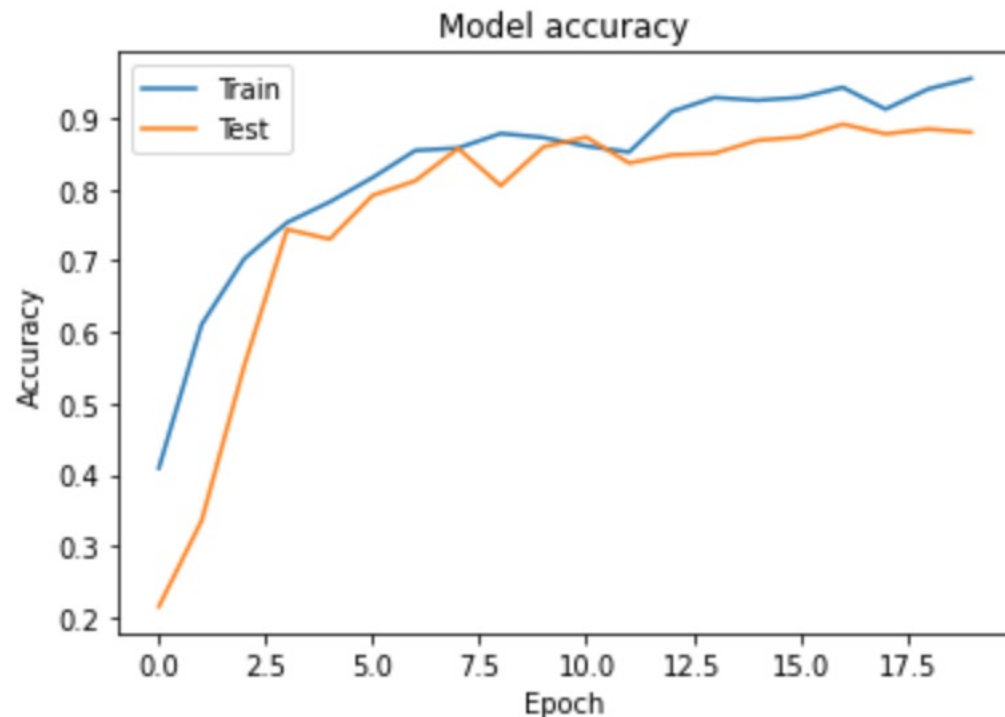
Oral Lesions – Image Classification Task

- Main challenge - Small Dataset, only **2462 images** in total
- Good news - The number of pictures is evenly distributed in each class
- Applied Data Augmentation to solve the problem.
 - Flip
 - Rotation
 - Zoom



Training Result

- Common CNN model – 2 convolutional Layers flatten to 1 dense layer, relu activation function
- Using Classification Accuracy as the Evaluation Metrics
- About 94% accuracy on testing data



Tasks and activities planned for the next two weeks (open conversation)

- Continue to develop of Object detection model
 - Hyperparameter tuning and try other object detection model (pretrained model)
- Compress/package Image Classification model (TBD)