Performance Report: Oral Disease Classification Using CNN

Final Achievement Scores

The CNN model achieved the following performance metrics on the test dataset:

- **Accuracy:** 95.34%
- **Precision:**
    - Class 0 (Caries): 93%
    - Class 1 (Gingivitis): 98%
- **Recall:**
    - Class 0 (Caries): 99%
    - Class 1 (Gingivitis): 92%
- **F1-Score:**
    - Class 0 (Caries): 95%
    - Class 1 (Gingivitis): 95%
- **Macro Average F1-Score:** 95%

Confusion Matrix

The confusion matrix below summarizes the classification performance:

|	Predicted: Caries	Predicted: Gingivitis
Actual: Caries	201	3
Actual: Gingivitis	16	188

- **True Positives (Gingivitis):** 188
- **True Negatives (Caries):** 201
- **False Positives:** 3
- **False Negatives:** 16

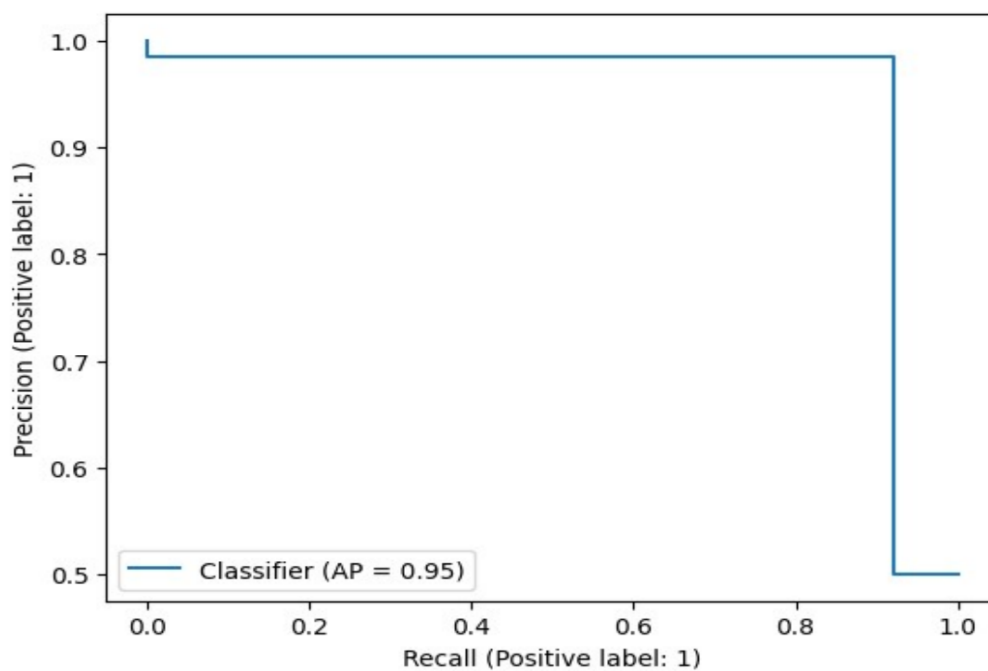## Analysis of Misclassifications

The majority of misclassifications occurred in classifying gingivitis. These errors could be due to:

- Overlapping visual characteristics between classes.
- Limited or imbalanced training samples for certain cases.
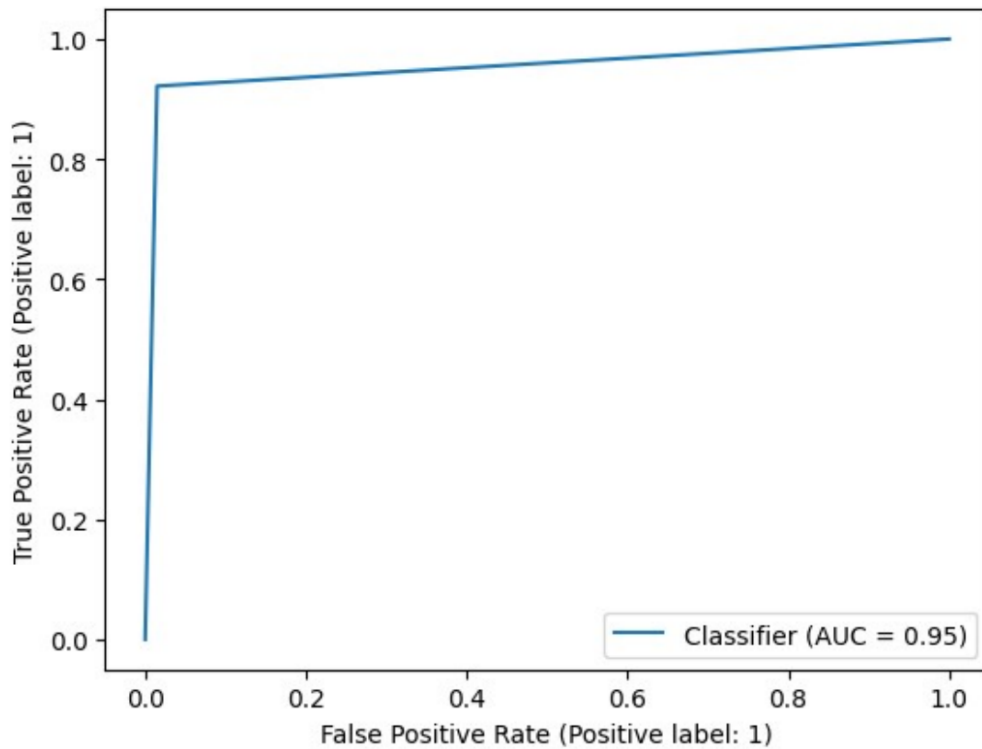
Confusion Matrix Visualization
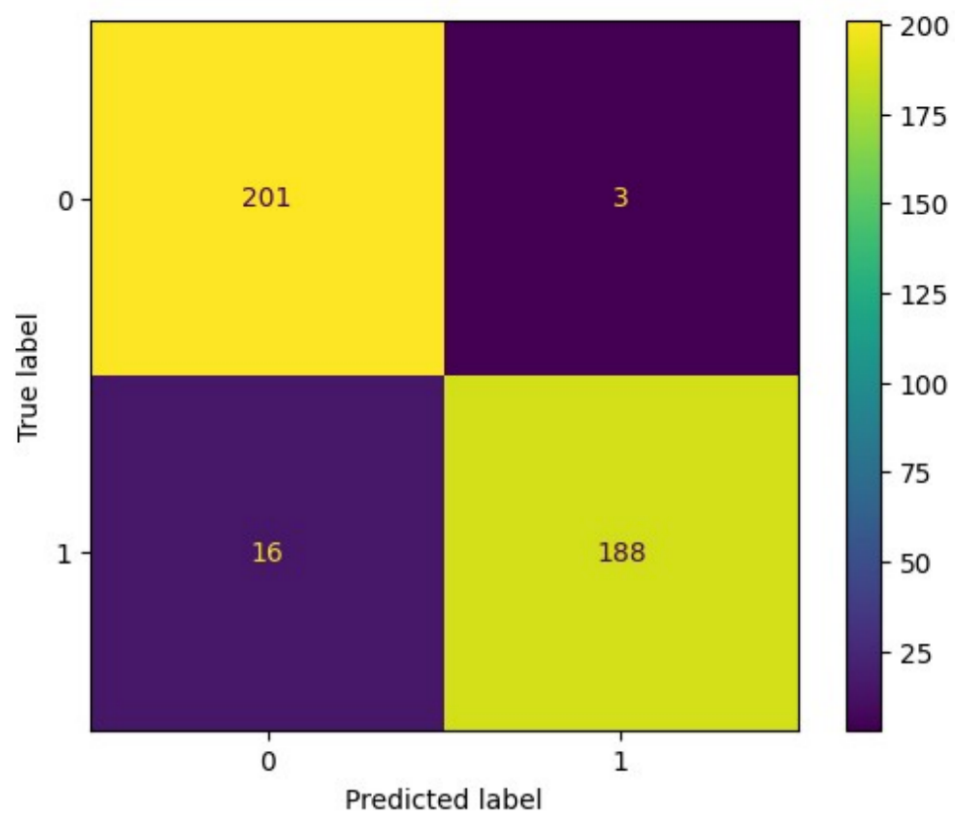
Precision-Recall Curve

The precision-recall curve highlights the model's trade-off between precision and recall, showing robust performance across different thresholds.

ROC AUC Curve

The ROC curve confirms excellent model performance with an Area Under the Curve (AUC) close to 1.

Additional Insights

- **Strengths:**

  - High accuracy and balanced F1-scores suggest that the model generalizes well on the test dataset.
  - Efficient training achieved through data augmentation and dropout layers.

- **Limitations:**
  - Sensitivity towards minority class (e.g., gingivitis) could be improved.
  - The model's robustness against noisy images or different lighting conditions was not evaluated.

- **Future Improvements:**
    - Incorporating a larger and more diverse dataset for training.
    - Exploring advanced architectures like EfficientNet or ResNet for enhanced performance.
    - Fine-tuning hyperparameters and using techniques like SMOTE for addressing class imbalance.

Visualizing Performance

Loss and Accuracy Curves

Loss Curve:

- Training and validation losses decrease consistently, indicating proper convergence.

Accuracy Curve:

- Both training and validation accuracies improve steadily, reflecting good model generalization.

Conclusion

The CNN model demonstrated excellent performance in classifying oral diseases, achieving 95% accuracy on the test dataset. The results, combined with the confusion matrix and other metrics, showcase its potential for deployment in real-world applications, with room for further refinement to improve performance on difficult cases.