Oral Disease Classification using Deep Learning

Project Overview

Oral diseases such as **Caries** and **Gingivitis** are common health issues. This project demonstrates the use of transfer learning with **MobileNetV2** to classify oral disease images into two categories. A minimalist **Flask web application** is provided for easy interaction and real-time predictions.

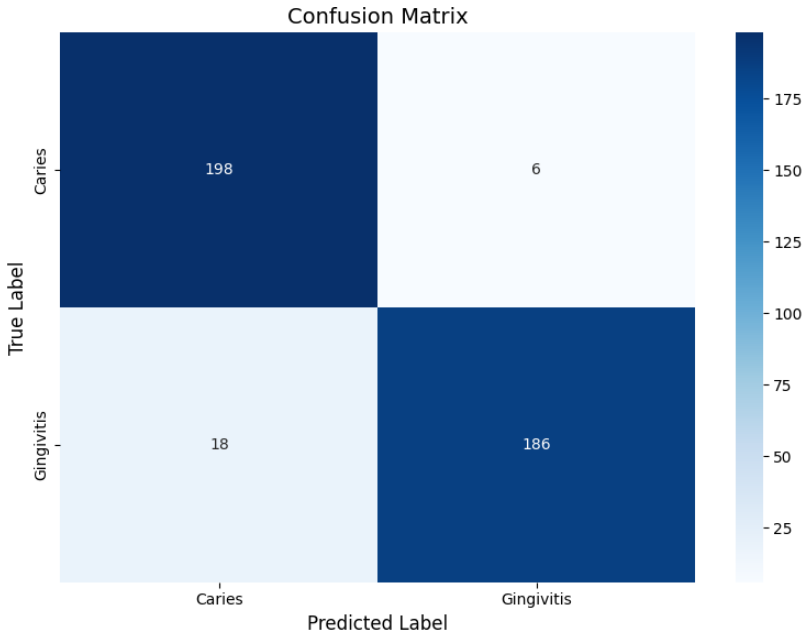
Final Model Scores

The table below highlights the key performance metrics of the model on the test dataset:

Metric	Caries	Gingivitis	Overall
Precision	0.92	0.97	0.94
Recall	0.97	0.91	0.94
F1-Score	0.94	0.94	0.94
Accuracy			0.94

Confusion Matrix

The confusion matrix below provides an overview of the model's performance on test data:



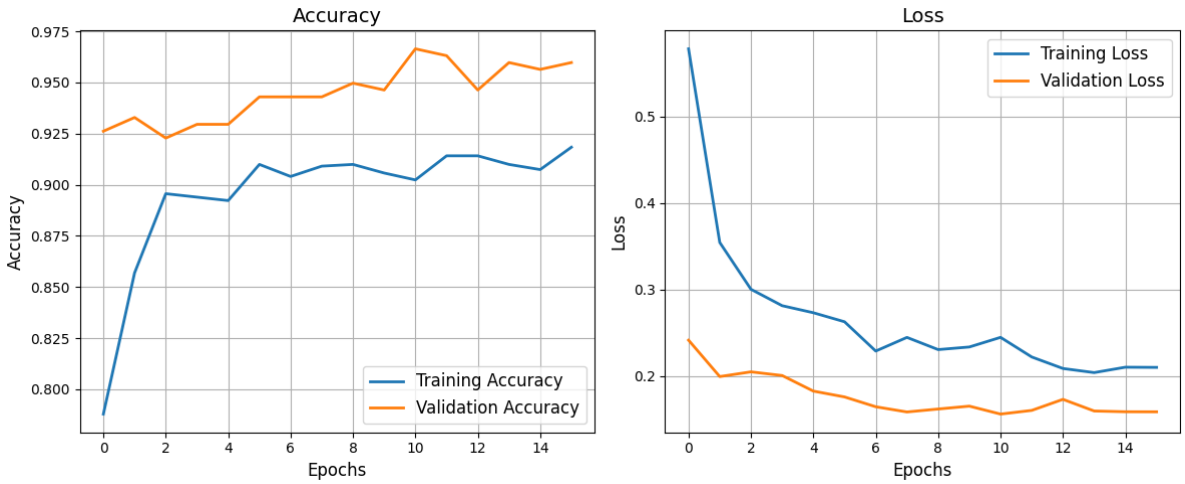
The confusion matrix shows the correct and incorrect classifications for the two classes. The model performed well with minimal misclassifications:

- **Caries**: 198 correctly classified, 6 misclassified.

- **Gingivitis**: 186 correctly classified, 18 misclassified.

Training Performance

The training and validation performance metrics are shown in the graphs below:



Description:

- The training accuracy consistently improved, while the validation accuracy stabilized at around **96.6%**.
- The loss curves show steady improvement, indicating minimal overfitting.

Insights

- The model achieved high accuracy and recall for both classes.
- Caries and Gingivitis are well-classified with minimal false negatives and false positives.

Model Limitations and Ideas for Improvement

Limitations

- **Image Quality**: Model performance may slightly degrade on poor-quality images or images with inconsistent lighting or focus.
- **Dataset Scope**: The dataset does not include a **Healthy** class, limiting the model's ability to detect healthy oral conditions.
- **Generalization**: Further validation on larger and more diverse datasets is required to ensure strong performance across different populations and settings.

Ideas for Improvement

1. **Expand Dataset**:
    - Add a **Healthy** class to cover scenarios where no disease is present.

- Increase dataset size by including more images with diverse lighting, orientation, and backgrounds.

2. **Experiment with Architectures**:
    - Explore alternative lightweight architectures like **EfficientNet** or **DenseNet** to improve classification accuracy further.
3. **Hyperparameter Tuning**:
    - Adjust hyperparameters (e.g., learning rate, dropout rate) to optimize model performance further.
4. **Data Augmentation**:
    - Introduce augmentation techniques such as brightness adjustment and rotation to improve the model's robustness to real-world conditions.

Conclusion

This project successfully demonstrates the classification of oral diseases using a **MobileNetV2-based deep learning model**. The Flask web app provides an easy-to-use interface for real-time predictions. With further enhancements, this model can serve as a valuable tool in aiding dental health diagnostics.

Appendix

Classification Report:

	precision	recall	f1-score	support
Caries	0.92	0.97	0.94	204
Gingivitis	0.97	0.91	0.94	204
accuracy			0.94	408
macro avg	0.94	0.94	0.94	408
weighted avg	0.94	0.94	0.94	408

Training History (CSV): The full training history.

Epoch	Loss	Accuracy	Validation Loss	Validation Accuracy	Learning Rate
1	0.578009	0.7879	0.241641	0.9262	0.001
2	0.354440	0.8569	0.199601	0.9329	0.001
3	0.300391	0.8956	0.205059	0.9228	0.001
4	0.281441	0.8939	0.200806	0.9295	0.001
5	0.273289	0.8923	0.182827	0.9295	0.001
6	0.262876	0.9099	0.176086	0.9430	0.001
7	0.229049	0.9040	0.164747	0.9430	0.001
8	0.244829	0.9091	0.158734	0.9430	0.001
9	0.230746	0.9099	0.162135	0.9497	0.001
10	0.233763	0.9057	0.165467	0.9463	0.001
11	0.244880	0.9024	0.156286	0.9664	0.001
12	0.222208	0.9141	0.160542	0.9631	0.001
13	0.208932	0.9141	0.173292	0.9463	0.001
14	0.204182	0.9099	0.159845	0.9597	0.001
15	0.210414	0.9074	0.158981	0.9564	0.0001
16	0.210203	0.9184	0.158909	0.9597	0.0001