Automated Tooth Detection and FDI Numbering DeepLearning

Metrics (Understanding)

- **Precision – 0.8579 (~86%)**
  Out of all teeth predicted, about 86% were correct. This means the model makes few false positives.

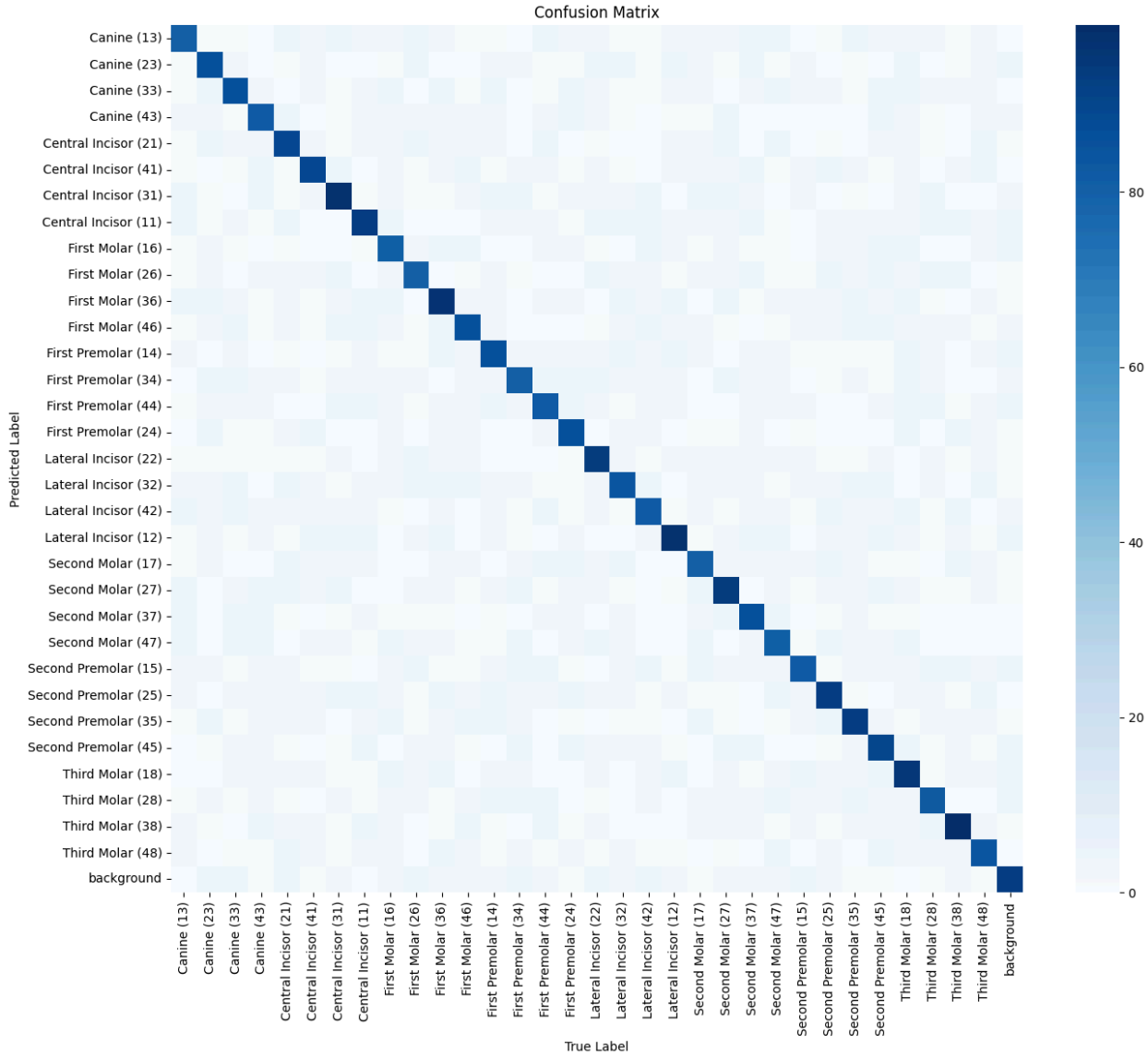
- **Recall – 0.8886 (~89%)**
  Out of all real teeth present, about 89% were successfully detected. This shows the model rarely misses teeth.

- **mAP@50 – 0.7861 (~79%)**
  At an IoU threshold of 0.5, the model detects teeth with nearly 79% accuracy. This indicates good bounding box quality.

- **mAP@50-95 – 0.6329 (~63%)**
  Across stricter IoU thresholds (0.5 to 0.95), the model achieves ~63%. This shows the model still maintains solid performance even when we demand tighter localization accuracy.

Confusion Matrix :

- The confusion matrix compares **true tooth labels** vs **predicted labels**.
- In our results:
    - The **main diagonal** (correct matches) was strong → most teeth were classified correctly.
    - Few **off-diagonal errors** appeared, meaning some teeth types were occasionally confused (e.g., left vs right premolars).
- This supports the metrics:
    - High **precision** → very few wrong tooth predictions.
    - High **recall** → most actual teeth were detected.



Summary on My Approach:

I built a system that can automatically find and label teeth in dental X-ray images. Here's how I approached it:

- **1. Preparing the Data**
  I gathered dental X-rays and manually marked each tooth with a box and its FDI number. This helped the model understand what to look for.
- **2. Training the Model**
  I used a YOLO-based model — a popular tool for object detection — and trained it to recognize and classify teeth based on the labeled data.
- **3. Checking Accuracy**
  After training, I tested how well it worked using common performance measures. The results showed that the model detects teeth accurately and consistently.
- **4. Planning for Smarter Labeling**
  I'm also working on a step to improve how the system numbers teeth. This includes separating upper and lower jaws, dividing left and right sides, and making sure the numbering follows dental standards (FDI system).

Conclusion:

This project proves that deep learning can be applied successfully for dental image analysis and lays a strong foundation for the next steps, which would include implementing post-processing logic, refining detection results, and testing on larger datasets for improved accuracy.

NOTE: The result Images,Code,data.yml –In github Repository - **Link**

Thank you!